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Scientific Method in Bibliography.

THE printed chronicle of human endeavour in all civilised countries of the world, in many tongues and recorded in multifarious publications, has long been accumulating at a rate so great, that not merely is its co-ordination beyond the power of any single mind, but also no central institution has been able to analyse it, so that this priceless store of knowledge may be made available for further advance.

At an earlier period, the author of a scientific or technical paper may have cherished the fancy that, by publishing his work, he was giving it to the world. To-day we have learnt by experience that to print a magazine article may be merely adding padding to a volume on the library shelf, for, without an index to recorded information, it is likely to become inaccessible. Nearly every one of that comparatively small band of workers who are patiently seeking to extend the boundaries of knowledge, to discover new and better methods of manufacture, or to invent and improve apparatus and machinery, must have realised the continual duplication of effort, which acts as an ever-present check to progress.

The lack of an extensive index to information was felt during the War; then machinery was hastily invented and methods of manufacture quickly devised, while the records of better apparatus and processes were lying buried on the library shelves. It is agreed that in peace and war a comprehensive guide to recorded knowledge would be an asset of the greatest value that would lead at once to important scientific and technical developments, while without it untold time and energy are being wasted throughout the world by the useless repetition of research and invention.

Various attempts have been made from time to time to collect, classify, and distribute information. A large number of publications are, or have been, devoted to the bibliography of special subjects; perhaps the greatest of all was the International Catalogue of Scientific Literature. There are, besides, many bureaux, both English and foreign, of divers types, engaged in the preparation of indexes to particular classes of information. Yet, in spite of all this activity, not the semblance of the desired key to knowledge is available.

This deplorable failure, which is restricting progress and prolonging unnecessary discomfort and inconvenience, may be due in great part to the lack of that which it is the purpose of bibliographies to supply; that is, information. For want

of knowledge, bibliographical research is being undertaken everywhere, at home and abroad, without attention to the canons of bibliography or previous experience of its methods. Each abstracting or indexing body adopts a different system of classification and the abstracts or index slips are produced without regard to size, so that they cannot be mounted on cards and amalgamated with other bibliographies, and the information collected becomes hopelessly lost in thousands of separate parts. Moreover, every bureau indexes or abstracts papers that are done by, usually, a number of other bureaux, and only a fraction of the literature is covered.

The science of bibliography is not a subject of general study, and many scientific workers who realise the need of practical training in scientific method as well as knowledge of previous work appertaining to their special field of investigation, fail to understand that the same is true of bibliography. The would-be bibliographer must bring a scientific mind to the study of his task and must gain proficiency in bibliography by laborious practice. The indexing of scientific papers has also the added difficulty that the needs of scientific workers cannot be appreciated fully except by themselves. Thus an efficient index to scientific literature can scarcely be produced except by the application of a thorough knowledge of bibliographical science, wide experience in its application, and expert knowledge of the subjects indexed; that is to say, it is imperative that the scientific method be applied to bibliography.

Since the preparation of a complete index to published information involves the co-operation of many workers, it is necessary that a single system of classification should be chosen, which must be kept up-to-date by some central body. If, however, a definite classification were accepted and utilised by existing bibliographical undertakings, it would be possible to amalgamate their work into one series of cards which would go far towards the universal index desired. All information collected on a given subject would then fall together into one place to be available at need, and it would become apparent that identical information is being collected from the same periodicals by many different indexing agencies, and that information on a given subject is interesting to workers in many different branches of science or technology. By consultation, overlapping could be avoided, and energy, at present being wasted, could be used in indexing literature not dealt with hitherto.

The International Classification, described by Dr. S. C. Bradford elsewhere in this issue, is, ready to hand, such a scheme as is required for the preparation of a great index to recorded information, and no other suitable system is available. The general adoption of this code would make possible now the realisation of the index desired. Some thousands of bibliographies are in actual progress. At present their utility is very limited. But merely to number the bibliographical titles by the International Classification would make it possible to amalgamate them all into one index of the greatest value to mankind. The scheme has been utilised on the Continent as the basis of extensive bibliographies. The Classification is surely gaining ground and has received the support of the League of Nations. Recently, in Great Britain, the Optical Society has published an English translation of part of the Classification which has been used for the classification of the index to its *Transactions*. This can now be cut up, pasted on cards, and incorporated with other bibliographies numbered in accordance with the code.

When the International Catalogue of Scientific Literature came to an end, it was obvious that sooner or later the preparation of a comprehensive guide to scientific literature would have to be revived. The ideal solution to the problem has been suggested to be the building up of a National Science Library to take every important scientific periodical or publication together with a complete index to their contents, so that documentary research could be carried out in one building without waste of time journeying to different libraries.

As the Science Library at South Kensington contains an exceptionally extensive collection of scientific periodical literature, it seemed desirable that its resources should be developed so as to ascertain the possibility of realising such an ideal library. An organised effort is being made to augment the fine collection of scientific journals and transactions in the Library so as to make it as complete as possible. This has been so successful that periodicals are being added at the rate of a thousand or more a year, and the Library now includes between six and seven thousand of the items in the World List. The continuation of this undertaking, if possible on a somewhat larger scale, should lead in a few years to the gathering in the Library of a nearly complete collection of scientific periodicals.

After very careful consideration, the International Classification has been adopted in the Science Library for indexing the titles of its books and more important papers. The Library

contains also sets of certain other bibliographies, as well as of some smaller undertakings based on the same system. All these are now being collected into one repertory, to which it will be possible to add any bibliographies that adopt this classification afterwards. The whole will be available for consultation in the Library together with the books, or from the index it should be possible to supply extracts by post at the cost of typing and postage.

The work of the past three years shows that the attainment of the first half of the ideal is possible. Its complete realisation would follow if it were possible for bibliographical undertakings generally to adopt the Decimal Classification of the Brussels Institute.

Atomic Structures.

(1) *The Progress of Atomic Theory.* By Dr. Albert C. Crehore. Pp. ii + 230. (London: Taylor and Francis, 1926.) 12*s.* 6*d.* net.

(2) *Die Welt der Atome: Zehn gemeinverständliche Vorträge.* Von Prof. Arthur Haas. Pp. xii + 130 + 3 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) 4·80 gold marks.

(3) *La fisica dei corpuscoli.* Per G. Gianfranceschi. Terza edizione. Pp. viii + 267. (Roma: Università Gregoriana, 1926.) 18 lire.

(1) THAT the Rutherford-Bohr atomic model, despite its remarkable success in explaining and correlating so many of the facts of physical and chemical science, is not yet universally accepted, is evident from a study of the first of these three books, the title of which will probably lead many who are unfamiliar with Dr. Crehore's writings to expect something quite different from what they will find. The book is really an account of the progress of the author's own particular atomic theory. Although we fancy that it will win few converts to his views, it is, nevertheless, not without interest.

Broadly speaking, Dr. Crehore believes, as so many of us would like to believe, that all atomic processes can be explained in terms of classical electrodynamics. It will probably be in the earlier chapters that the work will prove least convincing. Here the author describes the atomic models on which his subsequent calculations are based. We are told that the hydrogen atom consists of a nuclear charge of two units with two spheroidal electrons in contact with it, one on each side: similarly, the helium atom has a positive charge of four units, and on each side of this charge are two electrons closely bound to it. From these two fundamental atoms Dr. Crehore proceeds to construct the more complex atoms by a suitable arrangement of hydrogens, heliums, and cementing electrons. His atoms are more or less close-packed assemblages the linear dimensions of which are of the order of 10^{-13} cm.

The difficulties presented by such atoms are manifold, but if once the reader gets past these early chapters and accepts, even if only for the sake of argument, the hypotheses, he will find the subsequent chapters more logical. Indeed, in the development of his theory, Dr. Crehore shows no small courage and considerable mathematical skill in dealing on classical lines with these unconventional atoms. Perhaps the most interesting problem he sets himself is to explain why it is that atoms so small as 10^{-13} cm. should build themselves into solids in which they are separated by distances some ten thousand times greater than this. For this problem he claims a solution in the case of hydrogen.

The origin of a spectrum line of wave-length λ involves, according to this theory, an excursion of an electron to a distance $0{\cdot}05\lambda$. This applies equally to the optical and X-ray regions. In considering the latter spectra, the author emphasises the fact that this excursion is small compared with atomic distances in the solid. It is of interest to note, however, that recent direct determinations of long wave-length X-radiations would involve excursions considerably greater than the distance of closest approach of neighbouring atoms.

In spite of a bold defence of these atoms, which includes an explanation, based on them, of gravitation, there are still many gaps which will have to be filled and many difficulties which must be overcome before the majority of physicists will consider that the theory has progressed sufficiently far to replace that which is more or less generally accepted.

(2) If a course of Dr. Crehore has shaken, ever so slightly, the reader's faith in the conventional atom of to-day, it should be easy to restore it by a study of the second of these books. Dr. Haas is well known as a writer with a very considerable gift for clear and concise exposition, and this latest work worthily upholds this reputation. It is based on a course of lectures intended for a non-specialist audience and covers practically the whole range of modern atomic physics. That is a great deal to expect of a relatively small volume, but the author has selected his material with excellent judgment and woven it together into a convincing

narrative. There is no need to enter into the details of his presentation of the subject; suffice to say that he shows us that, whether we approach the problem of atomic structure from the point of view of optical spectra, X-ray phenomena, radioactivity, or any of the other lines, we are led to similar conclusions and to similar conceptions as to the nature of the atom.

If any one offers criticisms it will probably be the specialist, who may feel that the whole subject, as here presented, seems too simple, the interpretation of the facts too straightforward, the structure of the atom too obvious. This is a criticism which most authors will welcome. Too often a book which is perfectly sound from a scientific point of view is a very poor product when judged from a literary or artistic viewpoint, but Dr. Haas deserves our congratulations and gratitude for having written an account which is not only an up-to-date expression of the situation but also, above all, one which is readable.

(3) The third volume, by Dr. Gianfranceschi, is of a different type again. It is intended for the student rather than for the general scientific reader. As the title suggests, the author is concerned rather with the development of the electrical theory of matter than with the details of atomic structure. After preliminary chapters dealing with the basis of modern views of the structure of matter, he gives an outline of the kinetic theory of gases and its application to the theory of electrons. This naturally leads to a discussion of the problems connected with the passage of electricity through metals and kindred phenomena. Following the historical development, the author introduces the quantum by a short account of black-body radiation, and then proceeds to a brief description of modern theories of atomic structure and optical and X-ray spectra.

It might be expected that such a book would be full of somewhat abstruse mathematical analysis, but Dr. Gianfranceschi has succeeded in presenting his subject with the help of only such mathematics as every serious student of modern physics and chemistry may be assumed to possess. It is essentially a theoretical work, and experimental methods and results are introduced only in so far as they provide a basis for the theoretical discussion or a verification of the predictions of the theory. The fact that the book is now in its third edition is sufficient recommendation and sufficient proof that it has already proved its usefulness to a wide circle: without doubt, this new edition will be as popular as its predecessors.

The Endocrine Organs.

(1) *The Endocrine Organs: an Introduction to the Study of Internal Secretion.* By Sir E. Sharpey-Schafer. Second edition. Part 2: *The Pituitary, the Pineal, the Alimentary Canal, the Pancreas, and the Sex Glands.* Pp. xi-xxii + 177-418. (London: Longmans, Green and Co., Ltd., 1926.) 20*s.* net.

(2) *The Comparative Anatomy, Histology and Development of the Pituitary Body.* By G. R. de Beer. (Biological Monographs and Manuals, No. 6.) Pp. xix + 108 + 11 plates. (Edinburgh and London: Oliver and Boyd, 1926.) 12*s.* 6*d.* net.

(1) THIS volume completes the second edition of the well-known monograph upon the endocrine organs issued for the first time in 1916 and founded on a course of lectures (Lane Medical Lectures) delivered by Sir E. Sharpey-Schafer at Stanford University, California, in the summer of 1913. The second edition, in two volumes, has greatly outgrown its predecessor, and the second volume is the larger of the two, more than half of its bulk being devoted to the pituitary body. The other endocrine organs treated in it are: the pineal body, the duodenal and gastric mucous membranes in their relation to the production of secretin and gastrin respectively, the islets of Langerhans of the pancreas and the sex glands, including the interstitial cells of the testis, the ovary, and corpus luteum.

The histology of these organs is detailed and their structure illustrated by numerous drawings and photo-micrographs, all admirably selected and reproduced. Development of the organ is described in the case of the pituitary body, where its consideration is essential to a proper understanding of its differentiation with regard both to structure and physiological properties. The chemistry of the active principles produced by the organs and the history of the attempts to isolate them are recorded in so far as trustworthy evidence is forthcoming. Much, however, remains to be investigated in respect to the chemistry of the internal secretions, and the threshold of this subject has barely been reached as yet.

The physiological action of extracts of the organs, illustrated by admirable graphic records, and the history of their discovery, are fully detailed. The references to authors cited are exhaustive, and are given in foot-notes on the pages on which they are quoted, the value of the work being thereby greatly enhanced.

Clinical evidence bearing upon the effects of increase and decrease of activity of the organs has been wisely selected. The physician will find the book an invaluable one as an authoritative guide to the proper appreciation of what results may and may not be legitimately expected from the use of preparations of the endocrine organs as remedies. Unfortunately, the autacoids or self-remedies secreted by the endocrine organs do not lend themselves in all cases to a relatively simple method of employment such as is illustrated by the active principle of the thyroid.

The importance of the endocrine organs in physiology and medicine has long been established, but the grain is apt to be missed in the chaff, so abundant and varying in value is the literature of the subject. No one is better qualified than Sir E. Sharpey-Schafer to undertake the sifting required, and in these two volumes he has succeeded beyond praise in producing a standard work upon endocrinology which will be indispensable to the research worker and welcome to the physiologist and practising physician alike.

(2) This monograph, profusely illustrated by drawings in the text, and by special plates of photo-micrographs and one of coloured drawings, deals entirely with the morphology, histology, and embryology of the pituitary body. The various classes of vertebrates are considered, and in the concluding chapters the homologies of the gland are summarised, a scheme drawn up of its evolution, and observations made upon the types best fitted for experimental purposes.

The opening chapter gives an indication of the methods of preparation employed by the author. No mention is made of Flemming's solution, which, in the reviewer's experience, is by far the best fixative for the pituitary body, but requires a special technique in the subsequent procedure of staining. The author has entirely missed the histological evidence of secretory material in the pars nervosa, although it can be demonstrated in abundance in all types of vertebrates in which extracts of the posterior lobe yield an active pressor material. Harvey Cushing (Cameron Lectures, 1925) has indicated the importance of this material in the human pituitary, and has commented upon the surprising way in which it is ignored by many histologists.

Few references to the literature of the subject are made in the text, and the reader will find it impossible to distinguish between the original observations of the author and what has already been noted by others. This is a serious fault, and deprives the book of much of its value as a basis for further workers. An appendix gives a bibliography of works upon the pituitary published since 1913.

Most of the illustrations are original. The drawings are helpful, but references to them in the text are not always accurate; *e.g.* on p. 12 the reader is referred to Fig. 28 for an illustration of variations in the Golgi apparatus of the cells of the pars anterior of the mammalian pituitary, and on turning over a number of pages finds a line diagram of a transverse section of a fowl's pituitary. The photo-micrographs are far too crowded, and although well reproduced, lose in value because of their arrangement and the absence of an adjacent description.

To turn from criticism, it must be admitted that the author has recorded much work that is praiseworthy. Methods have been devised which appear to enable a differentiation to be made between pars intermedia and pars tuberalis. He has much to say that is interesting although one may not always agree with it, and his views upon the homologies and evolution of the gland cannot be lightly dismissed. P. T. H.

Our Changing Earth.

Our Mobile Earth. By Prof. Reginald Aldworth Daly. Pp. xxii + 342 (15 plates). (New York and London: Charles Scribner's Sons, 1926.) 21*s.* net.

PROF. DALY of Harvard once again has presented in book form matter of geological interest gathered from all parts of the world, and has supplied the desirable connective tissue of theory and speculation. The present work is based upon a course of popular lectures given at the Lowell Institute of Boston. Below the surface, however, it is easy to realise that it has been prepared for the serious student as well as for his lay brother. There is something of the fascination of Lyell's "Principles" in these traveller's tales, each one with its moral; and the suggested references listed chapter by chapter at the end of the volume will be found most useful. The 187 illustrations, too, are excellent; and an author's note invites their reproduction except where covered by previous copyright.

To begin with, we are introduced to earthquakes, with proper emphasis on their scientific importance as well as their frightfulness—fewer people are now killed by earthquakes than by motors. The

localisation of earthquakes in the Tertiary mountain belts is explained as a result of up-and-down and sideways adjustments of already folded masses. Observed surface displacements are discussed with copious illustration. In passing, one may perhaps protest against ring-cracks being referred, in Fig. 10, to "torsion of the ground." These particular cracks are surely analogous to countless ring-fractures that a few years ago used to develop through settlement in relation to old shell-craters in Flanders. But to return from this aside, Daly not only illustrates surface faulting in connexion with the 1906 San Francisco earthquake, but also shows how the final snap was preceded by a more distributed distortion that has been traced in observations of the U.S. Coast and Geodetic Survey.

Daly next explains seismograms and the three kinds of earthquake waves distinguishable in these records. We are now getting to the heart of the subject. Advancing the usual arguments, our author claims that the continents are great discontinuous masses of aggregate granitic composition, and that they float in iceberg fashion with foundations immersed in crystalline basalt. He further suggests that below the crystalline basalt is a circum-mundane layer of *glassy basalt*, in which high temperature inhibits crystallisation. This conception has two important bearings upon volcanic and tectonic problems : it entails a limited inversion of the law of increasing density with increasing depth ; and it also gives a higher sub-crustal plasticity than might otherwise be expected. Probably many readers will hope that Daly will recast his theory to make his density inversion local as well as limited.

A chapter naturally follows on volcanic action. It is a valuable résumé, with much stress laid on Kilauea in general and gas-fluxing in particular. St. Helena is also mentioned as a geological paradise, and regret is expressed that Napoleon did not realise his opportunities in this direction.

An instructive attempt is made to disentangle earth and sea movement in comparatively recent phenomena of emergence and submergence. Jamieson's interpretation of isostatic earth-movement in connexion with ice-load is accepted as of prime importance for the understanding of the raised beaches of glaciated lands. On the other hand, a low raised beach, which Daly has traced along much of the shores of the Atlantic and Pacific Oceans, is attributed to a Neolithic withdrawal of water to augment some still existent ice-sheet. Similarly, Darwin's submersion theory of atolls is brought into relation with release of water during the wane of the glacial period. It would be interesting if some other isostatic expert were to approach Darwin's theory fortified with the apparently obvious assumption that all oceanic volcanic islands must in course of time subside.

The mountains of the globe are divided by Daly fairly comfortably into Mid-latitude-Mediterranean and Circum-Pacific zones. The nature of mountain folding and thrusting is illustrated, *inter alia*, by Fig. 148 of an overthrust outlier, Chief Mountain, Montana. In scenic expression it rivals the best of the Swiss *klippes*. Daly's outlook upon mountain problems is naturally reminiscent of the writings of Dana, James Hall (of New York), and Dutton, but it has notably original features. Here we need only point out that Daly joins Osmond Fisher, Dutton, Taylor, Wegener, and many modern alpinists in revolt against the old earth-contraction theory of mountain origin. He adopts instead the continental drift hypothesis, and adds new features. In outline, his statement is as follows :

(1) Continental drift is of the nature of a gigantic landslip—exceeding in scale the tectonic landslips envisaged by Schardt or Reyer.

(2) A cause is suggested for the continental doming that is supposed to have preceded continental slipping.

(3) The glassy substratum makes slipping easy.

(4) The slipping continents crumple marginal geosynclines.

(5) The glassy substratum allows of subsidence of crust-blocks beneath crumpling geosynclines, and the fusion and expansion of these blocks is responsible for eventual elevation of mountain chains.

A feature which continually crops up in Daly's discussion of mountains is an assumed lag between crumpling and elevation. In Europe, however, the evidence distinctly favours contemporaneity of these two phenomena (with, of course, later repetitions of upheaval in response to erosion as explained by Fisher in 1881). For example, the Tertiary Flysch and Molasse of Switzerland derived most of their material from already elevated Alps that were actually travelling. The travel was so real that the Flysch was in due course entirely incorporated in the Alpine chain, and even the Molasse, though it formed later and farther north than the Flysch, now lies marginally overturned and over-ridden.

E. B. BAILEY.

Letters to the Editor.

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The Band Spectrum of Mercury from the Excited Vapour.

IN my letter dated Mar. 1, which appeared in NATURE of Mar. 12, p. 387, it was stated that the 'forbidden' line λ2270 appeared in the excited vapour in association with the band spectrum.

I now find that the other 'forbidden' line at the computed position λ2655·60 also occurs in the excited vapour, and much more strongly than λ2270. The observed position of the line is λ2655·73. This measurement might doubtless be improved upon, but the line is very definitely on the less refrangible side of the line λ2655·13 in a comparison arc spectrum. The 'forbidden' line is absent from the latter, and, so far as I know, it has not been observed before in any circumstances. RAYLEIGH.

Terling Place, Chelmsford,
Mar. 8.

Truth or Convenience.

DR. WILDON CARR'S letter in NATURE of Feb. 5, p. 199, serves as a reminder that the mathematics of relativity is one thing and the philosophy based on it is another; so I take advantage of the opportunity to comment controversially on a few philosophic points, and especially to protest against a comparatively recent anti-scientific tendency to teach that we are not making an attempt to ascertain actual truth about the universe, but only to formulate propositions that are practically helpful and convenient.

In explaining the theory of relativity in ordinary language, stress is usually laid on the 'observer,' and at one time we were told that metaphysical ideas were evaded by attending solely to what could be observed with the aid of measuring instruments, and that thus physicists might be placated, since they were dependent on laboratory measurements for all their knowledge. But if physicists had proceeded solely on that basis, they would not have got very far in their generalisations and theories. The laws and conceptions of physics, like those of mechanics and geometry, are surely ideal; the exact truth of their propositions holds, not in the world of experience, but in an ideal world the axioms of which are infinitely true if true at all; experience might enable these theorems to be rejected as false, but their accuracy could not be tested by any precision of measurement, which must be limited to the fifth or sixth or perhaps the ninth decimal place.

The laws of motion, for example, and any other simple generalisation like Ohm's law, originate as hypothetical challenges, to be definitely disproved if possible, or to be verified approximately, or to be modulated by subsequent refinement, or to be applicable subject to certain conditions. Meanwhile they are taken as precisely true. Newton's law that acceleration is proportional to resultant force was treated as exact; the minor dependence of the ratio on speed was a discovery two centuries later. The constant ratio of e.m.f. to current in a metallic conductor may be modified by many circumstances of which the molecular disturbance caused by the current itself is chief. The law, moreover, may be found to apply to liquids, and be inapplicable to rarefied gases. Departure from an ideal law in any given case is a matter of measurement.

Truth is in the ideal. The actual world is an approximation thereto. No one has ever encountered an exact circle or triangle, but the Euclidean propositions apply to actuality as near as makes no matter. That is perhaps the excuse for saying that we do not aim at truth; but it is a bad excuse. We always aim at truth beyond the range of our experience or measuring achievements. Absolute truth may be an unattainable ideal, but it is our clear and permanent aim.

Similarly, the relativity axioms are incapable of any but approximate verification. They, too, belong to the ideal. This applies obviously to the equations, which as they stand are superhumanly accurate, but it also applies to the verbal interpretation or elucidation of such equations in terms of different observers. On no practical grounds can it be held that measurements made by an observer flying past the instruments, or the thing to be observed, are just as good as those made by one who is sitting still, and that we have no reason for preferring the observations of one more than those of the other. I take it that all the modes of statement in which different observers are mentioned are merely attempts to put into words, and thus make clear to literary philosophers, the meaning (say) of the Larmor-Lorentz transformation. From this point of view no doubt an 'observer' can be replaced by a photographic plate, except that neither a photograph nor anything else has a meaning until it is interpreted by a mind. But so far as the record is concerned, it does not matter whether the images are on the retina of the eye or on something else: the ultimate interpreter, in either case, is interpreting a physical record.

The exposition of the basal principles of relativity by Dr. Jeans in the new volumes of the "Encyclopædia Britannica" is a masterly production, and as he does not enter upon philosophy, save in a few subordinate sentences near the end, no fault can be found with it. But when it comes to an application of those principles to philosophy the ground is far less secure. The subordinate sentences I refer to in this fine article are where he says:

> "Relativity teaches us that this velocity $[c \pm u]$ is always precisely c, and this in itself disposes of the ether of Faraday and Maxwell."

But surely the teaching of relativity on that subject is an assumption, based no doubt upon negative experiments and highly plausible, but not really verified; hence its force as an abolishing agent is by no means overpowering. It might even be said that the relativity rule for compounding any two velocities, u and v, essentially implies a medium in which the motions occur, because its characteristic constitutional velocity c is inevitably involved. Nevertheless it may be fully admitted that an ether subject to the ordinary laws of dynamics, so as to be illustrated by mechanical models, has had to be abandoned. All our science and natural laws have hitherto been limited to matter. Directly we go beyond that we are in the dark: somewhat literally our senses leave us. That is why I presume we are so loath to admit the existence of anything immaterial.

Again, it is said that it "is impossible to discriminate between gravitational and centripetal acceleration"; but surely one has relation to an axis, the other to a centre. At any given place discrimination may be impossible; but taking the whole surface of the earth into consideration it is not impossible. It is well known that they have

been and must be discriminated: so, of course, the above is not Dr. Jeans's meaning, unless absolute rotation is abolished. But it is apt to be taken as his meaning, and so force or constraint gets abolished too.

Again, it is sometimes wrongly understood that two events are said by relativists to be simultaneous when a ray of light can be present at both. Or in the words of the philosophical article immediately following that of Dr. Jeans: "If a ray of light can move so as to be present at both events the interval is zero." Thus it might be understood that the flash of a pistol was simultaneous with its impression on the eye; or that the outburst of a solar flame or a new star is synchronous with the formation of its image on a plate. That is doubtless the appearance, but it has no reality. Every one really allows for time taken by the messenger. 'Interval' is a new technical term, involving both space and time, which may as it were partly or wholly cancel each other. The statement quoted above is only an interpretation of the usual expression for an interval ds in the so-called four-dimensional equation,

$$ds^2 = dx^2 + dy^2 + dz^2 - c^2dt^2,$$

with $ds = 0$ when light is concerned. In the interpretation of this equation, in which the velocity c has been introduced, that velocity is often called 1, and eliminated; but we cannot eliminate it from reality and regulate the nature of time or the sequence of events to suit any physical traveller. Zero interval does not mean simultaneity in time. The observer ought never to be allowed the last word. I suppose it may be truly said that thunder and lightning are really and truly simultaneous; but that cannot be the impression of any observer. Ascertained truth is the result of a mental operation superposed on mere observation. One observer may be as good as another, but an interpreter surpasses both.

Doubtless these objections are minor ones, and are not likely to be admitted without emendation; but there is a real tendency, initiated apparently by Mach, and pursued by Poincaré, to contend that physical generalisations are not so much true as convenient. And further, that all manner of absurdities can be tolerated if they help us to arrive at results. Well, I admit that they can be tolerated in an interim manner; as in any consistent system of mathematics, $\sqrt{-1}$ and the rest are very useful; but they always disappear from the final result, or at least from the interpretation of that result. The tendency that I fear is that some of the absurdities will be retained by philosophically minded interpreters, and will be foisted into their scheme of reality. For example, in dealing with the quantum drop of an electron from one orbit to another, some writers seem willing to contemplate the extinction of an electron in one place and its re-creation in another; so that its world-line, instead of being continuous, is dotted. (I see that this very thing is illustrated in a letter immediately following Dr. Wildon Carr's.) Again I find in a review of a book by Prof. G. N. Lewis in NATURE of Feb. 12, p. 228, an assumption that destination affects emission, or that an atom only emits light to or towards another atom; or in other words, "that we can influence events which are already past." So that, for example, the dark spaces in interference bands are to be accounted for by the light that would have fallen there being actually not emitted. This last contention, however, unlike some of the others, is demonstrably false; for we know that interference is only redistribution, and that extra light is accumulated in the bright spaces. Some popular statements about interference, however, have led people to suppose that light destroys light, not only locally but absolutely, in contradiction to the conservation of energy. Trivial errors like this may be of no consequence; but somehow people are led to say, what is actually said on p. 228, that the question of true or false "has no meaning in science. All that one is concerned with, as in the case of all scientific theories, is its usefulness." I venture to urge that contentions of that kind ought to be stigmatised and rebelled against as heresy.

There is a further but more recondite contention that our great physical generalisations (the conservation and relativity laws, for example) are not so much laws of Nature as identities, when properly regarded with full knowledge, so that their contrary is inconceivable. There may be some important philosophic truth in this, and perhaps it might be extended to include everything that is; so that, regarded from an impossible point of view of full and complete knowledge, everything is inevitable and could not be otherwise (unless this is limited to the inorganic world, and is not true of life and mind). However that may be, the discovery of these identities is the achievement of scientific exploration, and surely such identities are a real truth about the nature of things, and not mere human conveniences of expression. Regarded as conveniences, some relativity statements rather fail by not being convenient.

I know that this is a presumptuous letter, open to attack from many sides; but I do want to enter a protest against the idea creeping into scientific philosophy (not perhaps sufficiently guarded against by that admirable philosophic combination, the late James Ward and J. H. Poynting) that we are not out for truth, but only for handy methods of formulation; and, further, that we can contemplate absurdities, geometrical and other, not only as auxiliary and contemporary and intermediate aids, but also as representing something actually existing in the universe, although repugnant to our mental make-up. For mind, after all, is part of the universe,—by it our laws are formulated, and on it our test of truth depends. Minds are not infallible, however. It is therefore necessary to be cautious in stigmatising anything as an absurdity, lest its absurd aspect be only relative to our own incomplete experience and inadequate knowledge. OLIVER LODGE.

Radio-activity and the Heat of the Earth.

WHILE recognising the importance of the evidence brought forward by Dr. Lawson in NATURE of Feb. 19, p. 277, I cannot agree that it is sufficient to demonstrate that only an insignificant portion of the energy emitted by radio-active elements in rocks is expended in effecting changes in the surrounding minerals. He states that when such elements are placed in glass tubing, the energy absorbed in producing modifications in the glass does not amount to more than one per cent. of the total given off and is probably not more than about a tenth of this value. He infers that a similar state of things must prevail where biotite mica instead of glass is exposed to the radio-activity, and this in spite of the fact that on heating the pleochroic spheres (usually referred to as haloes) that result, they "exhibit the phenomenon of thermo-luminescence," but claims that "the energy so liberated does not produce catastrophic results, and is manifestly small." The last statement is, to say the least, by no means obvious. The question at issue is simply quantitative, and it therefore seems to be dangerous to argue that because glass tubing containing about 70 per cent. of silica and a certain amount of lime and soda absorbs but a small proportion of the radio-active energy, this will also be the case with biotite containing, say, 38 per cent. of

silica with smaller amounts of alumina, iron oxide, potash, and titanium oxide. That the alteration in the biotite caused by the radio-activity is very considerable follows from the fact that, as shown by Dr. Brammell of the Imperial College, the pleochroic spheres persist even when the biotite has been converted by pneumatolytic agencies into a substance practically identical with muscovite. He also found that it was necessary to keep biotite at a dull red heat for about six hours to render the 'haloes' invisible. During that time a very large amount of heat might be released without "catastrophic results."

Recently, records have been published of a deep boring at Dubbeldevlei in the Cape Province of South Africa (about Lat. 30° 30′ S. and Long. 21° 35′ E.), and they deserve consideration in connexion with this question. It reached a depth of approximately 5080 feet, and a survey by Prof. G. A. Watermeyer (*Trans. Geol. Soc. S. Africa*, vol. 26, pp. 65-7, 1924) showed that the depth could not be in error more than 0·3 of a foot. Temperature measurements were made by L. J. Krige and H. Pirow with the greatest care (*ib.* pp. 50-64). Down to 2137 feet the rocks consisted of horizontal Ecca and Dwyka beds, shales, with occasional dolerite sills, and tillite. Then came 550 feet referred to the Fish River Series, correlated with pre-Cambrian Pretoria Series. The remainder of the boring was in the ancient granites and gneiss which outcrop about fifty miles to the northward. They are widely extended in South Africa, not only at the surface but also below ground, as evidenced by fragments in the Kimberlite pipes (Du Toit, "Geology of South Africa, p. 44, 1926). They probably underlie all sediments except the primitive metamorphic rocks of pre-Witwatersrand age, into which they appear to be intrusive, and extend downwards for a depth of several miles at least. Being of acid composition they are presumably rich in radio-active substances. They must contain, too, a considerable amount of potassium, which Dr. Lawson claims as being radio-active.

The average temperature gradient for the whole depth of the boring was 1° C. in 31 m., but varied from 1° in 18·3 m. to 1° in 51·8 m., mainly in accordance with the conductivity of the local rock. In the granite and gneiss, the conductivity of which lies between 0·005 and 0·006, the average gradient was 1° in 45·4 m. In shale the gradient was at its highest, 1° in 18·3 m., for the conductivity of shale is stated to be only 0·0023. In the Witwatersrand mines the gradient is so low as 1° C. in 112·8 m., the conductivity of vein-quartz and quartzite being 0·0095, and that of pure quartz more than twice as much.

It is remarkable that the presence of extensive granite and gneiss in the lower 2400 feet of the bore, and for a far greater depth below, seems to have had no appreciable effect on the gradient. Unfortunately, no determination of the radio-activity of the rocks traversed appears to have been made. It is to be hoped that this will be carried out, as the cores are apparently still available. JOHN W. EVANS.

'Seizure' with Sliding Surfaces.

IN his letter to NATURE on "The Polishing of Surfaces" (Feb. 19) Mr. N. K. Adam refers to Hardy's work on static friction, showing the tearing away of surface particles of glass when one glass surface slides over another glass surface. In a leading article, *Engineering* (Jan. 23, 1925) emphasises the difficulty in understanding how forces of cohesion, exerted through surface layers, can ever be great enough to overcome the forces of cohesion between a particle of glass on the surface and the particles of glass immediately below the surface, in order that a scratch may result. The writer in *Engineering*, as an alternative explanation, has recourse to ideas with regard to friction which Prof. Muir tells me were described so long ago as 1776 by Oliver Goldsmith in his "Survey of Experimental Philosophy": "The little risings in one body stick themselves into the small cavities of the other in the same manner as the hairs of a brush run into the irregularities of the coat while it is brushing. If the bodies slide one over the other, the little risings of one body in some measure tear or are torn by the opposite depressions."

What appears to me as a better explanation of the phenomenon of 'seizure' is afforded by the suggestion I made with regard to the polishing of surfaces (NATURE, Sept. 4, 1926), namely, that actual fusion of the surfaces occurs. The temperature at the point of seizure (one of the many points of 'contact' between plane surfaces) rises so high that actual fusion of the glass occurs across the surface layers, with subsequent rupture. It is only at first sight that this hypothesis seems extravagant, but Mr. N. K. Adam's reference (in the letter referred to above) to the "small thermal conductivity of the material," and his comments with regard to points of contact, indicate that some further explanation of the manner in which the thermal agitation is set up is desirable.

Space demands brevity, but there should be little difficulty with regard to the points of contact. Even such a material as wash-leather cannot possibly adjust itself to molecular irregularities. With regard to the setting up of the molecular agitation, it may be helpful if I refer again to the analogy of originating sound vibrations. My attention has been directed to a calculation made many years ago (I do not know by whom) showing that the natural frequency of sound or elastic vibrations of a particle of molecular dimensions is a high temperature frequency. Thus frequency $= \sqrt{E/\rho}/2l = \sqrt{10^{12}}/10^{-8} = 10^{14}$ per sec., and the frequency of the dominant wave length in black body radiation at a 'bright red temperature' is about 10^{14} vibrations per sec.

In conclusion, I would comment on Mr. Adam's statement that "Clearly the random removal of particles . . . from one point of the surface to another, must result in forming an amorphous layer, if continued long enough," by remarking that the ends of a freshly fractured glass rod do not cohere when pressed into contact again, and I do not understand how small fragments of glass in the polishing process can form an amorphous layer, polished or otherwise, without the intense molecular agitation or increase in temperature which gets rid of the surface layers.

JAMES M. MACAULAY.

Natural Philosophy Department,
Royal Technical College,
Glasgow, Feb. 24.

On the Volatility of Borax.

IN a discussion of the standardisation of hydrochloric acid with different standard substances (*J. Amer. Chem. Soc.*, 70, 1772, 1926), I made the following remark: "After the substance [borax] had been dried at 200°, the crucible was placed in an electric oven at a temperature of 700-750°, until constant weight was attained. When afterwards it was heated at 800°, at which temperature the salt fuses, the weight did not change. We cannot confirm the statement of H. V. A. Briscoe, P. L. Robinson, and G. E. Stephenson (*J. Chem. Soc.*, 122, 150, 1925), who state that fused borax loses sodium oxide. Even after the substance had been heated for two hours at 800° the weight did not change."

Prof. Briscoe and P. L. Robinson (NATURE, 118,

374, 1926), remark on this statement that the fact is well established that borax is volatile at high temperatures. They even were able to show in a qualitative way that fused borax is decomposed at higher temperatures. They say: "The inside of the silica muffle used for the fusions of borax in our investigation was completely coated with a white opaque enamel, about 0·06 inch thick, of a product of a reaction between the volatilised material and the silica."

As there is such a discrepancy between Briscoe's and my own results, I repeated the latter, but again I found a negligible loss in weight after two hours' heating at 800°. Now Prof. Briscoe and his collaborators say they fused the borax in a *platinum dish* (large surface), in the electrically heated muffle in *a current of air* free from carbonic acid and dried over solid caustic potash. In total they heated it for 2-2½ hours. Hence they worked under conditions very favourable for volatilisation. In my experiments the borax was heated in a covered platinum crucible (surface of the fused borax about 2·5 cm.), without passing a current of air over it.

In order to check the results formerly obtained we heated about 3 gm. anhydrous borax in the electric oven under the same conditions as described.

We continued the heating for about fifteen hours at 880°, and afterwards twenty hours at 940°. At different intervals the borax was weighed. (It is unnecessary to take precautions against hygroscopicity of the anhydrous salt, as the melt of borax with its small surface attracts water from the atmosphere very slowly. Even after standing in an open crucible overnight in the balance, the weight did not change.) From the results it appeared that the borax lost at 880° 0·16 mg. per hour, and at 940° 0·23 mg., due to the volatilisation.

We must therefore confirm the statement of Briscoe and his collaborators, that fused borax is volatile. *On the other hand, it is evident that under favourable conditions* (heating in a crucible without passing over it a current of air, and at a temperature of about 800°) *the loss due to the volatilisation of sodium oxide is so small that it is negligible, even for most accurate analysis, if the heating is not prolonged for more than two hours.*

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The Coat of Sheep.

IN an important work, "Das Haarkleid des Menschen," published in 1908, Dr. Hans Friedenthal points out (1) that in man the coat between the fourth and fifth month of development consists entirely of fine wool fibres, and (2) that shortly before birth there appear among the fine wool fibres strong pigmented fibres with a pith or medulla, *i.e.* fibres corresponding to the coarse fibres forming the outer coat of wild sheep. Hitherto it has been assumed that the simple pithless fibres forming the coat of the Merino and other fine-wooled sheep are modified true hair fibres—hair fibres that have lost their medulla, from which, according to Bowman (the author of the standard work on wool), "the medulla has been bred out." From an investigation which has been in hand for some time on the structure of the fibre forming the coat of sheep, it has been ascertained that in sheep, as in man, the first coat consists entirely of simple pithless fine-wool fibres.

In the case of sheep, the gestation period lasts about twenty-two weeks. Though at the end of the twelfth week of development there are only a few fibres on the lips and at the tip of the tail, there is a complete coat at about the end of the fourteenth week. The fibres forming the first coat vary in length. In some areas they are so short that they are inconspicuous, in others they are nearly a quarter of an inch in length. The long fibres in sheep at the end of the fourteenth week, like the long eyebrow fibres in the human embryo, are obviously wool fibres. Though up to the middle of the fifteenth week the coat consists entirely of fine pithless wool fibres, at the end of the fifteenth week, more especially in the embryos of Highland Blackface and other coarse-wooled breeds, short coarse true-hair fibres with an interrupted or a continuous medulla are found among the fine-wool fibres of the first coat. As the development proceeds the coarse medulated fibres increase in number, and even in some fine-wooled breeds attempt to form an outer coat. In Europeans, as Friedenthal points out, there is, even in old age, usually a vestige of the first coat of wool.

In all wild sheep there is during winter a complete inner coat of very fine wool and an outer coat of coarse hair. Even in present-day domestic fine-wooled breeds there is always, on the head and limbs, a remnant of the original ancestral outer coat of coarse hair.

From this short account of the investigations in hand, it follows that a study of the coat of sheep during fœtal life lends no support to the view hitherto held by Bowman and others that wool is hair from which the pith or medulla has been bred out, but shows that wool is a distinct and primitive type of fibre different alike from fur and hair.

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Non-Magnetic Films of Iron, Nickel, and Cobalt.

THE letter by Mr. Hanawalt and Prof. Ingersoll on "Non-Magnetic Films of Iron, Nickel, and Cobalt" (NATURE, Feb. 12, p. 234) raises a number of interesting questions.

Oseen's explanation (*Z. für Phys.*, 32, 940; 1925) of the properties of the previously announced non-magnetic films of nickel was based on the supposition that 'non-magnetic' signified not only the loss of ferromagnetism but also of the magnetic moment of the nickel atom itself. An electronic rearrangement but no other change was postulated as a result of which the nickel atom obtained a completely symmetrical configuration, thus leading to a non-magnetic film in the above double sense. It may be pointed out that, while such an explanation could be extended to the case of iron, it would not be applicable for cobalt, as this atom contains an odd number of electrons.

It is not possible to state definitely from the data so far published whether the term 'non-magnetic' should be interpreted as in Oseen's paper or merely as indicating a loss of ferromagnetism as it is apparently intended. So far as the physical nature of the non-magnetic films is concerned, it seems that these may differ from the ordinary metals in bulk in that (1) the metallic atoms are farther apart; (2) chemical combination probably of a rather loose type may have taken place; and (3) there may have been an electronic rearrangement in the metallic atoms. (1) is shown to be the case from Hanawalt and Ingersoll's observations, and (2) is rendered probable. The reality of either (2) or (3) or both could be determined if it were possible to state whether the material of these non-magnetic films is diamagnetic or paramagnetic, and in the latter case, by measuring the susceptibility over a range of temperature, to evaluate the magnetic moment of the metallic atoms. The occurrence of

paramagnetism would be consistent with the existence of change (1) with or without (2) and (3). A knowledge of the actual magnetic moment would probably enable a definite decision to be made as to the reality of changes (2) and (3).

If diamagnetism were found and the films of iron, cobalt, and nickel are really of a similar nature, then it would be very probable that all three changes had taken place. The metallic ions would then be in states which might correspond to that of iron in, say, $K_4Fe(CN)_6$, cobalt in most co-ordination compounds of tervalent cobalt, and nickel in, say, $Na_2Ni(CN)_4$.

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The Action of 'Antiknocks.'

THE following conclusions, amongst others, have been reached during an investigation on the effect of 'antiknocks'—such as lead tetraethyl—on 'knocking' in petrol engines :

(1) Antiknocks do not influence detonation in rapid combustion mixtures (*Proc. Roy. Soc.*, 114, 137, 1927).

(2) They function in the initial stages of the combustion as negative catalysts. In the slow combustion of a hydrocarbon, aldehydes are produced which readily form peroxides, which auto-catalyse or induce oxidation of the earlier stages. If these are removed, combustion proceeds more slowly. By reason of such effects on the processes of slow combustion preceding ignition, 'antiknocks' influence greatly the igniting temperature, particularly in the case of aldehydes. Similarly they effect those same processes which occur at a flame front in a comparatively slow burning mixture.

(3) Those metals which give effective organometallic antiknocks are found to be capable of forming higher oxides. Such metals as potassium, which form peroxides in equilibrium with other oxides at about 400° C. are very effective. Non-oxidisable metals such as gold are ineffective. The unstable peroxide formed in the combustion of the fuel and the metallic peroxide are considered mutually to destroy each other. The rate of destruction of the positive catalyst is greater than its rate of production, so that combustion is delayed. The metal atoms in a state of incipient oxidation are thus the effective anti-catalysts.

(4) A purely organic antiknock like aniline is effective for the same reasons; only those types of organic substances are effective as antiknocks as have been shown to be effective in retarding the oxidation of certain aldehydes at normal temperatures in the liquid phase. The mechanism adduced to explain their action in such circumstances by Moureu and Dufraisse is similar to that which we have given above. Such organic antiknocks themselves undergo combustion and are destroyed, a larger quantity of the negative catalyst being therefore required for the same effect.

(5) Both for 'ignition' and 'knocking' there is a condition of sensitiveness to change of reaction rate, and the effect of 'antiknocks' is in general much the same on the two phenomena. The views given are supported by the effect of such substances (aldehydes, organic peroxides, etc.) which promote knocking or favour ignitibility.

These conclusions elaborated and the experimental data which suggest them, will be detailed in papers which it is hoped soon to publish.

A. EGERTON.
S. F. GATES.

Oxford.

Electron 'Reflection' *in Vacuo*.

IN the *Proceedings of the Cambridge Philosophical Society* (Pt. 5, vol. 23), just received, there is an interesting article by Mr. C. F. Sharman on the application of the magnetic spectrum method to the study of secondary electron emission.

Several investigations of this type are now and have been for some time in progress in this laboratory, and we hasten to point out that at least one of our results obtained within the last six months has a bearing on Mr. Sharman's work. We find, in accord with him, that a fraction of the electrons emitted from a filament and accelerated towards a reflecting plate under potential V are 'reflected' with energy corresponding to that full potential V, and that energies immediately less than about 12 volts below V appear to be absent in most of the spectrum photographs taken. Generally speaking, there is a continuous spectrum starting at $(V - 12)$ and extending down to lower energies in an impartial manner. One of the two hundred or so photographs so far obtained is here reproduced (Fig. 1) with a potential scale in

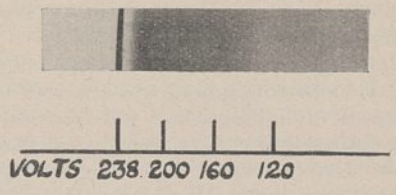

FIG. 1.

volts added for comparison. The sharp-edged black line in the spectrum at 238 volts shows the 'reflection' (from a copper target in this particular case) of the full energy electrons; there is then a white space, and thereafter a general reflection of all energies below about 226 volts. We think that this gap of 12 volts is in all probability real and not instrumental, as Mr. Sharman suggests. Our experimental results are in agreement with a short note by J. Becker (*Phys. Rev.*, 1924), in which during an investigation into the photoelectric emission from various surfaces a very similar effect was recorded.

D. BROWN.
R. WHIDDINGTON.

Physics Laboratories,
The University,
Leeds,
Feb. 17.

Is Darwinism Dead?

REFERRING to the correspondence in NATURE of Feb. 19, p. 277, Mr. H. Belloc writes to say that his statement regarding the impossibility of birds having been evolved from a reptilian form was based on Prof. L. Vialleton's "Membres et Ceintures des Vertébrés Tétrapodes" (1924), not, as Sir Arthur Keith had supposed, on that author's "Éléments de Morphologie des Vertébrés" (1911). The mistake seems to us to be immaterial to the question at issue—namely, "Is Darwinism Dead?"—and we suggest that it would not have occurred if Mr. Belloc had followed the usual practice of giving references to his authorities.

As to the particular point under discussion, it has been referred to the leading authority upon the subject, who replies: "It is absolutely certain that the birds came from reptiles." EDITOR, NATURE.

The Sun, the Earth's Atmosphere, and Radio Transmission.

By Prof. S. CHAPMAN, F.R.S.

THE immense present-day importance of radio communication has directed the attention of a wider circle than ever before to the conditions prevailing at great heights in the atmosphere. Even to the professional meteorologist it seemed formerly that what happens above a height of 30 or 40 kilometres has no bearing on the practical affairs of humanity, however interesting the problems of these upper levels might be to the pure theorist. Almost the only influence of these levels upon the technical operations of mankind seemed to consist in the occasional interruption of telegraphic communication at times of great magnetic storms and auroral displays; the interference was pretty clearly due to currents induced in the earth and the cables by the rapidly varying magnetic field, but the direct association of the latter with the upper atmosphere was somewhat hypothetical, though the auroræ were quite indubitably atmospheric phenomena.

Now that signal transmission is not confined to cables, and electromagnetic oscillations over a wide range of wave-length are sent out into space, the upper air assumes more direct importance, for it is known that a large part of the energy transmitted to distant points travels intermediately at high levels. The manner in which the waves are affected in the upper levels is already partly understood; the rate of propagation is increased by the presence of ions, so that if the ionisation increases with height the upper part of a wave front travelling at an upward inclination to the horizontal is tilted forward, and the wave train may thus be refracted downwards again, quite sharp angles of bending being possible. At the same time, some of the energy of the wave, communicated to the ions, is lost by the latter during collisions with surrounding molecules; if the mean free path of the ions is short, and collisions frequent, the energy of the waves may be rapidly absorbed; the absorption increases with the density of the ionised layer, and is greater for long (low frequency) waves than for short waves. Moreover, the earth's magnetic field deflects the ions while they are oscillating under the influence of the waves, and brings about a change of polarisation of the waves, which is responsible for some of the errors in direction-finding by wireless.

These facts make it clear that changes in the ionisation of the upper atmosphere have an important bearing on wireless transmission, and should be carefully investigated in order that, if possible, the methods of signalling may be adjusted to the changing conditions. Probably in the future the upper atmospheric phenomena will become known by wireless investigations themselves with a thoroughness and detail not otherwise attainable—the results already achieved seem to promise this. But, at least in these early days of such work, some help towards the understanding of wireless problems may be gained from the knowledge slowly accumulated during three or four generations by the study of solar phenomena, auroræ, and terrestrial magnetism.

The ionisation of the atmosphere at high levels may be partly due to the penetrating radiation studied by Kolhörster, Hess, and Millikan, or by the runaway electrons the probable occurrence of which during thunderstorms has been pointed out by C. T. R. Wilson. It seems unlikely, however, that the ionisation thus produced is comparable in importance with that due to solar action. The magnetic variations are intimately connected with the ionisation of the upper atmosphere, and indicate its general distribution and its more important changes, which are unmistakably associated with the state of the sun, or its presentation towards the earth. Further study may reveal magnetic phenomena indicative of ionisation unconnected with the sun, but it appears improbable that such can be of the same order of magnitude as that of which the sun is obviously the cause.

The sun ionises the upper air by two independent agents. One of these travels rectilinearly and falls only on the hemisphere of the earth which faces the sun, that is, on the day or sunlit hemisphere. Many facts indicate that this agent is ultra-violet radiation, absorbed in the upper atmosphere, principally by ozone, itself produced by the first stage of such absorption; another consequence is that the temperature of the layer in question (extending upwards from about 50 km. height) is raised above that of the air at ground-level. As the revolving earth carries any particular region of the atmosphere into the night, when the ionising radiation is cut off, the ions re-combine, and most rapidly at the lower surface, which in the course of a few hours moves upward from a level of about 50 km. to 100 km. or more. The conductivity of the ionised layer is consequently diminished at night, by the reduction in both the thickness and the specific conductivity; this affects the electric currents flowing in the ionised layer, to which the daily magnetic variations are due. The latter are much more intense by day than by night, and in low latitudes (where the sun's rays are most direct) than in regions farther from the equator. The magnetic variations also show clearly that the conductivity of the layer ionised in this way is distinctly greater (by at least 25 per cent.) at sunspot maximum than at sunspot minimum; this requires a change of intensity in the ultra-violet radiation by about 60 per cent., which is remarkable in view of the absence of any comparable variation, during the sunspot cycle, in the sun's visible radiation. The increase in the ultra-violet radiation seems to be due to enhanced emission from the sun's surface as a whole, and to be independent of particular disturbed localities on the sun.

The other solar ionising agent is corpuscular, and proceeds from locally disturbed areas on the sun's surface, often, though not always, associated with visible markings such as sunspots. The corpuscles

are ejected in laterally limited streams, the direction of which varies as the sun rotates. When such a stream happens to impinge on the earth, the air becomes highly ionised in the atmospheric regions affected, which are situated geographically within about 20° of the poles of the axis of magnetisation of the earth, though they spread farther towards the equator when the streams are specially intense. The corpuscles can penetrate the earth's atmosphere down to not less than 80 km. above the ground; they impinge not only on the side of the earth facing the sun, but also bend round to the right side of the earth, where they produce visible auroræ. The deflexion of the corpuscles towards the magnetic poles is due to the earth's magnetic field, and indicates that the streams have a slight excess charge and are ionised.

The ionisation of the auroral zones renders these regions of the atmosphere highly conducting, and permits intense electric currents to flow in them; the changing magnetic field of these currents is observed as a magnetic storm (or lesser disturbance). Even if auroræ were not visible, the magnetic observations would indicate the existence of highly conducting upper air in polar regions.

The ionisation of the air due to the solar corpuscles is much less uniformly distributed than the ionisation over the sunlit hemisphere due to ultra-violet radiation; the limited distribution of bright auroræ gives visible indication of this. Also the ionisation by corpuscles varies irregularly with time, and cannot be predicted at present with any certainty; it depends both on the activity and presentation (towards the earth) of the disturbed solar areas. If such an area remains active after the lapse of a solar rotation period (about 27 days), it may affect the earth a second time, or even several times after successive rotations. Hence arises the clearly marked tendency for magnetic disturbance to recur after 27 days; but this is only a tendency, for the direction of the stream from a solar disturbed area may change, or the area may not remain long active.

The influence upon wireless transmission of the regular change of ionisation from day to night has long been recognised; the improved conditions at night, especially for long waves, are naturally accounted for by the withdrawal of the refracting ionised layer to greater heights at night, where the ions have longer free paths and where their less frequent collisions dissipate less of the energy acquired from the electric waves. The influence upon wireless of the less regularly distributed but occasionally very intense ionisation due to solar corpuscles has only lately become reasonably certain. The effects are likely to be complicated, and it will doubtless be a long time before they are clearly ascertained. An interesting feature suggested by recent observations is that transmission from Europe to America is more affected than that from Europe to the East. This is not unexpected, in view of the inclination of the earth's magnetic to its geographical axis; the centre of the north auroral zone is about 10° from the geographical north pole, in the direction of Canada, and auroræ are observed in Canada in much lower latitudes than in Europe. The region of abnormal corpuscular ionisation will therefore extend about 20° farther towards the equator in Canada than in Russia.

The Decimal Classification of Melvil Dewey and its Extension by the Brussels Institute of Bibliography.

By Dr. S. C. BRADFORD, The Science Library, S.W.7.

THE study of classification is a necessary preliminary to the preparation of a comprehensive guide to recorded information. Of the multifarious systems that have been suggested for the classification of literature, Dewey's "Decimal Classification and Relative Index," first developed in 1873, seemed the most hopeful of any produced hitherto, and was hailed with jubilation in many quarters. But, although it proved successful for the purpose for which, in the first place, it was designed, *i.e.* the classification of books, it has been found inadequate when applied to greater bibliographical detail, such as individual scientific and technical papers. In its original form it is therefore unsuitable for the preparation of a detailed index to the records of human work and thought.

Dewey's scheme comprises two parts: a classification in which more or less logically arranged subdivisions of knowledge are given separate arbitrary numbers, and an alphabetical index of subjects, regarded by Dewey as the more important feature of the system, to indicate the respective numbers of the subdivisions. The index aims at giving similar or synonymous words and the same words in different connexions, so that any person of intelligence can scarcely fail to get the right number. In this scheme the whole of knowledge is represented by unity, and divided into ten main divisions. The first, comprising all numbers between 0·0 and 0·1, is assigned to works dealing with general subjects such as encyclopædias, bibliographies, etc., and those that cannot be allocated to the nine more definite subdivisions that follow. These are:

0·1 Philosophy.	0·6 Applied Science.
0·2 Religion.	0·7 Fine Arts.
0·3 Social Sciences, Law.	0·8 Literature.
0·4 Philology, Languages.	0·9 History, Geography,
0·5 Pure Science.	Biography.

Each of these main groups is again subdivided by addition of another decimal place, and further subdivision of these secondary and succeeding groups is obtained as desired. Thus:

0·5 Pure Science.	0·5315 Gravity, Ballistics.
0·53 Physics.	0·53157 Internal Ballistics and
0·531 Mechanics.	the Energy of Projectiles.

In practice the initial decimal point is omitted, and

others may be intercalated to assist the memory or aid the eye. Thus catalogue titles, or abstracts, of books, pamphlets, monographs, papers, notes, etc., dealing with internal ballistics, are to be mounted on cards of uniform size and filed under the number 531·57; and no matter by what bibliographical agency the information is indexed, all the index cards relating to this subject fall together automatically. The student who requires to know what has been recorded on this subject, having ascertained the number from the alphabetical index to the subject-classification, can, by looking at the cards bearing this number, gain access immediately to all the information desired that has been rendered available.

The advantages of this system are: (1) Its simplicity: the order of filing is merely that of the decimal numbers, so that sorting of cards is mechanical; (2) each subject is represented by a single decimal number occupying a definite position in numerical sequence and independent of the language in which the conception is expressed; (3) nine further subdivisions can be obtained as desired by addition of one more figure, and these new subdivisions can be inserted between two previously established divisions without disturbing their numerical order; and (4) the number representing a given conception can be ascertained from the alphabetical index without consulting the classification.

Dewey's classification contains also the germ of an idea which, developed afterwards by the Brussels Institute, converted his classification into a powerful instrument of bibliography. There are certain general groups into which bibliographical material may be divided that are independent of subject, or common to a large number of conceptions. Thus, at the head of each of the main subdivisions (*e.g.* of 5, Pure Science), there is a section

01 Philosophy, Theories.	06 Societies, Transactions.
02 Compends, Text-books.	07 Education, Methods of Teaching.
03 Dictionaries, Encyclopædias.	08 Collected Works.
04 Essays, Lectures, Addresses.	09 History.
05 Periodicals.	

Such subdivisions relate to the form or purpose of the work. For example, the *Proceedings* of the Physical Society would be numbered 53·06. Again under geology, 55, there is a section, 554 to 559, to be subdivided by countries like geography, 94 to 99. Altogether, a good many examples occur of the application of such an idea, but the classification, as published, was suitable for the purpose of arranging the books in the New York State Library, and the principle of common subdivisions was not developed in detail. If a universal guide to knowledge should be organised on the basis of the Decimal Classification, mankind will owe much to Melvil Dewey, and it is not the less to his credit that the original scheme proves inadequate when applied, as Dewey hoped, to the indexing of scientific papers as a whole.

However, the classification of separate articles requires much more subdivision than the grouping of works even on the largest scale. The main subject-classification itself requires to be more detailed, and when this has been developed as much as possible, there remain the various common aspects of a given subject to be dealt with. As an example, the number 661·25, in the extended classification, represents the sulphuric acid industry; and this requires to be further subdivided according to the process of manufacture. When this has been done, we have yet to provide for a variety of considerations that may apply to the number 661·25 or to its subdivisions. For example, there will be papers on theoretical or experimental studies relating to the manufacturing process, at the start, while in use, or after modification; papers from the point of view of realisation of the manufacture, such as gathering materials, special operations, raw materials, accessory products, machines employed, fixed machinery, engines, machine tools, implements, results obtained, by-products, fittings and apparatus; papers from the economic point of view, such as cost of materials, labour, selling price; and from the point of view of premises, sites, and personnel of various kinds.

These and other general points of view are common to the various branches of the sulphuric acid industry, as well as to a vast number of specific subject-divisions. Again, it will be necessary, in many cases, to classify bibliographical material according to place, time, or language, or, it may be, according to the form of the work. Thus, sulphuric acid manufacture may need to be treated from the point of view of country, or period, or it may be desired to distinguish between large treatises, manuals, books of tables, popular descriptions, collected papers or historical studies.

Now although, as it has been stated, Dewey's classification contains the germ of an extension by common subdivisions, this was not developed, and his tables have no places for grouping material by common headings such as have been mentioned. Indeed, to provide for such subdivision as necessary in each case, without perfecting a system of general classes, would have increased the size of the classification to several hundred volumes. For this reason his scheme in its original form is hopelessly unsuitable for the preparation of a comprehensive index to knowledge, and appears never to have been used for bibliographical work on a large scale.

This was the state of affairs when, in 1895, the first International Conference on Bibliography was held in Brussels. The Conference had to search in a spirit of impartiality for the principles on which could be established a universal bibliographical classification. It decided that the Dewey system was based on such principles and was capable of being transformed into a highly satisfactory classification. As a result of the Conference, the Institut International de Bibliographie was founded, which undertook the work of perfecting the Dewey code.

The classification itself was considerably extended, and, in addition, the conception of auxiliary tables for common subdivisions was developed. These are of two kinds: (1) Analytical subdivisions

that relate to special subjects only, and (2) common subdivisions that may be added to any item of the classification. For example, general operations in photography are made into a group of special analytical subdivisions that are available for arranging matter relating to any of the various photographic processes. The numbers representing such subdivisions are preceded by a zero. For example, toning is one such division, represented by 0235, and this number can be added to any of the numbers representing a photographic process—thus 77·21 denotes silver processes in general, and 77·21·0235 means toning in relation to processes based on the use of silver salts.

Besides these special subdivisions that relate to particular parts of the classification, there are five tables of common subdivisions that may be used in any connexion. The first relates to the form of the publication, and is developed from the general subdivisions of the Dewey scheme described above, the numbers being enclosed in parentheses. Thus (05) represents a periodical, so that a magazine restricted to acetylene welding, for example, can be indicated by adding (05) to the number for that process as 665·882(05). Table II. comprises the geographical subdivisions. These are also enclosed in parentheses. Thus (493) denotes Belgium. Consequently sulphuric acid manufacture in Belgium would be 661·25(493). Table III. has subdivisions by language and Table IV. by time. The fifth of these common groups includes all subdivisions corresponding to general points of view. These are indicated by numbers commencing with a double zero; *e.g.* 00311 represents net cost of the raw materials. If it is desired to classify a paper on that aspect of the sulphuric acid industry, it would be numbered 661·25·00311; and these ten figures represent an idea requiring eleven words to express it in English.

By such a logical extension of Melvil Dewey's scheme it was converted into a beautiful bibliographical tool of the greatest power that is suitable for work of the finest detail; and in order that the classification may be kept up-to-date, a Commission was established to issue additions as needed. From time to time, with the progress of science and invention, new divisions become necessary and are published by the Commission. Or, an expert who discovers the need may suggest a considered extension of the scheme, and if this is drawn up in accordance with the principles of the classification, it will be incorporated.

Obituary.

PROF. E. H. RENNIE.

TIME irresistibly takes its terrible toll and the names left upon the roll of our old guard are now very few. The Australian mail just in brings me a copy of the Adelaide *Register* of Jan. 10, with an account of the sudden death of my old friend, Prof. Edward H. Rennie. He seemed to be in good health but on Saturday, Jan. 8, going into the garden, he took a drink of water, lay down—and just died. A few days previously, I had received a long chatty letter from him, dated Dec. 20. In this he speaks of having had a very strenuous year and feeling somewhat played out. During the first six months, he had been acting vice-chancellor of the University; then came the University jubilee and after this the meeting at Perth, of the Australasian Association for the Advancement of Science, of which he was president. Added to this, he had much anxiety on account of the illness of his wife and daughter. He tells me of the journey across the arid region to Perth, lasting three days. At one part, the railway runs in an undeviating straight line, nearly 400 miles, across flat desert, where nothing was growing, he says, over about 2 feet high, the horizon being unbroken by a single tree or elevation of any kind. People seldom realise how much of Australia is country of this order. "Aboriginals were seen here and there almost in their primitive condition, except that they wore clothes."

Rennie's first communication to the Chemical Society was made with Alder Wright. He then worked with me at the London Institution. The record of our work appeared only in the *Chemical News*. I was greatly attracted to him and was hoping to secure him as my chief assistant at the Finsbury Technical College, at the opening in 1883, but a more tempting offer came from home and he returned to Australia in 1882. Two years later, he became professor in Adelaide University. I visited him in 1914, reaching Adelaide a week ahead of the Association, in order to stay quietly with him. I then gained some idea of the man's devotion to his post and the great burden of work upon his shoulders. Rennie's services to his University as a teacher cannot be over-rated. He was extraordinarily thorough, deliberate and exact in his outlook and work, a most painstaking teacher. His scientific services to Australia are also to be ranked very high, though unfortunately, owing to the calls upon him as teacher and administrator, he had but little spare time for original inquiry. He devoted himself particularly to the study of native materials. Perhaps his most interesting discovery was that of trihydroxymethylnaphthaquinone in *Drosera Whittakeri*.

Australia is remarkable for its numerous species of long trailing Drosera. Rennie and I spent a delightful day in the hills behind Adelaide and nothing interested me more, in my journey around the continent, than his digging up the Drosera tubers and showing me the beautiful glistening crystals of the hydroxyquinone present in the outer layers. Why or wherefore such a compound should so come to the surface in a plant is difficult to say.

We spent another day on the seashore tracking down *Lotus australis*, which I was anxious to compare with our *corniculatus*. We found it in quantity, highly cyanophoric, very like the dwarf plant growing at Ballantrae in the sandhills. I fancy *corniculatus* must have wandered to the Antipodes and changed its name.

Australians are in no way sufficiently alive to the need of studying their natural organic products. The wonderful work on eucalyptus oils done by Smith and Baker of Sydney has not yet been appreciated. Only recently (Feb. 12), an advertisement was printed in NATURE for a lecturer and demonstrator in organic chemistry, at the University of Sydney, salary £350 per annum. Only by accident is a chemist good enough for such a post likely to be bought at so low a price, perhaps that of a dock labourer—what Billy Merson earns in a week. No one there will rate a man very high who is paid such a salary. It were time that organic chemical science were put upon a higher footing, especially in so important a seat of higher learning as Sydney—so that it may have some chance of being mentioned along with the harbour.

Australia can ill afford to lose a man of Rennie's calibre and will do well to take warning and relieve them more of ordinary routine labours, if she find other such men to serve her.

HENRY E. ARMSTRONG.

MR. A. B. LEE.

ARTHUR BOLLES LEE, who died on Mar. 3 at Clarens, Switzerland, was born at Froyle, Hampshire, in 1849. He spent most of his life in Switzerland, and hence, though well known by name, was scarcely known personally in Great Britain. He was for several years an assistant under Prof. Korotneff in the Russian Marine Laboratory at Villefranche.

Mr. Lee was the author of a number of papers chiefly on oogenesis, spermatogenesis, and other cytological subjects, published from 1884 onwards, the last of which appeared in December 1924. But he was best known as the author of "The Microtomist's Vade-Mecum: a Handbook of the Methods of Microscopic Anatomy," first published in 1885. This work contained an account of all the methods that had, up to that time, been recommended for the preparation of microscopic objects whether as whole mounts or in section, and it became at once the standard work of reference on the subject. In the subsequent editions Mr. Lee judiciously discarded many of the older and less satisfactory methods as he added careful accounts of new processes, so that the "Vade-Mecum" was always a helpful guide to what had been proved best in methods of fixation, clearing, imbedding, section-cutting, staining and mounting of organisms and of tissues. Seven editions of this work in English up to 1913, at least two in French (by Lee and Henneguy) and four in German (by Lee and Mayer) afford evidence of the value and usefulness of this manual, which, indeed, formed part of the essential equipment of a zoological laboratory, where it was the source of reference on all matters of technique for senior students and for investigators. The last English edition (1921)—the eighth—was edited by Dr. J. B. Gatenby, but, as he stated in his preface, the bulk of the volume was still largely the work of Mr. Lee.

In recognition of his services to microscopical science, Mr. Lee was elected an honorary fellow of the Royal Microscopical Society. He leaves a daughter and two sons, one of the latter, Dr. G. W. Lee, being one of the Senior Geologists in the Scottish office of the Geological Survey of Great Britain.

A VETERAN botanist of striking personality, Prof. Ludwig Radlkofer, has recently been removed by death in his ninety-eighth year, on Feb. 16 last. He was born in Munich on Dec. 19, 1829, took the degree of M.D. at that University in 1854, of Ph.D. at Jena the following year, and in 1863 became professor of botany in his native city. He began his career as an author in 1855, soon being attracted to the Sapindaceæ, especially the genus Serjania, which he monographed in 1875, returning to it more than once, and continuing to write even so late as the last few months. He received many distinctions abroad, and was elected a foreign member of the Linnean Society of London in 1897. He claimed to have been the first to introduce the anatomical method in academical teaching, and was very anxious that his pupil, Dr. Hans Solereder (1860–1920), should be permitted to examine the Linnean herbarium and also the older plant collections in the British Museum such as the Clifford and Sloane herbaria. He introduced the topic at the Norwich meeting of the British Association in 1868 by his paper "On the Structural Peculiarities of Certain Sapindaceous Plants," and again in 1885 at Aberdeen "On the Application of the Anatomical Method to the Determination of the Linnean and other Herbaria." Needless to say, this proposal that every specimen should be so examined could not be entertained, as it involved the practical destruction of the types destined for the information of later generations of botanists.

B. D. J.

WE regret to announce the following deaths:

Prof. D. Berthelot, professor of physics in the University of Paris (Faculty of Pharmacy) and *membre titulaire* for the section of general physics of the Paris Academy of Sciences, aged sixty-two years.

Kommandør C. F. Drechsel, General Secretary of the International Council for the Exploration of the Sea, at Copenhagen on Mar. 2, aged seventy-three years.

Prof. Carl Runge, professor of applied mathematics in the University of Göttingen, distinguished for his work as a mathematician and spectroscopist, early in January, aged seventy years.

Prof. A. W. Scott, for fifty-five years Phillips professor of science at St. David's College, Lampeter, on Mar. 7, aged eighty-one years.

Prof. Yovan Tzvyitch (Cvijić), of the University of Belgrade, president of the Yugoslav Academy of Science and an honorary corresponding member of the Royal Geographical Society, who was well known for his geographical, geological, and ethnographical studies, on Jan. 16, aged sixty-one years.

Dr. A. E. Verrill, from 1864 until 1907 professor of zoology at Yale University, and emeritus professor since 1907, who worked chiefly on marine invertebrates, aged eighty-seven years.

News and Views.

THE new Sir William Dunn School of Pathology was formally opened at Oxford on the afternoon of Friday, Mar. 11. Unfortunately the Chancellor of the University, Viscount Cave, who was to have performed the opening ceremony, was prevented by illness from being present. The circumstances which led the Sir William Dunn trustees to make this magnificent presentation to Oxford were detailed by Mr. C. D. Seligman, the senior trustee present, and the building was gratefully received and declared open by the Vice-Chancellor, the Warden of All Souls, on behalf of the University. The objects of this munificent offer made to the University in Nov. 1922, subject to confirmation by an Order in the Court of Chancery of Feb. 1924, have thus been carried out. Of the total gift of £100,000, £80,000 has been devoted to the building and to its equipment, and £20,000 has been invested as a fund for maintenance and for the encouragement of the study of pathology. On the other hand, the University has provided a site of $2\frac{3}{4}$ acres near the south-east corner of the University Parks, and covenants to make permanent provision for the upkeep of a chair of pathology and for a full teaching staff. £3000 has, moreover, been allocated for the refitting of Prof. Dreyer's old Department of Pathology as a school of pharmacology —a subject which hitherto was poorly housed in attics under the roof of the old Radcliffe Library in the Museum.

THE building which students of pathology in Oxford have now for their use is of red brick with stone coins, and is in three storeys in a simple and pleasing style of architecture, well lit by large windows. The main entrance leads up to the first floor, where are the lecture-room, museum, library, chemical laboratories and culture rooms. The large students' laboratory, and numerous research rooms are on the upper floor, while the service rooms, the refrigerating plant and cold chamber, centrifuge room, low-pressure apparatus room, engineering work-shop, store rooms, etc., are in the basement, whence a covered way leads to the animal house, an important two-storey building where there is accommodation for the live-stock and a caretaker. The requirements of any modern building for biological research are now of so varied a character that a gift for planning of a high order is needed to provide all needful accessories in suitable juxtaposition, and Prof. Georges Dreyer is much to be congratulated upon his great and obvious success in this matter. He now controls the finest scientific building in Oxford. The following inscription is placed on the main staircase:

Hoc aedificium A.S. MCMXXVI completum
suppeditavit Gulielmi Dunn Baronetti
munificentia pecuniis ingentibus ad levandos
humani corporis dolores testamento devotis.

IN a paper read to the Institution of Electrical Engineers on Mar. 3, Commander H. T. Harrison discussed the problem of public lighting by electricity. He pointed out that, since the War, practically no advance in public lighting has been made in Great Britain. In America, on the other hand, good progress is being made in this direction. The town of Indianapolis, for example, installed a system of public lighting ten years ago. It has now completely scrapped the system, with the result that the illumination has been doubled with very little increase in the annual cost. The reason given for the change was that the great increase in automobile traffic made it necessary. Commander Harrison, who is responsible for many public lighting schemes, favours centrally suspended light sources for most business thoroughfares. In streets with buildings on either side, the span wires can be fixed to the buildings; in other cases they can be attached to steel columns set well back from the road so as not to offer obstruction to the traffic. He said that in shopping districts, where improved lighting benefits trade, it is easy to get permission to fix the span wires to privately owned buildings. If high-powered gas-filled lamps were used they would only want renewing about three times a year. Access to the lamps could be obtained by electrically propelled and operated tower wagons. Heavy batteries at the base would provide the necessary power and ensure stability.

WHILST we admit, with Commander Harrison, that economies could be effected in this way with improved lighting, we think that many will be opposed to span wires. It is true that the main streets of the city of London are lit in this way, but we think that the unnecessary multiplication of overhead wires is to be deprecated. In a gale of wind it is noticeable that the movements of the shadows produced by the vibrations of the lamps are objectionable. For lighting high roads and arterial roads passing through populated districts and used by motor traffic, Commander Harrison proposes that concentrated light sources at a considerable height above the ground should be used. In our opinion, such a solution would make special additional lighting arrangements necessary in foggy weather. Some of the lighting problems discussed, for example the relative advantages of having lights in the centre of the road or at the side where the reflecting power of buildings must be taken into account, will be of value in the theory of photometry.

SIR FLINDERS PETRIE'S preliminary report on the work of the School of Archæology in Egypt, which, owing to the conditions imposed on archæologists in Egypt, is now engaged in investigating the Egyptian remains on the Palestinean side of the frontier, describes the infertile conditions which have prevailed on the frontier during the current winter. These, however, have provided a more plentiful supply of labour than is normal, and have in this way been propitious for the initial year of the School's work in the area. The fortifications of Gaza have been examined, and a fourteenth-century B.C. wall revealed, of which the lower construction may be of Canaanitish age. The present state of desolation of much

of the built-over area seems to offer a favourable opportunity for excavation, but much Roman material would have to be moved. In Sir Flinders Petrie's opinion, the site most likely to be profitable in historical results is that of Tell-Jemmeh, a mound about nine miles south of Gaza. The city was important in Hyksos times and flourished until about 1000 B.C., accumulating about 50 ft. depth of buildings. It was afterwards burnt and refortified, but its life ended about 500 B.C. A ruin in the neighbourhood named Umm Jerrar was supposed to be the Gerar of Abraham and Isaac, but this name probably belongs to the Tell. Gerar was of importance under the Philistine king Abimelech, but only appears once later under Asa in 940 B.C. During this season it is proposed to search thoroughly a fort with the surrounding buildings on the more prominent end of the Tell.

PROF. A. S. EDDINGTON, in his ninth Gifford Lecture in the University of Edinburgh on Friday, Mar. 11, reminded his audience that the typical laws of physics are not controlling laws; they are identities implied in the structure of the cycles of entities to which they refer. The controlling laws (if any) in the basal material are of a type which has not yet come within our knowledge. The physical universe cannot be completely subject to deterministic law unless mental states are also subject; it was for that reason that Prof. Eddington emphasised in an earlier lecture that through the new quantum theory physics is no longer pledged to a deterministic system—so that the nature of the governing laws of the mental substratum may be left open. After all, we have intimate acquaintance with a part of this substratum in our own minds. Prof. Eddington thinks that the hypothesis that this procedure is expressible by mathematical equations is scarcely plausible. We are disinclined to make this philosophical outlook too definite because we do not yet know how to place the physical laws of atomicity and quanta. The quantum theory is developing along rational lines, and this seems to suggest that the laws of atomicity will ultimately be assimiliated with the field laws by some profound extension of the idea of physical cycles. But the opposite view that whereas all other physical properties are due to our mental selection in world-building, the integral character of atoms and quanta is inherent in the basal world-stuff, is attractive. It reminds one of Kronecker's famous saying in pure mathematics—"God made the integers; all else is the work of man."

THE Friday evening discourse at the Royal Institution on Mar. 11 was delivered by Sir George Macdonald on "The Wall of Hadrian." Hadrian's Wall consists of the stone wall itself, the ditch in front, the series of forts, mile-castles and turrets which housed its defenders, and the earth-work in its rear known as the Vallum. Excavation has shown that the earth-work is certainly not older, and probably rather later, than the forts, and was not a military work but a civil or legal boundary. The forts, again, or at least some of them, have been definitely proved to be earlier than the stone wall. Thus we seem to get the chronological sequence—isolated forts, Vallum, stone wall. The evidence of pottery and coins suggests unmistakably that there was extensive destruction and restoration about A.D. 180, events that are certainly to be associated with the great rising in which southern Scotland was lost. The barrier was again swept about A.D. 270, and yet once more about A.D. 330. The final abandonment came about half a century later. In 1895, Prof. Haverfield and his colleagues of the Cumberland Excavation Committee discovered at Appletree a long stretch of wall built of turf, abutting at either end on the Wall proper, with which it did not seem otherwise to be organically connected. At first it looked as if the turf wall were going to provide a new and unexpected way of reconciling the rival claims of Hadrian and Severus, but in 1925 it (or another turf wall) was found six or seven miles farther east at Aesica, this time on the north of the stone wall and ultimately beneath it. Until further digging has taken place, it is unwise to theorise further. The key will probably be found at Birdoswald.

A PAPER read by Mr. H. N. Green at a recent meeting of the Illuminating Engineering Society dealt with a subject of great scientific interest, on which little is generally known—the use of artificial light in connexion with aerial navigation. Much care is now expended on the marking out of air-ways by beacons and the illumination of aerodromes to facilitate safe landing by night. The summit of a hill is not always the best site for a beacon. Hills are apt to be capped with clouds. It appears better to select a site slightly above the level of surrounding country and mount the beacon on a tower high enough to clear ground mists. Distinctiveness is usually given to beacons by flashing, the optical system rotating as a whole. But recently neon gas beacons, on account of the unmistakable colour of the light (red-orange) and the rapidity with which such lights can be flashed, have come into favour. It is even stated that the neon beacon at Croydon aerodrome can be seen in clear weather by pilots leaving the French coast. Effective methods of 'floodlighting' landing areas have now been introduced, and by means of lights sunk in the ground, pilots can be informed of the intensity and direction of the wind. The greatest difficulty is fog. Regular flying is not yet attempted at times when the visibility is very low. But pilots are liable to be caught in a mist, and in such circumstances can receive effective aid by means of directional radio, and the 'leader cable,' which carries a low frequency alternating current, and traces the correct route into the aerodrome. Once this cable has been picked up by the instruments on the aeroplane, the pilot can steer his way to the landing ground, where special lights assist his descent.

PART 12 of Volume 3 of the *Rendiconti della Reale Accademia Nazionale dei Lincei*, which has recently been issued, contains an account of the meeting of the Academy held on June 5, 1926, in the presence of the King and Queen of Italy. In his opening speech the president, Prof. Scialoja, referred briefly to the activities

of the previous session. The library has been extended by the addition of premises adjacent to the Palazzo Corsini and should now meet the needs of the Academy for many years to come. The Copernican Museum, which was presented to Italy some years ago by the Pole, Wolinsky, and includes valuable records of the distinguished astronomer, together with old astronomical instruments and terrestrial and celestial globes, has been transferred from the Collegio Romano to a more fitting setting in the premises of the Academy. Among the donations announced were: the sum of 100,000 lire, given by the Bank of Italy, the Bank of Naples, and the Bank of Sicily, to celebrate the completion of the twenty-fifth year of the King's reign, to be awarded as a single prize for a thesis on the economic, financial, and social consequences of the European War; an equal amount, given by the Italian Banking Association, to provide a biennial prize; a similar sum, presented by the Assurance Company of Milan, on the occasion of its centenary, for the purpose of making a biennial award for scientific work bearing on insurance; 35,000 lire from the Italian Institute of Social Hygiene, to create two awards for investigations on the pathology of cancer and for work on social hygiene, and to furnish two gold medals to be given for work on social hygiene and industrial hygiene respectively; the sum of 125,000 lire, collected by public subscription in honour of Battista Grassi and presented by him to the Academy, to found an annual award for investigations on parasitology.

IN the succeeding discourse, dealing with the conceptions of the atom and molecule due to Avogadro and Cannizzaro, Prof. Nasini protested against the opinion that, in the light of recent developments, the old fractional atomic weights correspond with mixtures similar to that present in sea-water and must be regarded as deposed. Prof. Nasini discussed the so-called 'Avogadro number' and is unwilling to consent to this magnitude being known as the 'Loschmidt number.' This name may justly be given to the number of molecules in unit volume of a gas for which Loschmidt was the first to determine an approximate value; the name 'Avogadro number' should, however, be retained for the number of molecules in the gram-molecular weight of any substance, this being a universal constant derived directly from Avogadro's law. Furthermore, although the ultimate particles of matter are now known to be the electrons and protons, and not the atoms, Cannizzaro made the definite statement that extension of the means of analysis available in his day might lead to further division of the atom of hydrogen, and later (1874) asserted that the atom contains parts capable of relative motion. The bearings on this question of the transformations of radioactive elements, of isotopes, and of the periodic law were also discussed.

THE March issue of the *Nineteenth Century* contains an interesting article by Mr. Edwin Edser entitled "Science and Wonderland." Mr. Edser's thesis is that physical science has left the broad highway of logic and consistency and strayed into meadows where all is new, surprising, and paradoxical—the wonderland to which his title refers. While practically all men of science must agree that the present position, with its coexistence of wave theory and quantum theory, and the difficult physical implications of the generalised theory of relativity, is full of paradoxes and trouble, it is open to question whether Mr. Edser's presentation preserves due proportion, and whether his particular criticisms are really cogent. He urges that an ether must exist by means of such arguments as, "If light is propagated through space in the form of waves, the space must be occupied by a medium which can propagate the waves. To speak of the propagation of waves in an empty space is as meaningless as to discuss the propagation of the human race in an uninhabited country."

THE real question, however, is not whether we use the term 'ether' or not, which is a question of words, but what meaning and properties we are to attribute to the ether. Einstein himself is quite ready to call empty space in which gravitational and electromagnetic fields prevail the 'ether,' but the properties of this ether are not the traditional mechanical properties which it was formerly sought to attribute to it. Mr. Edser's discussion of the theory of relativity, to which much of the article is devoted, gives a comparatively long account of the Michelson-Morley experiment. No distinction, however, is made between the special and the generalised theory, which are not even mentioned separately by name, while it is definitely suggested that the influence of gravitation on light was predicted by Einstein on the basis of a corpuscular theory. Again, the discussion of the quantum theory of spectra is not very satisfactory, for the statement that in the atom "only those orbits are possible in which the kinetic energy is equal to an integral number of quanta," scarcely represents the essence of Bohr's theory, as usually understood. There is no reference to the new quantum mechanics of Heisenberg and his followers, the general trend of which can be put quite simply.

THE inclusion of Boyle's experimental notes on the mechanical origin of electricity and the mechanical production of magnetism in the "Old Ashmolean Reprints" being issued by Dr. R. T. Gunther (Magdalen College, Oxford. 3*s*.) was a happy thought. The notes give a clear account of the experimental knowledge and the orthodox theories of the subject current in 1675. We read how, when amber is rubbed or heated, it emits rays or "files of unctuous steams," which, when they become a little cooled by the external air, shrink back to the amber and carry with them any light bodies in the neighbourhood. Boyle points out how odoriferous gums and perfumes send forth fragrant steams when heated. Apparently navigators and others of that period were willing to pay the owner of a good lodestone to have their needles, swords, knives, etc., magnetised. It is also interesting to read how a bar of steel placed vertically acquires a temporary 'verticity' (polarity), and how when its direction is reversed the polarity is often reversed also. This was one of the experiments

Lord Kelvin used to show in his lectures on magnetism to students. He demonstrated also, like Boyle, how unstable was the induced magnetism.

DR. GEORGES SCHREIBER in an article in *The World's Health* for February discusses the important question, "Should a medical examination before marriage be obligatory?" In a few of the United States a pre-nuptial certificate is necessary as regards the absence of venereal diseases, and in some States, in addition, absence of tuberculosis, epilepsy, and alcoholism. While generally restricted to the male, in two States the woman must also present a certificate. In other States a declaration on oath without medical examination is required. In the Netherlands, France, Germany, and Austria, pre-nuptial medical examinations are advocated by the health authorities, but there is no compulsion. In Scandinavia the registration by a doctor of a declaration on oath by the contracting parties as to their state of health is required. Dr. Schreiber considers that there are many objections to a compulsory pre-nuptial medical examination, and that the Scandinavian system seems to provide the most equitable, the most efficacious, and simplest safeguard.

AT a recent meeting of the Zoological Society of London, Lord Rothschild exhibited a mounted specimen of *Varanus komodensis*, the 'Dragon' of Komodo Island, Dutch East Indies. Specimens of other species were also shown for comparison. Much has been written lately about this, the largest of the lizards, but most of the statements are much exaggerated. The type-specimen is 12 feet 4 inches in length. None now alive on the island exceeds 10 feet in length, but their bulk is very considerable. The interesting feature of the Komodo monitor, apart from its bulk, lies in its relationship. The twenty-two other Indo-Australian species all have smooth scales, with one exception, tails much longer than the body, and narrow heads; *V. komodensis*, on the other hand, has the scales much raised with a central keel, a comparatively short tail, and a broad blunt head; in these respects it resembles the much smaller West African lace-lizard *V. albigularis*. The only Indo-Australian Varanus showing raised scales, and these on the hind neck only, is *V. rugicollis* of Borneo, but this is a small slender species. *V. salvator* of western Malayasia and *V. giganteus* of New Guinea come near to *V. komodensis* in length, examples nearly reaching 8 feet being on record; but neither ever approaches this species in bulk, a 10-foot specimen of which weighed 3 cwt. alive.

THE Ural region has a special interest for archæologists, lying as it does on the route of migrations of prehistoric races between European Russia and Siberia. During the bronze age the region was one of the main centres of mining industry, as is evidenced by numerous remains of primitive mines. A still earlier period left its traces in various sites of palæolithic culture. But most interesting of all are numerous finds of wooden objects like boats, figures of gods, etc., which occur in the pith-deposits near the main ridge of the Ural mountains; these remains are similar to those found on the sites of ancient lake settlements on piles in Switzerland. No systematic investigations have been so far undertaken in the Ural region, but the Russian Academy of Sciences is organising a special expedition there in 1927.

THE Council of the British Association has nominated Sir William Bragg as president of the Association for the meeting in Glasgow in 1928. Rapid progress is being made with the arrangements for the forthcoming meeting in Leeds this summer, under the presidency of Sir Arthur Keith, and it is expected that a preliminary programme will be issued in April.

DR. HAROLD JEFFREYS has been awarded the Adams Prize for the period 1925-26 for an essay on "The Constitution of the Interior of the Earth, and the Propagation of Waves through the Interior and over the Surface of the Earth." The prize is awarded by the University of Cambridge every two years for an essay on some branch of pure mathematics, astronomy, or other branch of natural philosophy, and is of the value of about £250.

THE executive committee appointed to make arrangements for an International Botanical Congress in England in 1930 has decided that the Congress shall be held in Cambridge, commencing about the middle of August. The following officers have been appointed: *Chairman of the Executive Committee*: Prof. A. C. Seward; *Treasurer*: Dr. A. B. Rendle; *Secretaries*: Mr. F. T. Brooks and Dr. T. F. Chipp.

IN a letter to the editor, Mr. A. G. Tarrant refers to the sympathetic attitude displayed in the leading article in NATURE of Mar. 5 towards the appeal which is being circulated by the National Union of Scientific Workers. He raises the problem of the unqualified practitioner in science, and states that unless a definite assurance is given by the executive of the Union that it does not include any such workers in its membership, it will meet with opposition from members of such bodies as the Institute of Chemistry and the Institute of Physics. We have communicated with the general secretary of the Union, who informs us that it is definitely stated in the rules that one of the objects is "to insist on a legally recognised qualification for all scientists engaged in the practice of science for remuneration," and that "only those who possess a recognised degree in science, mathematics, or technology, or other qualification recognised as equivalent thereto," are entitled to the privileges of membership.

AT the annual general meeting of the Society of Public Analysts, held on Mar. 2, the following officers were elected: *President*: Mr. E. Richards Bolton; *Vice-Presidents*: Mr. R. L. Collett, Mr. C. H. Cribb, Mr. John White; *Hon. Treasurer*: Mr. Edward Hinks; *Hon. Secretary*: Mr. F. W. F. Arnaud.

MR. A. E. MOURANT, Department of Geology, University Museum, Oxford, writes asking for reports of the earthquake which affected lands bordering the English Channel shortly before 11.30 P.M. on Feb. 17.

Further information regarding the shock of July 30 last would also be welcome (see NATURE, Aug. 7, 1926, p. 204).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A pathologist at the Charing Cross Hospital Institute of Pathology—The Secretary, Charing Cross Hospital Institute of Pathology, 62 Chandos Street, W.C.2 (Mar. 23). A junior scientific assistant for Admiralty research—The Secretary of the Admiralty (C.E. Branch), Admiralty, Whitehall, S.W.1 (Mar. 26). Two junior technical officers in an Admiralty Experimental Establishment—The Secretary of the Admiralty (C.E. Branch), Admiralty, Whitehall, S.W.1 (Mar. 26). An assistant in the Liverpool Observatory, Bidston—The Mersey Docks and Harbour Board, Liverpool (Mar. 31). Six forest officers for service under the Government of Burma—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (April 1). A scientific officer under the directorate of scientific research, Air Ministry, primarily for research in connexion with electrical ignition appliances—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (April 6, quoting A. 81). An adviser in agricultural entomology in the University of Manchester—The Registrar, University, Manchester (April 19). A professor of anatomy in King's College, London—The Academic Registrar, University of London, South Kensington, S.W.7 (April 21). An instrument maker for experimental work in the Experimental Department of the Fine Cotton Spinners' and Doublers' Association, Ltd., Rock Bank, Bollington, Macclesfield—The Secretary. A demonstrator in the mechanical engineering branch of the Artillery College, Woolwich—The Assistant Commandant, Artillery College, Red Barracks, Woolwich, S.E.18. An agricultural entomologist at the Kirton Agricultural Institute—The Principal, Kirton Agricultural Institute, nr. Boston, Lincs. A junior chemist, and a senior laboratory assistant, under the Lancashire and Cheshire Coal Research Association—The Director of Research, Lancashire and Cheshire Coal Research Association, College of Technology, Manchester.

Our Astronomical Column.

DISCOVERY OF A NEW COMET, 1927 *d*.—A telegram from Prof. Shapley, circulated by the I.A.U. Bureau at Copenhagen, announces the detection of the fourth comet of 1927. The discovery was made by Dr. C. L. Stearns, at the Van Vleck Observatory, Wesleyan University, Middletown, Connecticut, on Mar. 10 at $10^h\ 4{\cdot}8^m$ U.T. in R.A. $15^h\ 16^m\ 6{\cdot}0^s$, south declination, 7° 21′ 43″. The comet was of the tenth magnitude, and its daily motion was -16^s, North 19′. On Mar. 19 it will be in R.A. $15^h\ 13^m\ 42^s$, south decl. 4° 53′, assuming uniform motion. This is some 5° north of β-Libræ. Meridian passage will be about $3^h\ 30^m$ A.M.

RADIO RECEPTION AND SOLAR ACTIVITY.—A paper entitled "The Correlation of Radio Reception with Solar Activity and Terrestrial Magnetism" is contributed by G. W. Pickard in the *Proceedings of the Institute of Radio Engineers*, Feb. 1927. The purposes of the paper are to emphasise the need for prolonged systematic observations of radio reception and to give preliminary results which have been obtained from data extending over nine months. At the outset it appears that poor broadcast reception coincided with practically every magnetic disturbance of note between 1922 and 1926 as registered at Cheltenham, U.S.A., but in order to establish a more definite correlation, a series of nightly measurements of the radio reception at Boston of WBBM at Chicago (operating at 1330 kilocycles) was commenced early in 1926. Over this relatively short interval the author obtains a correlation factor of $-0{\cdot}89 \pm 0{\cdot}06$ between radio reception and magnetic character on a monthly average basis. The graph for monthly averages show little correlation with sunspots, but on using moving weekly averages it appears that an increase of solar activity is paralleled by an increase in magnetic disturbance and a decrease in reception. Another graph, giving weekly departures from monthly means of sunspots, magnetic character of days, and radio reception, shows a succession of peaks suggestive of the well-known 27-day interval relation between solar disturbances and magnetic storms. Other points of interest are, first, that the low frequency end of the radio spectrum is not very sensitive to solar disturbances, the most sensitive portion being apparently between 1000 and 1500 kilocycles; secondly, that although the magnetic storm and reception depression begin together, the storm reaches its maximum before reception is at a minimum and magnetic quiescence returns two or three days before reception is normal. It is greatly to be hoped that the observations will be continued to substantiate thoroughly these interesting preliminary results.

SOLAR ECLIPSE OF JUNE 29.—The Ordnance Survey has published a very useful map of the circumstances of the total solar eclipse across England and Wales on June 29 (Southampton: Ordnance Survey, 1927. 3*s*.). The scale is ten miles to the inch. The central line, north and south limits of totality, the lines where the magnitudes are 0·99, 0·98, 0·97, 0·96, the lines where the sun's altitudes are 10°, 11°, 12°, 13°, and those where central eclipse occurs at U. T. $5^h\ 20^m$, $5^h\ 21^m$, etc., to $5^h\ 28^m$, are all laid down from computations made at the Nautical Almanac Office. As estimated corrections have been applied to the moon's positions calculated from Brown's Tables, the various curves should be accurate within a mile. The map shows contour lines for every 400 feet of altitude, the spaces between them being printed in different colours; this information is of use in selecting stations, as the sun is so low in Wales that it is important to ascertain whether high ground will interfere with the view.

The width of the track of totality is 28 miles on the west coast and 31 miles on the east coast; the speed of the shadow is about 100 miles per minute.

It may be mentioned that two excursions to the eclipse from London are announced; one by Messrs. Cook to Southport, the other by the L.N.E.R. to some point in Yorkshire near the central line. The departure from London is on the afternoon or evening of June 28, returning on the following afternoon. These should be very useful to observers pressed for time.

Research Items.

THE SAVIGNANO STATUETTE.—M. Raymond Vaufrey in T. 36, Nos. 5-6 of *L'Anthropologie*, discusses the possible dating of the female statuette in serpentine discovered at Savignano, in the province of Modena, northern Italy, some three years ago, and now in the Museum of Ethnography and Prehistory of Rome. The question is of some importance in relation to the occurrence of different phases of the palæolithic period in the Po valley; but in default of stratigraphic evidence, it depends entirely upon morphological considerations. The statuette is 225 mm. high, and, if it be of palæolithic age, is the largest of these figures yet discovered. Its material is presumably of local origin, as similar serpentine occurs in the neighbouring Appenines of Emilia. The superficial details of the sculpture are much worn. In form the statuette is an elongated ellipse with the arms pressed close against the body; the legs join, the oblique position of the line of division suggesting the action of walking; the feet are not indicated. The head is a prolongation of the body without indication of a neck, and is pointed, the general appearance being as of a head-dress falling over the shoulders. The breasts, abdomen, and thighs are prominent but beautifully sculptured. The genitalia are not indicated. The statuette is markedly steatopygous. Italian archæologists are not in agreement as to its probable age, one school represented by M. P. Graziozi attributing it to the Aurignacian, while M. U. Antonielli considers it neolithic. The statuette, however, strikingly resembles those of Barma Grande. The position of the arms clasped on the breasts is characteristic of the palæolithic type, for in statuettes of later date the hands support the breasts. Notwithstanding the absence hitherto of evidence of the Aurignacian in the Po valley, its occurrence on other sites in Italy supports the attribution to this period.

THE EMERYVILLE SHELL MOUND, CALIFORNIA.—An exceptional opportunity for examining the structure and composition of one of the many shell mounds, nearly four hundred in number, on the shores of the Bay of San Francisco, occurred in 1924, when it was decided that the Emeryville Mound, one of the highest, should be levelled to make room for a factory site. The use of the steam shovel made it possible to examine the whole of a horizon at one time, while further excavations could be made at the base when the whole mound had been removed. A report of the investigations carried on in these favourable conditions by Mr. W. Robert Schenck has been issued as No. 3 of Volume 23 of the *University of California Publications in American Archæology and Ethnology*. As a whole, the results go to show a general uniformity of culture, though there was a number of periods of occupation. The primary purpose of the settlement was to gather shellfish. The occupation would appear to have been seasonal; but all the groups who used the site were not identical; indications of difference exist. The culture was simple and not of a high level. Fires and basketry were known from the beginning. Food was probably cooked in the baskets by means of hot stones. Snares, traps, and wooden weapons were used rather than the bow and arrow. Sea food, obtained by raft, acorns, seeds, and other vegetable foods, were in use. Fish were caught by hook and line and not by net. Warfare was apparently infrequent, as few of the skeletal remains show signs of death from violence. Shell ornaments and beads were used on pipes and whistles, mortars and clothes. The grave furniture varied in different cases, even in infant burials, some interments being accompanied by many articles, others by none. Special groups of subjects—*e.g.* whistles, pipes, and charmstones—suggest a certain specialisation of occupation and social position. Objects of a ceremonial nature—crystals and charmstones—indicate the existence of a cult, while the scarcity of pipes points to the ceremonial nature of smoking. Burial was by inhumation or, more rarely, by cremation, graves occurring in groups near the dwelling-places. Artefacts buried with the dead were 'killed.' A speculative dating places the beginnings of the mound at about a thousand years ago.

TECHNICAL TERMS IN BREWING AND MALTING.—A list of technical terms used in the brewing, malting, and allied trades has been compiled by S. K. Thorpe, and appears in a recent number of the *Journal of the Institute of Brewing*, 33, 15; 1927). The list, which is very comprehensive and includes even commercial terms connected with the industries, contains a number of interesting notes on the origin and history of the words described. Words which deal with brewing are mostly of Flemish or Dutch origin, whilst those connected with barley or malting are of Celtic or Anglo-Saxon origin. Most of the words have preserved their original meanings throughout the ages, though the term "maltster" was probably a female "malter," just as a "spinster" was a female "spinner." "Ale" also was originally the name applied to sweet unhopped wort and was not identical with "beer," which was made from a weaker wort boiled with hops or a herb such as gentian. The word "bridal" or bride-ale" indicates its original connexion with feasting. In more recent times a new set of terms has evolved, though "cocktail," which dates from the American War of Independence, is usually thought to be of later origin. "Punch" is the subject of interesting speculation, since although derived from the Hindustani word "panch," meaning five (the number of ingredients), it is older than the British occupation of India, and may have come to western Europe via the Near East.

SCOTTISH SALMON.—In a report on the salmon of the River Dee (Aberdeenshire) in 1923 (*Fisheries, Scotland, Salmon Fish.*, 1926, 4 (Sept. 1926)) Mr. W. J. M. Menzies and Mr. P. R. C. Macfarlane confirm results obtained from examinations made in the two previous years, 1921 and 1922. A total of 1968 salmon and 833 grilse were examined, and information obtained on age, length, and condition is given, together with calculated lengths at the end of each year of life, as shown by scale readings. The 1+ and 2 winter groups have been the mainstay of the Dee salmon population during these years, the only other group of any importance being the 2+ group. February to April are exclusively spring fish months. May is characterised by a mixture of spring and summer salmon, and fish that seem to be in a transition stage between the two, these last being an obstacle to the theory that spring and summer salmon are of separate races. Previous evidence that fish which have already spawned return to fresh water for their second spawning in the same 'class' as on the first visit is confirmed. The majority of smolts at migration were two years old, although in 1922 the three-years-old smolts were rather plentiful. There is a distinct correlation between lengths attained each year; *e.g.*, large one-year parr become large two-year smolt, while small

one-year parr become small second-year smolt, or remain in the river to become third-year smolt. This correlation is continued even in sea life.

ZOOLOGICAL EXPLORATION IN SIBERIA.—A special expedition of the Russian Academy of Science was working during the summer of 1926 in the Far East collecting insects and studying their distribution. More than 30,000 insects have been brought back by the expedition, and a preliminary study of the material, published in the *Information Bulletin* of the Academy, showed a large percentage of undescribed forms of all orders. A very striking feature of the collections is a very considerable number of species which have been previously known only from Japan and China. Of special interest is a giant longicorn beetle *Callipogon relictus* Sem., a representative of the fauna of relict Tertiary forests which is known only by a few specimens. A member of the expedition, Prof. A. K. Mordvilko, studied specially the Aphidæ (plant-lice), of which 215 species have been collected, many of them new, others known previously from Japan or China, while most of the European species are represented by special local races. Another small expedition of the Academy was studying at the same time the water fauna of Ussuri-land and of Lake Baikal. Special attention was paid to some less-known and little-collected groups of invertebrates, particularly to the Turbellaria. Of these, 40 fresh-water species have been found, 17 of them new to science, while nearly all of the 26 species collected in the Japanese Sea near the shores proved to be undescribed. A highly peculiar fauna of Turbellaria was found in Lake Baikal, where not less than 26 endemic species were discovered, some of them representing new genera and even new families.

THE MICROPLANKTON OF CHESAPEAKE BAY.—A very large amount of material has been collected for the quantitative study of the microplankton of Chesapeake Bay ("An Investigation of the Microplankton of Chesapeake Bay." By J. J. Wolfe and Bert Cunningham, with the assistance of N. F. Wilkinson and J. T. Barnes. *Journal of the Elisha Mitchell Scientific Society*, vol. 42, Nos. 1 and 2, Oct. 1926), which has been worked out by Mr. J. J. Wolfe and Mr. B. Cunningham. The samples were obtained by means of a water bottle and centrifuged, the volume of deposit measured, and portions of such deposit diluted and recentrifuged for counting. The investigations show that the Bay is by no means short of microscopic organisms, the average total for all collections distributed over two years being about 75,000 per litre, the largest collection being more than three million per litre. When one considers that a very large number of minute cells were probably not seen, judging from the lists given, this shows it is not at all poor. The authors are of the opinion that the most important factor in the growth and increase of the diatoms is temperature, the range in the Bay being from 30° F. to 76° F., the optimum temperature for diatoms being between 46° F. and 55° F. On the other hand, the protozoa, including dinoflagellates, are at their lowest at these temperatures and highest when the diatoms are low. Taking the total number of organisms throughout the year, there are two maxima, one in spring and one in autumn. These are usually due to diatoms, but high up in the Bay in autumn in two areas the cause is the dinoflagellate Prorocentrum, and these are the regions of low salinity. The spring maxima are almost always caused by diatoms, the largest numbers being due to Chætoceros, Skeletonema and Rhizosolenia also being very common. The voluminous mass of data relating to the above studies is filed with the Bureau of Fisheries, where it will be valuable for future reference when more investigations with regard to available fish food are undertaken.

CILIATED PROTOZOA AND CONTRACTILITY.—In a communication made to the Royal Lombardy Institute of Science and Letters, Prof. Antonio Pensa describes his observations on ciliates of the genus Balantidium, found as parasites in the intestine of the frog. These organisms prove capable of motion independently of the cilia, more especially when progress with the help of the cilia is retarded by the conditions of the surrounding medium. Such secondary movement results from contractility of the plasma and may be superposed on the principal effect due to vibration of the cilia so as to exert a modifying influence. The contractility is manifested mainly by the appearance of furrows, which may be either partly or completely annular. These furrows originate at the anterior part of the animal and undergo gradual backward displacement, the more fluid portion of the endoplasm apparently flowing at the same time in the opposite direction. The contractile wave stops when it reaches the posterior extremity of the animal, which then moves with a slight leap. If the furrow is circular, complete, and perpendicular to the axis of the body, the displacement is directly forward, but with a complete and inclined furrow it is perpendicular to the plane of the furrow and hence oblique and lateral; lateral motion towards the side occupied by the furrow occurs when this is partial and lateral. Another characteristic form of contraction consists in a rapid and circumscribed retraction of the posterior pole of the protozoon; this phenomenon is often almost rhythmic and effects arrest of the progress caused by ciliary vibration. Localised retraction of the posterior pole may determine a slight backward impulse. There seems little doubt that these contractions are proper to the endoplasm and are due to a peculiarity of structure or constitution which may be rendered evident by the application of silver reduction methods.

COAST AND GEODETIC SURVEY IN THE UNITED STATES.—The report of the United States Coast and Geodetic Survey for the year ending June 30, 1926, has been issued. In addition to revision of coast surveys in the United States, progress was made in those of oversea possessions. Coast surveys of the Philippines are almost complete except for the north-east coast of Luzon and parts of Palawan and of the Sulu archipelago. In the Hawaiian Islands there are still some gaps in the hydrographic survey and a few in the coast topographic survey. Work on the approaches to the Panama Canal and on the waters and coasts of the Virgin Islands and Porto Rico is practically finished. Good progress was also made in Alaska. Work was continued in the readjustment of the first-order triangulation to the westward of the ninety-eighth meridian in the United States, and there is the usual record of magnetic and tidal work. A matter of some interest in the report is a statement regarding the redetermination, this time by radio time signals, of the old longitude station at Seattle, Wash. A comparison between the old and the new determination showed a difference of only 0·003 second. The report contains a large number of index maps showing the present state of coastal surveys in American territory.

FOSSIL PERMIAN INSECTS FROM EUROPEAN RUSSIA.—While there is a considerable number of records of fossil Permian insects from North America, practically nothing was known of them in Europe. It is therefore interesting to learn from the *Information*

Bulletin of the Russian Academy of Sciences that Dr. A. V. Martynov was fortunate enough to discover and collect a good series of these fossils on the shores of the river Kama, in northern European Russia. Best represented in the collection are Homoptera and Mecoptera; then there are some highly interesting Protorthoptera, also Neuroptera, Psocoptera, and others. A preliminary study of the collection permits one to conclude that the fauna was somewhat similar to the Permian fauna of Kansas, but not identical with it, since not only genera, but even families, were different though related to those of Kansas. More extensive and detailed investigations are proposed during the next season.

X-RAY SPECTROSCOPY.—The issues of the *Physikalische Zeitschrift* for Jan. 1 and 15 contain a report of 70 pages by Dr. A. E. Lindh on the development of Röntgen or X-ray spectroscopy during the years 1921-1925. It comprises the following subjects: Apparatus—tubes and spectrographs—the development of technique, the gratings, the deviation from the simple law $n\lambda = 2d \cdot \sin\theta$, refraction and total reflection, emission spectra, the K, L, M, and N series, absorption of the K, L, and M series, the conditions for the production of the various lines, the measurement of their intensities, their energy levels, the influence of chemical structure on spectra, the Compton effect, and the β-ray spectra. The report, which devotes 10 pages to the literature of the subject, will prove of great value to those working in this field.

MEASURING ZONAL ABERRATIONS.—Part 1 of Volume 28 of the *Transactions of the Optical Society* contains an account of the method of determining the foci of the various zones of an optical system invented by Mr. Conrad Beck and communicated to the Society on Nov. 11 last. An accurately centred metal disc has two short slits cut in it with their centres at opposite extremities of a diameter of the zone to be investigated, and with their directions making with the diameter an isosceles triangle with basal angles 45°. The width of each slit is about one-third the length. Light from a fine hole in a silvered glass surface placed in the axis of the system is allowed to pass through the slits to the system, by which it is brought to a focus. The exact position of the focus is determined by the fact that at the focus the diffracted images of the slits form a symmetrical cross. By the use of discs with the slits at different distances apart, the focus for each zone and the zonal aberration may be determined.

CONCENTRATION OF WATER VAPOUR IN COMPRESSED GASES.—An important paper on the concentration of water vapour in compressed hydrogen, nitrogen, and mixtures of these gases in the presence of condensed water has been published by E. P. Bartlett in the *Journal of the American Chemical Society* for January 1927. The water vapour content depends on the nature of the saturated compressed gases, and the values calculated from the ordinary gas laws differ considerably from those actually observed. Thus, volume for volume, at 1000 atmospheres and 50°, nitrogen will hold 44 per cent. more water vapour than will hydrogen, and the water-vapour contents are much larger than the theoretical. No thermodynamical relations have been found that will connect the observed and calculated results. The phenomena are explained qualitatively by assuming that the compressed gas is a solvent for water vapour.

FREQUENCIES EMPLOYED IN SPEECH AND MUSIC.—In the *Bell Laboratories Record* for February, an account is given of phonograph records that have been made to demonstrate the effects of excluding notes of definite pitch from speech and music. The research was made by the American Telegraph and Telephone Company with the object of improving telephony. Electrical 'filters' were employed which could suppress sounds of a given range of frequencies. The frequency of the vibrations occurring in speech vary from about 100 to 8000 cycles per second. The effect of cutting out all the vibrations below 375 per second is to alter the character of the voice, although the intelligibility remains perfect. When all sounds having a frequency less than 750 were eliminated, the voice sounded most unnatural and had no character. The vowel sounds were badly distorted, but the speech could be interpreted mainly through the consonant sounds. When all the lower vibrations are restored but those having frequencies greater than 2500 are suppressed, the voice sounds natural but the interpretation is not good. When all the vibrations above 1000 are suppressed, the speaker's voice has a guttural character, and it is very difficult to understand what he says. Whole phrases are sometimes missed, owing apparently to the absence of consonant sounds. Another record shows similar effects produced in transmitted music when sounds of certain frequencies are suppressed. When the filter passes only the frequencies above 375 the melody is present but the tonal character is missing. When all sounds below 750 are suppressed, the music assumes a tinkling character. When the higher notes above 2500 are eliminated the music becomes dull, all the brilliance of tone disappearing. If all the notes above 1250 are eliminated the music becomes practically a thumping noise. Another record shows the effects of forcing a vacuum tube to carry more than its rated load. In this case harsh extraneous sounds called 'buzzing' and 'rattling' are introduced.

PHILOSOPHY AND PHYSICS.—The greatest workers in mathematics and physics have always been philosophers as well. A complete insight into these subjects is impossible without philosophy. In "Het Nut van het Wijsgeerig Denken in Wis-en Natuurkunde," Dr. J. H. Tummers deals in an interesting manner with the benefit to be derived by mathematicians and physicists from philosophical thinking. While the whole of the contents of the brochure may not receive universal acceptance, it can be read with profit by all. In developing his thesis, Dr. Tummers sketches the history of the ether from the beginnings of the wave theory of light up to the Michelson-Morley experiment. The failure of the latter to show us the ether recalls to mind Planck's axiom, "Only that which can be measured exists." Einstein, contemplating the experiment in this light, has shown us how to do without the ether. This aspect of the theory of relativity and the changes which the latter has brought about in our ideas of space and time are next considered. It is emphasised that we must look inside the mathematical superstructure and find out what are the philosophical bases of the theory—what is contained in and implied by the differential equations. Before dealing with the ideas of space and time of the theory of relativity, Dr. Tummers sketches the philosophical and mathematical bases of the various geometries which have been proposed. He discusses the idea of the geodesic and shows how the geometries of Riemann and Lobattschewski are equivalent to ordinary Euclidean geometry on the surface of a sphere and on a Beltrami surface respectively. These geometries stand on an equal footing as regards their being 'true.' Einstein has not shown that space is non-Euclidean, but that the phenomena of Nature can be more conveniently represented by a non-Euclidean concept of space.

Forthcoming Books of Science.

Agriculture, Forestry, and Horticulture.

George Allen and Unwin, Ltd.—The Physiological Basis of Drought-Resistance in Plants, N. A. Maximow. Translated from the Russian, edited by Prof. R. H. Yapp; The Evolution of the English Farm, M. E. Seebohm. *Cambridge University Press.*—The Physiology of Reproduction in the Cow, J. Hammond; The Economics of Small Holdings, E. Thomas. *Chapman and Hall, Ltd.*—Teaching Agricultural Vocations, Stewart and Getman. *John Murray.*—A Primer of Agricultural Economics, Sir Henry Rew. *Oliver and Boyd.*—The Potato, P. M'Intosh. *Kegan Paul and Co., Ltd.*—Year Book of Agricultural Co-operation in the British Empire, with a Census of Producers' Organisations, edited by the Horace Plunkett Foundation. *Charles Scribner's Sons.*—The Beginner's Garden, Mrs. F. King.

Anthropology and Archæology.

D. Appleton and Co.—The American Indian: North, South, and Central America, A. H. Verrill. *Cambridge University Press.*—The Naron, D. F. Bleek (first of a series of Publications of the School of African Life and Languages); Papers on the Ethnology and Archæology of the Malay Peninsula, I. H. N. Evans. *W. Heffer and Sons, Ltd. (Cambridge).*—A Study of Races in the Ancient Near East, W. H. Worrell. *Macmillan and Co., Ltd.*—The Kiwai Papuans of British New Guinea, Dr. G. Landtman; The Circle and the Cross, A. Hadrian Allcroft, 2 vols., Vol. I., The Circle; Vol. II., The Cross. *Methuen and Co., Ltd.*—The Civilization of Greece in the Bronze Age: The Rhind Lectures on Archæology (1923), Dr. H. R. Hall. *Kegan Paul and Co., Ltd.*—Melanesians of the South-East Solomon Islands, Dr. W. G. Ivens; The Civilisation of the South American Indians, with special reference to Magic and Religion, Prof. R. Karsten.

Biology.

George Allen and Unwin, Ltd.—Birds and Beasts of the Roman Zoo, Dr. T. Knottnerus-Meyer, translated by Bernard Miall. *G. Bell and Sons, Ltd.*—Readable School Biology, O. H. Latter (Bell's Natural Science Series). *A. and C. Black, Ltd.*—Natural History: Animals, G. Jennison. *Cambridge University Press.*—Bibliography of Sponges, 1551–1913, by the late Prof. G. C. J. Vosmaer, edited by Dr. G. P. Bidder and C. S. Vosmaer-Röell; A Treatise on the British Freshwater Algæ, by the late G. S. West, new and revised edition by Prof. F. E. Fritsch; The Structure and Development of the Fungi, Dame Helen Gwynne-Vaughan and B. Barnes. *Chapman and Hall, Ltd.*—Evolution, B. Gruenberg; Text-book of Zoology, Curtis and Guthrie; Biochemical Research Methods for Students of the Biological Sciences, Morrow. *Epworth Press.*—British Wild Fruits and How to Identify Them, R. Morse ('How to Identify' Series). *Longmans and Co., Ltd.*—Plant Autographs and their Revelations, Sir Jagadis Chunder Bose; Magnolias, J. G. Millais. *Methuen and Co., Ltd.*—Science Studies, Sir Ray Lankester. *F. Warne and Co., Ltd.*—Bird Life at Home and Abroad, T. A Coward; Favourite Flowers of the Garden and Greenhouse, E. Step, in 13 fortnightly parts.

Chemistry.

G. Bell and Sons, Ltd.—Practical Physical Chemistry for Schools, Dr. J. F. Spencer (Bell's Natural Science Series). *Ernest Benn, Ltd.*—The Making of a Chemical, E. I. Lewis and A. A. King; The Manufacture of Ammonium Products, P. Parrish; The Chemical Age Dictionaries, II. The Dictionary of Organic Substances; Encyclopædia of the Ceramic Industries, A. B. Searle; Chemistry, Dr. P. E. Spielmann. *Chapman and Hall, Ltd.*—Introduction to Physiological Chemistry, Bodansky; Nature Origin and Interpretation of the Etch Figures of Crystals, Honess; Experiments in Organic Chemistry, Underwood; Colloids, Kruyt and Van Klooster; Organic Syntheses, Whitmore, Vol. VII. *C. Griffin and Co., Ltd.*—Foods: their Composition and Analysis, Dr. A. Wynter Blyth and M. Wynter Blyth, revised by Dr. H. E. Cox, new edition. *Longmans and Co., Ltd.*—Flame and Combustion in Gases, Prof. W. A. Bone and Dr. D. T. A. Townend. *Sir Isaac Pitman and Sons, Ltd.*—A Course of Volumetric Work, E. Clark.

Engineering.

Ernest Benn, Ltd.—Electric Switch and Controlling Gear, Dr. C. C. Garrard, new edition; Insulated Electric Cables, Vol. II.: Manufacture and Installation, C. J. Beaver; Electric Winders, H. H. Broughton; Colloid Mills, Dr. S. P. Schotz; Sinking Shafts and Driving Adits, E. O. F. Brown. *Chapman and Hall, Ltd.*—The A. C. Commutator Motor, C. W. Olliver; Tables of Safe Loads on Steel Pillars, with Practical Notes on Design and Construction, E. S. Andrews and W. C. Cocking, Vol. I.; A Short Text-book on Sewage Disposal, T. H. P. Veal; Electric Rectifiers and Valves, Prof. A. Günther-Schulze, translated by N. A. de Bruyne; Electrical Engineering Practice, J. W. Meares and R. E. Neale, Vol. II.; Hydro-Electric Handbook, Creager and Justin. *Constable and Co., Ltd.*—Propagation of Electric Currents in Telephone and Telegraph Conductors, Dr. J. A. Fleming, new edition; The Practical Design of Irrigation Works, W. G. Bligh, new edition; The Diesel Engine for Land and Marine Work, A. P. Chalkley, new edition; Designs of Small Oil-engined Vessels, W. Pollock. *C. Griffin and Co., Ltd.*—Overhead Electric Power Transmission Practice, W. T. Taylor; Pocket-Book of Electrical Rules and Tables, Munro and Jamieson, under the general editorship of W. R. Cooper and Rollo Appleyard, new edition; Carbonisation Technology, and Engineering, the Production of Coke, Charcoal, and other Fuels, J. Armstrong; Lubrication and Lubricants, L. Archbutt and R. M. Deeley, new edition. *Crosby Lockwood and Son.*—Water-Power Practice: The Principles, Practice, and Development of Water Power, F. Johnstone-Taylor; Sewage Works, F. C. Temple; Gas Meters: Their Construction, Use, Fixing, Inspection, and Maintenance, A. T. Gilbert; Science of Roadmaking, J. W. Green and C. N. Ridley; Modern Ignition Simply Explained, H. H. U. Cross; Dredging and Dredging Appliances, P. M. Dekker, with an Introduction by Sir Robert Hadfield, translated from the Dutch; Domestic Electric Heating, H. G. Solomon; Magneto Manual, H. R. Langman. *Longmans and Co., Ltd.*—Modern Electrical Illumination, C. Sylvester and T. E. Ritchie, with a Foreword by R. A. Chattock; Thermodynamics Applied to Engineering, Prof. A. F. Macconochie; Mechanics Applied to Engineering, Prof. J. Goodman, Vol. II. *Sir Isaac Pitman and Sons, Ltd.*—The Care and Maintenance of Steam Plant, T. E. Braham; Applied Thermodynamics, Prof. W. Robinson; Coal Carbonisation, J. Roberts; Engineering Inquiries, J. C. Connan; Mining Law and Mine Management, A. Watson; Mine Ventilation and Lighting, C. D. Mottram; Colliery Explosions and Recovery Work, J. W. Whitaker (Mining Certificate Series).

Geography and Travel.

Edward Arnold and Co.—The Wilderness of Sinai, H. J. L. Beadnell. *A. and C. Black, Ltd.*—Try-for-Yourself Geography, M. Warington. *Cambridge University Press.*—The Life of Sir Albert Hastings Markham, M. E. and F. A. Markham. *Constable and Co., Ltd.*—Nepal: An Account of the History and Topography of the Country, with a description of its Flora and Fauna, P. Landon. *W. Heffer and Sons, Ltd. (Cambridge).*—An Asian Arcady: The Land

and Peoples of Northern Siam, R. le May. *Oliver and Boyd.*—The Settlements and Roads of Scotland—a Study of Human Geography, Grace Meiklejohn. *Kegan Paul and Co., Ltd.*—In China, 1920–1921, A. Bonnard.

Geology, Mineralogy, and Mining.

Cambridge University Press.—The Founders of Seismology, Dr. C. Davison. *Chapman and Hall, Ltd.*—Optical Mineralogy, Winchell, Part II.; Handbook of Ore Dressing, Taggart. *Thomas Murby and Co.*—Eruptive Rocks—Their Genesis, Composition, Classification and Their Relation to Ore Deposits, S. J. Shand. Alluvial Prospecting — The Technical Investigation of Economic Alluvial Minerals, Dr. C. Raeburn and H. B. Milner, with a foreword by Dr. J. D. Falconer.

Mathematical and Physical Sciences.

G. Bell and Sons, Ltd.—Mechanics of the Atom, Prof. Max Born, translated by J. W. Fisher; Isaac Newton, 1642–1727, edited by W. J. Greenstreet; The Acoustics of Buildings, Drs. A. H. Davis and G. W. C. Kaye. *Ernest Benn, Ltd.*—Relativity, J. Rice. *A. and C. Black, Ltd.*—Stage A Geometry, R. W. M. Gibbs. *Cambridge University Press.*—Integral Bases, Prof. W. E. H. Berwick; The Foundations of Euclidean Geometry, H. G. Forder; The Calculus of Variations, Prof. A. R. Forsyth; Cremona Transformations, Hilda P. Hudson. *Constable and Co., Ltd.*—Field Astronomy, D. Clark. *Ginn and Co., Ltd.*—Young's Manual of Astronomy, revised by H. N. Russell, R. S. Dugan, and J. Q. Stewart, Vol. II. *Longmans and Co., Ltd.*—Comets and the Sun, with New Theories regarding their Structure, Dr. J. W. Weir; Ordinary Differential Equations, Prof. E. L. Ince; Elementary Algebra, F. Bowman, Part II.; Four Place Mathematical Tables with Forced Decimals, arranged by Prof. F. S. Carey and S. F. Grace; A Treatise on Light, Dr. R. A. Houston, new edition; Spectroscopy, Prof. E. C. C. Baly, new edition, Vol. II. *Macmillan and Co., Ltd.*—Physics for Colleges, H. H. Sheldon, Prof. C. V. Kent, Prof. C. W. Miller, and Prof. R. F. Paton. *Methuen and Co. Ltd.*—A Short History of Physics, H. Buckley; Thermionic Phenomena, E. Bloch, translated by J. R. Clarke; Sir Isaac Newton: A Brief Account of his Life and Work, Prof. S. Brodetsky; Test Examinations in Mathematics, A. S. Pratt; Spherical Harmonics: An Elementary Treatise on Harmonic Functions, with Applications, Dr. T. M. MacRobert; A Preparatory Geometry, C. J. H. Barr.

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George Allen and Unwin, Ltd.—Sex Hygiene, Drs. Julia Kinberg von Sneidern and Alma Sundquist; A Doctor's Views on Life, Dr. W. J. Robinson, edited by Eden and Cedar Paul. *D. Appleton and Co.*—A Text-Book of Bacteriology, Drs. H. Zinsser and E. E. Tyzzer, new edition; Preventive Medicine and Hygiene, Dr. M. J. Rosenau, new edition; Diseases of Infancy and Childhood, Drs. L. E. Holt and J. Rowland, new edition. *G. Bell and Sons, Ltd.*—Finlayson's Clinical Manual for the Study of Medical Cases, new edition, edited by Drs. C. H Browning, E. P. Cathcart, and L. Findlay. *Cambridge University Press.*—The Development of Psycho-pathology, Dr. B. Hart (In "Cambridge Comparative Physiology" Series); The Comparative Physiology of the Heart, Prof. A. J. Clark; The Genetics of Sexuality in Animals, Dr. F. A. E. Crew; The Comparative Physiology of Internal Secretion, Prof. L. T. Hogben. *Chapman and Hall, Ltd.*—The Theory and Practice of Radiology, with a Synopsis of Radiography and Radiotherapy, B. J. Leggett. *Constable and Co., Ltd.*—Vaccines and their Relations in Therapeutics, L. S. Dudgeon; The Ductless Glands in Medicine, Dr. W. L. Brown; Modern Methods in the Diagnosis and Treatment of Renal Disease, Dr. H. Maclean, new edition; Modern Methods in the Diagnosis and Treatment of Glycosuria and Diabetes, Dr. H. Maclean, new edition. *W. Hodge and Co. (Edinburgh).*—The Principles and Practice of Meat Inspection, Dr. G. Leighton. *E. and S. Livingstone (Edinburgh).*—A Handbook of Practical Therapeutics, Dr. D. Campbell; A Handbook on the Nervous System, Dr. D. E. Core; A Handbook of Mental Diseases, Dr. H. J. Norman; Handbook of Infectious Diseases, Dr. D. S. Sutherland; A Handbook of Histology, A. M. Watson; Handbook of Medical Diagnosis, Dr. A. J. Whiting; In "Outlines of Dental Sciences" Series—Dental Anatomy and Physiology, D. Headridge and S. K. Gibson; Dental Surgery and Pathology, 2 vols., J. L. D. Buxton and R. B. Gill; Histology, Dr. Livingston; Metallurgy, Dr. A. J. Brown; Orthodontia, G. Wilson. *Macmillan and Co., Ltd.*—The Nervous System of Man, Prof. R. J. A. Berry. *John Murray.*—Good Health and Happiness: A New Science of Health, J. Ellis Barker: With an Introduction by Sir Arbuthnot Lane, Bart.

Metallurgy.

Chapman and Hall, Ltd.—Working of Aluminium, E. T. Painton; The Metallurgist's Manual, T. G. Bamford and H. Harris.

Miscellaneous.

Chapman and Hall, Ltd.—Simplified Practice, C. Chisholm. *John Murray.*—Science, Leading and Misleading, Col. A. Lynch. *Kegan Paul and Co., Ltd.*—The Natural History of Ice and Snow, illustrated from the Alps, Dr. A. E. H. Tutton. In "To-day and To-morrow" Series; Balbus, or the Future of Architecture, C. Barman; Gallio, or the Tyranny of Science, J. W. N. Sullivan; The Conquest of War, Prof. W. McDougall; Socrates, or the Emancipation of Mankind, H. F. Carlill; Stentor, or the Future of the Press, D. Ockham; Aeolus, or the Future of the Flying Machine, O. Stewart.

Philosophy and Psychology.

George Allen and Unwin, Ltd.—The Making of the Modern Mind, Prof. J. H. Randall, jun.; Science and Philosophy, and other Essays, Bernard Bosanquet; The Nature of Deity: A Sequel to "Personality and Reality," Dr. J. E. Turner. *D. Appleton and Co.*—Mental Decline and Growth, H. L. Hollingworth; Applied Psychology: Its Principles and Methods, A. T. Poffenberger; The Springs of Human Action, M. K. Thomson; The Psychology of Personality, P. F. Valentine; The Inner World of Childhood, F. G. Wickes, with Introduction by C. G. Jung; From Myth to Reason, Dr. W. Riley. *Ernest Benn, Ltd.*—Psycho Analysis, Dr. E. Jones; The Mind and its Workings, C. E. M. Joad. *Cambridge University Press.*—The 'Faculty' of Imagination, H. L. Hargreaves; Essays in Philosophy, by the late James Ward, edited by Dr. W. R. Sorley and G. F. Stout, with a Memoir by Olwen Campbell. *Constable and Co., Ltd.*—Psychology of Children—Normal and Abnormal, Dr. Mary Scharlieb. *Macmillan and Co., Ltd.*—The Abilities of Man: Their Nature and Measurement, Prof. C. E. Spearman. *Methuen and Co., Ltd.*—Mind and Body, Dr. H. Driesch, translated by T. Besterman; Psychology: Its Methods and Principles, Prof. F. A. C. Perrin and Prof. D. B. Klein. *Kegan Paul and Co., Ltd.*—Psychology and Ethnology, the late Dr. W. H. R. Rivers, Preface by Prof. G. Elliot Smith; The Meaning of Meaning, C. K. Ogden and I. A. Richards, new edition; Sex and Repression in Savage Society, Dr. B. Malinowski; Religious Conversion: a Bio-Psychological Study, Prof. Sante de Sanctis; The Analysis of Matter, Bertrand Russell; The Psychology of Character, Dr. A. A. Roback; Social Life in the Animal World, Prof. F. Alverdes; The Effects of Music: a Series of Essays edited by Max Schoen.

Technology.

Chapman and Hall, Ltd.—The Manufacture of Artificial Silk, with Special Reference to the Viscose process, E. Wheeler; Concrete Builders' Handbook, Crane and Nolan; Care and Operation of Machine Tools, Barritt; Aerial Photography, C. Winchester and F. L. Wills. *Crosby Lockwood and Son.*—Standard Manual of Brewing and Malting and Laboratory Companion, J. Ross-Mackenzie.

Wind Drift.

A STRONG wind at sea has long been known to cause a drift of the upper layers of water superimposed upon the regular and periodic tidal currents. Sailing coastwise in clear weather, the navigator can determine the position of his vessel by bearings on landmarks, but in thick weather he can no longer do this, and it then becomes a matter of importance to know the velocity and direction of the currents, both tidal and wind-blown, to which his vessel may be subject. In sailing and slow-moving ships, seamen have need to make a rough allowance for this wind drift, in addition to the leeway made by the vessel, when calculating their position by dead reckoning in bad weather. The necessary allowance has never been more than a guess, usually on the assumption that the wind-blown current runs in the direction of the wind, simply augmenting or decreasing the normal speed of the tidal currents.

The early theory due to Zöppritz was based on a consideration of the internal friction of sea-water in regular motion, and took no account of either eddy motion in the water or the effect of the rotation of the earth upon the wind-driven current; it fitted in with the general experience of seamen, but did not accord with later observations of the drift of the *Fram* in the polar ice, during 1893–95, when the ice drifted some 28° to the right of the wind's direction and proceeded on the average at 2 per cent. of the wind's velocity. A mathematical consideration of the forces due to the tangential pressure of the wind on the surface and the rotation of the earth acting upon particles of water in motion led Ekman to conclude that, unless constrained by land or shallow depths, the surface water would move 45° to the right of the wind's direction throughout the northern hemisphere and at greater angles with decreasing velocity at greater depths. Observations of the upper 10 cm. to 60 cm. of water at a number of Finnish and Swedish light vessels in the Baltic showed a movement some 19° to the right of the direction of the wind. The speed was nearly twice as great when the wind blew in the same direction as the coast line, than when blowing directly on shore or off shore. The average speed of the current varied, not directly with the wind's velocity as occurred with the polar ice, but with its square root.

A number of other estimates of the relation between the velocity of this surface drift and of the wind have been made, but they show no general agreement; a few observations suggest that this deviation from the direction of the wind increases with depth, as would be expected from Ekman's conclusions, but the depth to which these currents extend in varying circumstances is unknown. This facet of the subject is one of some practical interest in fishery research; for example, the young of herring born in the English Channel are carried by such a current into the North Sea.

The need for accurate knowledge of the wind drift as well as the tidal currents along the Pacific coast of the United States, where harbours are many miles apart, sailing courses long and periods of thick weather not infrequent, has led the U.S. Coast and Geodetic Survey[1] to collect and analyse numerous current data from five light vessels. After allowing for the calculated tidal current the residual drift, almost entirely due to wind, was obtained for several thousand observations. These were made by means of a pole 15 ft. long, weighted at one end and floating 1 ft. out of the water; no allowance is made for the pressure of wind on the exposed part of the pole.

The velocity of the wind drift set up by winds varying between 10 miles and 60 miles an hour was approximately 2 per cent. of the velocity of the wind, being slightly under this value for high winds. This is a similar relation to that found by Nansen for the polar ice, but an entirely different relation from that found by Whitting for the surface 10 cm. to 60 cm. in the Baltic. The latter also holds for the surface 15 cm. in the English Channel and North Sea, as deduced from the drift of bottles so weighted that only about 3 c.c. of the cork end floats above water.

The direction of the wind drift along the Pacific coast averaged 23° to the right of the wind's direction, except for winds from the south-west sector, in which case the coast line trending north and south constrained the current to move north, 24° to the left of the wind's direction.

The observations recorded by the U.S. Coast and Geodetic Survey are a definite addition to the data available, and have in consequence a wider interest than that of the purpose for which they were primarily made.

H. W. H.

[1] U.S. Coast and Geodetic Survey Special Publication, No. 121, pp. 80. Coastal Currents along the Pacific Coast of the United States. By H. A. Marmer. (Washington, 1926.)

The Japanese Earthquake of Mar. 7, 1927.

FOR the second time since the great earthquake of Sept. 1, 1923, Japan has been visited by a destructive earthquake. The Tajima earthquake of May 23, 1925, was followed on Mar. 7 at 6.28 P.M. (or 9.28 A.M. G.M.T.) by another in nearly the same district, but probably some miles to the east. According to the official report issued from Tokyo, the central zone covers the counties of Naka and Yosa in the province of Tango. It is also stated that the roads to the north of Maizuru are impassable owing to the deep fissures caused by the earthquake. Thus, the centre must be close to the west coast of Wakasa Bay on the Japan Sea side of the islands.

In the small towns of Mineyama, Iwataki, Kaetu, Amino, Kayamachi, Ishida, and Yamada, containing from two to four or five thousand inhabitants, most of the houses are demolished or destroyed by the fires that broke out afterwards. As these, however, are not industrial centres, the purely economic effects of the earthquake will not be serious. The great towns of Osaka, Kyoto, and Kobe, to the south of the earthquake-zone, though strongly shaken, have suffered but little damage. The total number of lives lost is reported to be 2459.

The name of the province of Tango appears but seldom in Sekiya's catalogue of Japanese earthquakes. About fifty miles to the south, however, lies the important seismic district of Kyoto, and about the same distance to the east and south-east are the provinces of Mino and Owari, in which occurred one of Japan's greatest earthquakes, that of Oct. 28, 1891, with its remarkable fault-displacements.

Though their results in the loss of life and the destruction of property have been serious, both the earthquake of 1925 and that of Mar. 7 last are typical examples of the earthquakes that occur on the Japan Sea side of the islands. The late Prof. Omori divided the destructive earthquakes of Japan into two classes, local and non-local, according as they affected one province or several provinces. From the fifth century to near the close of the nineteenth century there were 221 destructive earthquakes in Japan. On the Japan Sea side of the islands there have been scarcely any but local shocks, while the Pacific side has often been shaken by great non-local earthquakes.

C. DAVISON.

University and Educational Intelligence.

CAMBRIDGE.—S. Goldstein, St. John's College, and W. V. D. Hodge, St. John's College, have been awarded Smith's Prizes for essays on "Mathieu Functions" and "Linear Systems of Plane Algebraic Curves of any *Genus*," respectively. D. Burnett, Clare College, and C. A. Meredith, Trinity College, have been awarded Rayleigh Prizes for essays on "Electric Radiation over the Earth's Surface," and "Some Theorems on Infinite Cardinals," respectively.

The General Board of the Faculties has recommended that the Disney professorship of archæology shall be brought under the new statutes for election, tenure, and duties; that its stipend be raised from the endowment to £1200 a year; that it shall be assigned to the Faculty of Archæology and Anthropology, and that the field within which the professor shall give instruction shall be classical, medieval, and prehistoric antiquities and fine arts.

It is proposed to appoint Mr. H. Quinney as an assistant in experimental research in the engineering department.

APPLICATIONS for grants in aid of scientific investigations bearing on agriculture, to be carried out in England and Wales during the academic year beginning on Oct. 1 next, must be made to the Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1, by May 15 next. The Ministry is offering not more than seven research scholarships in agricultural and veterinary science, each tenable for three years, applications for which must be made not later than June 30 next; it also invites applications for not more than five agricultural scholarships tenable for two years. The latest date for the receipt of applications is June 30.

A PAPER on "University Government with special reference to the University of London" was read by Mr. T. Ll. Humberstone at the Education Guild on Mar. 9, Sir Richard Gregory presiding. After describing the origins and constitutions of the archetypal universities, Bologna and Paris, the university of students and the university of masters respectively, he pointed out that Oxford and Cambridge were modelled on Paris, and remained true to type as autonomous societies of masters. These universities have handed down from the Middle Ages a tradition of a self-governing community with full freedom of opinion as precious as their dreamy spires and moonlit lawns. Referring to the proposed new constitution of the University of London, he emphasised the importance of ensuring a high standard of attendance in the Council. Convocation representation on the Senate should bring the University into touch with the world of affairs, the professions, and industries. Mr. Humberstone is opposed to any extension of institutional representation on the Senate, considering that college principals should be selected and appointed on grounds of personal merit. The Principal of the University should be a member of the Council and of the Senate *ex officio*, as there is no warrant in the constitutional history of universities for the exclusion of a high officer from membership of the governing body. He urged that special attention should be given to methods of voting. There is need for greater publicity as to the work and aspirations of the University. The chairman agreed that the question of the status of the Principal should receive attention, and strongly supported the plea for greater publicity; support of the University would be more generous if the needs of the University were explained.

Calendar of Discovery and Invention.

March 20, 1800.—It was in his letter addressed "a Como en Milanois, ce 20 m Mars 1800," that Volta communicated to Sir Joseph Banks his discovery of the voltaic pile. The letter arrived in parts, but the whole was read to the Royal Society on June 26, 1800. From the information contained in the first part, Nicholson and Carlisle made a pile with 36 half-crowns and 36 zinc discs, and with this they decomposed water.

March 20, 1877.—Fifty years ago, on Mar. 20, 1877, in his presidential address to the Iron and Steel Institute, Sir William Siemens directed attention to the possibility of utilising the power of Niagara Falls for driving dynamos and for transmitting electricity over long distances for lighting and smelting. Thirteen years later the Niagara Commission, including Kelvin, Mascart, Sellers, Turretini, and Unwin, was appointed; in 1893 a contract was placed with Westinghouse, and in 1895 three 5000-h.p. machines were started. To-day more than half a million horse-power is developed by the various plants.

March 21, 1816.—The Royal Academy of Sciences of Paris was founded by Colbert in 1666. During the Revolution, in 1793, all the academies were suppressed, but two years later the National Institute was founded. With the Restoration, further changes were made, and on Mar. 21, 1816, the academies were placed on their original footing. It was at this time also the names of Carnot and Monge were removed because in 1792 they had voted for the death of the king.

March 22, 1792.—A notable improvement in rapid communication resulted from the invention of the semaphore by Claude Chappe, which he laid before the Legislative Assembly of France on Mar. 22, 1792. During trials a message was sent from the Louvre to Lisle, 48 leagues distant, in thirteen minutes. The semaphore was extensively used during the Napoleonic Wars, and up to 1849 the Admiralty maintained a chain of semaphore stations at Chelsea, Putney, Kingston, Esher, Cobham, Guildford, Godalming, Haslemere, Midhurst, Petersfield, and Portsdown. Chappe's monument stands in the Boulevard Saint Germain.

March 24, 1787.—On Mar. 24, 1787, Dalton made his first entry in a book entitled "Observations of the Weather, etc." During the course of the next fifty-seven years he entered some 200,000 observations in this journal, the last being made the evening before his death.

March 25, 1655.—To-day Saturn is known to have ten satellites. The first discovered and the largest, Titan, was seen by Huygens on Mar. 25, 1655. Between 1671 and 1684, Cassini discovered four more; Herschel added two in 1789, Bond and Lassell found Hyperion in 1848, while Pickering discovered the other two in 1898 and 1904 respectively. Phœbe, which was found in 1898, has a motion in the opposite direction to the other nine.

March 26, 1762.—In 1713 an Act of Parliament authorised the award of sums of £10,000, £15,000, and £20,000 for determining the longitude at sea within 60, 40, and 30 miles respectively. Many astronomers and mechanicians assisted in the solution of the problem, but the principal work was done by John Harrison, the inventor of the marine chronometer. His seagoing timepieces were made in 1735, 1739, 1749, and 1759, and it was with the fourth that his son made a voyage from Portsmouth to Jamaica and back, the voyage lasting from Nov. 18, 1761, to Mar. 26, 1762. During this time the error only amounted to 1 min. 54½ sec. E. C. S.

Societies and Academies.

LONDON.

Royal Society, Mar. 10.—A. **Levin** and J. **Wyman**: The viscous elastic properties of muscle. 'Viscosity' is a term used to denote irreversible processes which cause a loss of work, greater with greater speeds, and prevent the muscle from contracting instantaneously. A mechanical model consisting of two elastic elements (springs), of which one only is damped, will imitate muscular effects, and it is argued that the muscle is mechanically a system of this type. When the muscle is stimulated isometrically, tension is shared by the damped elastic and free elastic elements. When the muscle is then released at a constant rate, the damped elements lag behind, causing thereby a drop of tension, which, however, is not instantaneous, owing to the presence of the free elastic elements. As the shortening proceeds, a steady state of lag is reached exponentially. When the release stops, the damped elements continue to shorten, stretching the free elements, and the tension redevelops exponentially. In a stretch the events occur in the opposite order. The actual contractile structures are the damped elements. The free elastic elements act as 'buffers.'

F. W. R. **Brambell** and A. S. **Parkes**: Changes in the ovary of the mouse following exposure to X-rays. 75 per cent. of the animals killed upwards of five weeks after irradiation, when adult, were sterilised. No hiatus occurred in the œstrous cycles following irradiation. The elements already forming the cortex at the time of irradiation persist and constitute the tissues of the sterilised ovary. They are derived from the embryonic germinal epithelium and produce œstrin in the normal ovary; they continue to do so without interruption after irradiation. 'Anovular' follicles were formed from the smaller follicles, by the degeneration of the oocytes and the growth of the membrana granulosa cells, immediately after irradiation.

A. S. **Parkes**, Una **Fielding**, and F. W. R. **Brambell**: Ovarian regeneration in the mouse after complete double ovariotomy. Of 121 double ovariotomised mice, all of which showed initial cessation of the œstrous cycle, eleven afterwards showed signs of spontaneous œstrus. In eight of these eleven cases the presence of new ovarian tissue was demonstrated histologically. The exact site of regeneration could not be ascertained. In most cases follicles and corpora lutea were found in the regenerate tissue, and generally these cyclic structures could be correlated with the recent œstrous history of the animal. Most of the regenerate animals had a normal cycle after the first spontaneous appearance of œstrous symptoms, but in at least one case a very irregular series of œstrous-like phenomena occurred, prolonged cornification being the chief feature observed.

A. **Walton**: The relation between 'density' of sperm-suspension and fertility as determined by artificial insemination of rabbits. Experiments on artificial insemination of rabbits show that fertility is influenced by the density or number of spermatozoa introduced into the vagina of the female. Fertility is reduced where the estimated number of spermatozoa is less than about 10^6 per 3 c.c. Sterility occurs where the number is below 10^4 per 3 c.c. Three factors probably play a part in determining the results, but are not subject to separate quantitative estimation:—(*a*) The probability of any one spermatozoon reaching the fertilisable ovum is small; (*b*) the spermatozoa are not all capable of fertilisation; (*c*) toxicity may act differentially on sperm-suspensions of varying density.

Alexander **Hynd**: The action of glucosone on normal animals (mice) and its possible significance in metabolism. The subcutaneous injection of glucosone, a first oxidation product of glucose, in appropriate dosage, produces in normal mice a condition very similar to that caused by insulin, the symptoms being modified or inhibited by an injection of either adrenaline or pituitrin. The 'glucosone effect,' however, is not remedied by the administration of glucose. An injection of acetoacetic acid antagonises the effect of a glucosone injection, indicating that glucosone may be of significance in fat metabolism. Glucosone is, perhaps, formed by the action of insulin on blood sugar, and thus may be an important compound in the intermediate metabolism of carbohydrates.

CAMBRIDGE.

Philosophical Society, Jan. 31.—Sir Joseph **Larmor**: What determines the resistance and tilt of an aeroplane? Formulæ were given by J. J. Thomson in 1883, in which the six components of the resultant momentum in an unlimited field of fluid motion were expressed in terms of the distribution of vortical spin alone. When they are extended, in intrinsic invariant form, so as to apply to regions of a field of motion produced by solid bodies, passive or propelled, they ought to provide a formal foundation, possibly of technical value, on which to base the general dynamics of propulsion of an aeroplane or airship. Applications are made, for example, to the necessity for opposite nearly compensating vorticities in the wake: also, the relation to the current procedure which derives the supporting force from a definite smooth circulation of the air around the body: also, and historically, the nature of the process by which mainly a system of vortices is thrown off from a travelling solid body, which only later degrades into tumultuous disturbance.—L. H. **Thomas**: The effect of the orbital velocity of the electrons in heavy atoms on their stopping of α-particles. 'Collisions' between α-particles and electrons are divided into two classes; close collisions, which may be treated as if the electron were free, and slight collisions, which may be treated as small disturbances of the electron. For swift α-particles the two classes overlap. The second type of collisions is neglected altogether and the first type arbitrarily delimited as those for which the transfer of energy is larger than the ionisation potential (Henderson's assumption). For swift particles and heavy atoms the error so introduced is comparatively small. On the average a particle loses more energy to a moving electron than to a stationary one.—F. H. **Constable**: Surface adsorption and the velocity of chemical action at gas-solid interfaces. The formula previously deduced connecting the partial pressure of the reactant in a mixture with the fractional reaction velocity has been verified for mixtures of alcohol vapour diluted with water, acetone, and benzene; and for the composition of the adsorbed film on platinum exposed to mixtures of carbon monoxide and oxygen. The effect of the mixture of vapours on the temperature coefficient of reaction is considered. If the heat of desorption of the reactant is greater than that of the diluent, then the temperature coefficient is diminished; if they are equal, there is no alteration; and if less, the temperature coefficient is increased. Water present as a diluent in alcohol has little effect on the temperature coefficient of the reaction.—H. D. **Ursell**: The evaluation of Gibbs' phase integral for imperfect gases. The phase integral for a perfect gas (neglecting the factor corresponding to impulse co-ordinates) is V^N. It has sometimes been assumed that in general the value is $V^N(1+g)$ where g is of the order of the imperfection. This, however, is not correct,

the form taken being actually $V^N e^{Ng}$, and this fact invalidates any simple discussion of an imperfect gas. An exact expression is obtained for the phase integral in the form of a multiple series, from which different equations are written down which equally define it. When these have been expressed in terms of g it is possible to approximate, and thus to evaluate g, and hence the pressure, to any order for a given molecular model.

MANCHESTER.

Literary and Philosophical Society, Feb. 8.—Wilfred Irwin: The presence and distribution of salt in the air, rain, and rivers of this country. Samples were taken at twelve different stations in England simultaneously, each sample representing three months' rainfall at those stations. This was done during a stormy winter quarter, and again during a calm spring quarter. In the stormy period the content of the salt may vary from 199 parts per million at Maryport on the sea coast in Cumberland, to 5½ parts at Ryton on Dunsmore in Warwickshire, and in the mild period from 32 parts at Maryport to 5 parts at Ryton. In urban areas, chlorides are emitted along with smoke and the results are very irregular. Lakes in the Lake District were tested for salt; with the exception of Derwentwater and Bassenthwaite, which are influenced by the saline spring at Brandlehow, results show that Loweswater, the gathering ground of which is nearest to the sea, contains the most salt—16 parts per million—and that Haweswater, the farthest from the sea, has the least—only 8 parts. The salinity of the rainwater over England and Wales probably averages about 7 to 8 parts per million, and the average rainfall, 35 inches. This means that about one million tons of solid salt are annually carried in spray from the sea to the land, to be returned by the rivers to the sea. It is calculated that to bring the land in Warwickshire to the same salinity as that in the neighbourhood of Cockermouth, one hundredweight of salt per acre would be required to be added.

Feb. 22.—D. C. Henry: Some recent advances in colloid theory. Experiments recently made at the Cambridge Low Temperature Research Station on the freezing of gelatin gels throw some light on the constitution of such gels. In one series, measurements were made of the velocity with which the crystallisation of water is propagated through a supercooled gel when 'seeded' with a small particle of ice. Whereas a 1 per cent. gel does not greatly hinder the crystallisation process, a 2 per cent. gel reduces the crystallisation velocity to less than a tenth of its value in water, except in the immediate neighbourhood of the isoelectric point. In this neighbourhood the gel is turbid instead of clear, and it is probable that opaque fibrils are formed at the expense of the main structure of the gel, which is thus weakened sufficiently for the ice to break through without much hindrance. A second series of experiments has established the existence of a reproducible equilibrium between ice and gel of a definite concentration, varying with the temperature, and leads to definite conclusions as to the proportion of the water in a gelatin gel which may be considered as 'bound' to the gelatin.

PARIS.

Academy of Sciences, Feb. 7.—P. Villard: The chemical actions of radiations. Remarks on a recent note of A. Gargam de Moncetz.—E. Mathias: Contribution to the study of fulminating material. The decomposition of a certain kind of globular lightning, spontaneous and without sensible noise.—Charles Jordan: A generalised case of the probability of repeated trials.—Paul Alexandroff: A definition of Betti's numbers for any closed ensemble.—E. Lainé: The method of Darboux and Moutard's equations.—P. Lejay: The synchronisation at a distance of precision pendulums without use of any contact. A method is described which would appear to be applicable in other directions also. A small heterodyne short wave emitter is placed in the same room as the pendulum. To the condenser of the oscillating circuit which fixes the wave-length, a 20 cm. wire is connected and arranged so that the pendulum in oscillating passes some millimetres from its free extremity. The resulting variation of capacity of the wire with respect to the pendulum causes a sufficient variation of the wave-length to produce a record in the ordinary way. The notches produced on the record are perfectly symmetrical and have a base of 0·02 sec.—Nicolas de Kolossowsky: The specific heats of a sufficiently cooled non-condensed phase.—Pierre Jolibois and Pierre Montagne: A graphical method of calculation of the energy yield of homogeneous reactions.—Paul Riou and Paul Cartier: The influence of some organic substances on the velocity of absorption of carbon dioxide by solutions of neutral sodium carbonate. The viscosities of the sodium carbonate solutions were increased by addition of glycerol, dextrose, and saccharose. Tabulated results are given shewing the velocities of gas absorption per square centimetre of absorbing surface and the corresponding viscosities.—A. Boutaric and Mlle. M. Dupin: The existence of two zones of instability in the flocculation of ferric hydroxide sols by electrolytes with polyvalent cations.—Eugène Fouard: A general method of preparation of metallic colloids. The method requires a colloid (starch, gelatine, albumen) completely freed from associated metallic salts, and an electrical method for carrying out this purification is described. In an aqueous solution of such a purified colloid a metallic salt is dissolved, and this is electrolysed between two insoluble electrodes with a current of a few milliamperes. A colloidal solution of the metal is formed round the cathode. The method has been successfully applied to a large number of metals, including mercury, lead, bismuth, copper, and antimony, and also to arsenic, iodine, and tellurium.—G. Denigès: A new method for the volumetric estimation of molybdenum. The method is based on the reduction to Mo_3O_5 by aluminium foil in sulphuric acid solution, followed by titration with permanganate.—Max and Michel Polonovski: A new method for the transformation of the tertiary heterocyclic bases into secondary dealkylated bases.—Clément Duval: A cobaltiboroammine. The preparation of a new ammine is described: analysis showed it to be $CoBO_3(NH_3)_3$. It is insoluble in water and very stable.—A. Wahl and G. Vermeylen: A new transposition in the naphthylamine sulphonic acids.—L. Eblé: The periodic deviations from the vertical at Paris. An analysis of the results obtained with the horizontal pendulum at the Paris Observatory over a period of 31 months.—V. Vincent: The measurement of the ionimetric acidity by the inversion of saccharose. Application to complex media: sols.—C. Motas: Hydracarus of the genus Megapus in the Dauphiné Alps.—A. Labriet and R. Husson: Experimental analysis and synthesis explaining the passages of the singing voice in the theory of vocal accord.—A. Mordvilko: The biology of the Phylloxera of the vine. The conditions of its subterranean life. The influence of climate.—Marcel Abeloos: The speed of regeneration of the head in *Planaria gonocephala*. The influence of the level of the sections.—P. E. Pinoy and A. Nanta: The frequent existence of a mycosis of the spleen in Algeria. The pseudo-cysts causing enlarged spleen in Algeria are due to a fungus similar

to *Sterigmatocystis nidulans*, cultures of which have been obtained. The fungus penetrating the spleen introduces bacteria causing a secondary infection, and it is possible that the nature of the associated bacteria may modify the clinical type of the disease.

VIENNA.

Academy of Sciences, Jan. 13.—O. Wettstein: Five new European mammals, species of Pitymys from Croatia and Tyrol.—L. Walmann: Report on the geological survey of the Moravian primitive rocks in Lower Austria.—H. Leng: Adsorption experiments on glasses and filtration materials by the methods of radio-active indicators. Adsorption on glasses approaches saturation.—M. Holly: (1) A new subspecies of silurid from Kamerun; (2) a new species of cyprinid from the islands of Little Sunda.—L. Kober: The geology of the Salzkammergut.—A. Tauber: Integration of linear differential equations.

Jan. 20.—F. Wessely and M. John: Researches on α-amino-N-carbonic acid anhydride.—K. Przibram: The coloration of compressed rock-salt under Becquerel radiation.

Official Publications Received.

BRITISH.

County Borough of Halifax. First Annual Report of the Corporation Museums for the Year 1925–6. Pp. 15+2 plates. (Halifax.) 2*d*.

British Museum (Natural History). Picture Postcards. Set E45: Exotic Moths, Series No. 10. 5 cards in colour. 1*s*. Set E46: Exotic Moths, Series No. 11. 5 cards in colour. 1*s*. Set E47: Exotic Moths, Series No. 12. 5 cards in colour. 1*s*. Set E48: Exotic Moths, Series No. 13. 5 cards in colour. 1*s*. (London.)

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1925–1926. Pp. 161. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Leeds University. Twenty-second Report, 1925–26. Pp. 184. (Leeds.)

Report of the Botanical Survey of India for 1925–26. Pp. 9. (Calcutta.)

Board of Education. Regulations for Whitworth Scholarships, 1928. Pp. 15. 2*d*. net. Syllabus of the Science Scholarships Examination, 1928. Pp. 23. 4*d*. net. (London: H.M. Stationery Office.)

The Carnegie Trust for the Universities of Scotland. Twenty-fifth Annual Report (for the Year 1925–26) submitted by the Executive Committee to the Trustees on 9th February 1927. Pp. iv+79. (Edinburgh.)

Melbourne Observatory. Hourly Values of the Magnetic Elements at Toolangi, in 1924. Observed and reduced under the Direction of Dr. J. M. Baldwin. Pp. ix+37. (Melbourne: H. J. Green.)

Union of South Africa: Department of Agriculture. 11th and 12th Reports of the Director of Veterinary Education and Research. Part 1, September 1926. Pp. 817. (Pretoria: Government Printing and Stationery Office.) 10*s*.

Aeronautical Research Committee: Reports and Memoranda. No. 1047 (Ae. 233): Model Tests on a Combined Slot and Aileron Control on a Wing of R.A.F. 15 Section. Push Forward Type of Auxiliary. By F. B. Bradfield and A. S. Hartshorn. (A.2.a. Stability Calculations and Model Experiments, 112—T. 2291.) Pp. 10+8 plates. 9*d*. net. (London: H.M. Stationery Office.)

FOREIGN.

Cornell University Agricultural Experiment Station, New York. Bulletin 450: Results of Sweet-Corn Suckering Experiments. By H. C. Thompson. Pp. 15. Bulletin 451: The Relative Efficiency of some Copper Dusts and Sprays in the Control of Potato Diseases and Insect Pests. By Oran Cecil Boyd. Pp. 68. Bulletin 452: Economic Studies of Dairy Farming in New York. vi: Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1922. By E. G. Misner. Pp. 58. Bulletin 454: The Spruce Gall-Aphid. By Glenn W. Herrick and T. Tanaka. Pp. 17. Memoir 98: The Collection and Utilisation of Pollen by the Honeybee. By Ralph L. Parker. Pp. 55. Memoir 99: The Nitrogen and Carbohydrate Composition of the Developing Flowers and Young Fruits of the Apple. By Freeman Smith Howlett. Pp. 79. Memoir 103: The Growth of certain Micro-organisms in Planted and in Unplanted Soil. By J. K. Wilson and T. L. Lyon. Pp. 25. (Ithaca N.Y.)

Field Museum of Natural History. Botanical Series, Vol. 6, No. 1: Citrus Products. Part 1. By James B. McNair. (Publication 238.) Pp. xi+212+7 plates. Zoological Series, Vol. 12, No. 12: The Amphibians and Reptiles of Mona Island, West Indies. By Karl P. Schmidt. (Publication 236.) Pp. 147-163. Zoological Series, Vol. 12, No. 13: Amphibians and Reptiles of James Simpson-Roosevelt Asiatic Expedition. By Karl P. Schmidt. (Publication 237.) Pp. 165-173. Zoological Series, Vol. 16: Catalogue of the Edward E. Ayer Ornithological Library. By John Todd Zimmer. Part 1. (Publication 239.) Pp. x+364+8 plates. Part 2. (Publication 240.) Pp. 365-706+plates 9-12. (Chicago, Ill.)

Department of Commerce: U.S. Coast and Geodetic Survey. Terrestrial Magnetism. Serial No. 360: Magnetic Declination in the United States in 1925. By Daniel L. Hazard. (Special Publication No. 126.) Pp. 38+1 map. (Washington, D.C.: Government Printing Office.) 10 cents.

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review, Supplement No. 27: Montezuma Pyrheliometry. By C. G. Abbot. (W.B. No. 906.) Pp. 15. (Washington, D.C.: Government Printing Office.) 20 cents.

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-sè (Chine). Tome 14, Fascicule 2: Observations du soleil (taches et protubérances), 1923, 1924, 1925. Pp. A61-A120. (Zi-ka-wei.)

Bulletin of the American Mathematical Society. List of Officers and Members, 1925-1926. (Supplement to Vol. 32, No. 5, September-October 1926.) Pp. 60. (Menasha, Wis., and New York.)

Diary of Societies.

SATURDAY, MARCH 19.

BRITISH MYCOLOGICAL SOCIETY (London Meeting) (in Botanical Department, University College), at 11 A.M.—W. R. I. Cook: Influence of Environment on Infection by *Ligniera Junci*.—E. H. Ellis: Fungi in Japanese Carvings.—E. W. Fenton: Seed Mixtures and the Incidence of Fungal Diseases.—Miss M. P. Hall: Zoning in Cultures of *Monilia fructigena*.—K. R. Mohendra: Varieties in *Sphæropsis malorum*.—J. Ramsbottom: Fragmenta Mycologica VII.

GEOLOGISTS' ASSOCIATION (in Department of Anatomy, University College), at 2.30.—Prof. G. Elliot Smith: Demonstration of Fossil Remains of Man.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS (North of England Branch), at 3.—C. D. le Maistre: Standardisation of Colliery Electrical Requisites.

PHYSIOLOGICAL SOCIETY (at University College) (Annual General Meeting), at 3.—K. H. Coward and Dr. J. H. Burn: Variations in Response of Different Rats and Mice to Injections of Oestrin.—A. W. Bourne and Dr. J. H. Burn: (*a*) The Dosage of Pituitary Extract in Labour; (*b*) The Value in Labour of the Different Constituents of Ergot.—I de Burgh Daly: Blood Flow during Respiration: The Influence of the Heart and of the Lungs.—Prof. J. Mellanby: The Preparation of Fibrinogen and Fibrin Ferment from Oxalated Ox Blood.—Grace Briscoe: Graded Muscular Contractions of Natural Form Produced by Electrical Stimulation.—F. R. Winton: The Action of Squill Extracts on Rats.—I. T. Zeckwer: The Hyperglycæmic Response to Bacterial Vaccines.—Dr. F. W. R. Brambell: The Maturation of the Graafian Follicle in relation to Oestrus.—Dr. E. B. Verney: Some Acute Effects of Pituitary Removal in the Dog.—E. Ponder: The Reflex Act of Blinking.—W. P. Blount: The Blinking Reflex in Animals.—A. C. Hampson and M. Maizels: The Effect of *p*H on the Distribution of Phosphorus between Human Red Cells and Potassium Phosphate Solutions.—Demonstrations:—An Apparatus for Propelling Air round Small Enclosed Circuits when Leakage to CO_2 is to be Entirely Avoided, by F. M. Haines.—(*a*) Ovarian, Uterine, and Vaginal Changes during the Oestrous Cycle of the Mouse; (*b*) X-ray Sterilisation of the Mouse Ovary, by Drs. A. S. Parkes and F. W. R. Brambell.—The Respiratory Quotient of the Heart, by L. E. Bayliss, E. A. Müller, and Prof. E. H. Starling.—The Oxygen Usage of the Kidney, by A. Fee, A. Hemingway, and Prof. E. H. Starling.—A Stimulating Chamber for Plain Muscle, by F. R. Winton.—A Colorimetric Method for Roughly Controlling the CO Tension in Respiratory Gases, by L. M. Pickford and Dr. E. B. Verney.—(*a*) An Apparatus for Continuous Reading of E.M.F.; (*b*) A Photo-electrolytic Effect, by Dr. D. T. Harris.—An Improved Perimeter, by B. Lang.—The Histological Appearances of the Pituitary after Different Amounts of Insulin, by Elizabeth C. Eaves.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Alpha Rays and their Application to Atomic Structure.

MONDAY, MARCH 21.

VICTORIA INSTITUTE at Central Buildings, Westminster), at 4.30.—Rev. A. H. Finn: The Predictive Element in Holy Scripture.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. A. Piney: Hyperplasia and Neoplasia in Lymphatic Tissue.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. J. Mitchell and others: Discussion on Domestic Electrical Refrigeration.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—H. R. Ricardo: Some Notes on Petrol-Engine Development.

RAILWAY CLUB (at 25 Tothill Street, S.W.), at 7.30.—W. N. R. J. Back: The late History of the Great Northern Railway.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—G. Cator and C. E. M. Joad: Error (Symposium).

ROYAL SOCIETY OF ARTS, at 8.—G. I. Finch: Some Applications of Electrothermics (Cantor Lectures) (2).

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

CHEMICAL INDUSTRY CLUB.

TUESDAY, MARCH 22.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 4.—Prof. J. Barcroft: Physiology of Life in the High Andes (Wilde Memorial Lecture).

ROYAL DUBLIN SOCIETY (at Ball's Bridge, Dublin), at 4.15.—L. B. Smyth: On the Index Fossil of the Cleistopora Zone.—Miss Dorothy Beckett: The Influence of Separation and Pasteurisation on the Size of Fat Globules.—Exhibition by Dr. H. H. Poole of a convenient method of Charging Electroscopes.

ROYAL SOCIETY OF MEDICINE (Medicine, Diseases in Children, and Dermatology Sections), at 5.—Dr. S. E. Dore, J. H. Sequeira, Dr. A. Eidinow, and others: Special Joint Discussion: The Uses and Limitations of Ultra-violet Light Therapy.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir Charlton Briscoe: The Muscular Mechanism of Respiration and its Disorders (Lumleian Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. G. Shearer: X-rays and the Chemical Molecule (2).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (Annual General Meeting) (at Royal Society of Arts), at 5.30.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the month of February 1927.—G. C. Robson: Seasonal and Sexual Dimorphism in the Squid *Alloteuthis subulata*.—Daphne Atkins: Report on the Myzostomida collected by Mr. F. A. Potts in Torres Strait, together with a Description of a Species obtained by Prof. J. Stanley Gardiner from the Maldives.—Oldfield Thomas: On Mammals from the Gobabis District of Eastern Damaraland, South-west Africa, obtained during Capt. Shortridge's Fourth Percy Sladen and Kaffrarian Museum Expedition. With Field-notes by the Collector.—Dr. F. P. Stowell and V. P. Clancey: Microscopical and Bacteriological Investigation of the Water in the Society's Aquarium.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. W. E. Dalby: Heat Transmission and the Motor-Car Radiator.

INSTITUTION OF AERONAUTICAL ENGINEERS (at 39 Victoria Street), at 6.30.—L. A. Wingfield: Aircraft Law.

ILLUMINATING ENGINEERING SOCIETY (at Lighting Service Bureau, 15 Savoy Street, W.C.), at 6.30.—L. M. Tye, W. Millner, H. H. Long, C. A. Hughes, and others: Discussion on Various Problems in Illumination and Practical Solutions.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Derby Technical College), at 6.45.—G. H. Lake: Powdered Fuel.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (Annual Meeting) (at Technical College, Cardiff), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Col. E. Mercier: Notes on the 60,000-Volt Underground Network of the Union d'Electricité.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—W. T. Griffiths: Nickel-Iron and Related Alloys.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group) (Annual General Meeting), at 7.—Dr. O. C. de C. Ellis: Flame.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.15.—D. W. Parkes: The Removal and Recovery of Phenols from Ammonia Sulphate Still Effluents.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—I. Schapera: Native Chieftainship in South Africa.

WEDNESDAY, MARCH 23.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (Pathological Meeting in Laboratory of Maudsley Hospital, Denmark Hill), at 4.30.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—E. S. Cobbold: The Stratigraphy and Geological Structure of the Cambrian Area of Comley (Shropshire).

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—H. R. Ricardo: Some Notes on Petrol-Engine Development.

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, Strand), at 7.—Electric Power Appliance in the Home.

ROYAL SOCIETY OF ARTS, at 8.—C. S. Orwin: The Transition of Agriculture.

EUGENICS SOCIETY (at Royal Society), at 8.30.—Dr. C. C. Hurst: The Mechanism of Heredity and Evolution.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 1 Wimpole Street).

THURSDAY, MARCH 24.

CHEMICAL SOCIETY (Annual General Meeting), at 4.—Prof. H. Brereton Baker: Experiments on Molecular Complexity (Presidential Address).—Presentation of the Longstaff Medal for 1927 to Prof. R. Robinson, and of the Harrison Memorial Prize for 1926 to Dr. C. R. Harington.

ROYAL SOCIETY, at 4.30.—Sybil Cooper, D. E. Denny-Brown, and Prof. C. S. Sherrington: Interaction between Ipsilateral Spinal Reflexes acting on the Flexor Muscles of the Hind-limb.—Dr. F. W. R. Brambell: The Development and Morphology of the Gonads of the Mouse. Part I. The Morphogenesis of the Indifferent Gonad and of the Ovary.—Dr. R. J. Ludford: The Golgi Apparatus in the Cells of Tissue Cultures.—C. E. Walker and Margaret Allen: The Nature of Golgi Bodies and other Cytoplasmic Structures appearing in Fixed Material.—Dr. W. S. Patton and E. Hindle: The Development of Chinese *Leishmania* in *Phlebotomus Major* var. *Chinensis* and *P. Sergenti*. var.—G. S. Sansom: The Giant Cells in the Placenta of the Rabbit.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir Charlton Briscoe: The Muscular Mechanism of Respiration and its Disorders (Lumleian Lectures) (2).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. Guild: Colour Measurement and Standarisation (2).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Major M. Wronsky: German Commercial Air Development.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, at 7.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section, jointly with same Section of Society of Chemical Industry) (at North British Station Hotel, Edinburgh), at 8.—A. M. Cameron: Fire Risks in Industry.

FRIDAY, MARCH 25.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Dr. E. Mallett: Acoustical Experiments with a Mechanical Vibrator.—Dr. E. T. Paris: The Stationary Wave Method of Measuring Sound Absorption at Normal Incidence.—J. H. Awbery and Dr. Ezer Griffiths: A Ball and Tube Flowmeter suitable for Pressure Circuits.—Demonstration of the Astrolabe and some other Medieval Surveying and Navigational Instruments, by Dr. A. Ferguson.

INSTITUTION OF MECHANICAL ENGINEERS (jointly with Society of Chemical Industry, Chemical Engineering Group), at 5.15.—Dr. W. R. Ormandy: Lubrication.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—Sir Richard Glazebrook: Pure Science: the Service it has already rendered to Engineering, and a Review of Modern Developments and their Possible Future Application.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institute of Chemistry, Glasgow Section) (at 36 Buchanan Street, Glasgow), at 6.30.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—E. J. Bedford: Pocket Cameras and what can be done with them.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 7.30.—Major H. Myers: The Educative Influence of Aircraft Inspection.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30—S. R. Broderick: Notes on the Construction and Plant of the New Filtered Water Installation for the Seville Waterworks Company.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. C. T. R. Wilson: Thunderclouds.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section).

SATURDAY, MARCH 26.

GEOLOGISTS' ASSOCIATION (at Museum of Practical Geology), at 2.30.—Demonstrations:—Fossil Plants from the Coal Measures, by Dr. R. Crookall.—Goniatite Zones of the Millstone Grit of Central Lancashire, by S. W. Hester.—Fossils from the Neighbourhood of Leighton Buzzard, by J. Pringle.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Alpha Rays and their Application to Atomic Structure (2).

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—R. White: The Ventilation of a Pyrites Mine, with special reference to Fire-fighting, Safety and Rescue-work.

PUBLIC LECTURES.

SATURDAY, MARCH 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Animal Growth and Evolution.

SUNDAY, MARCH 20.

GUILDHOUSE (Eccleston Square), at 3.30.—Address on One of the World's Beliefs.

TUESDAY, MARCH 22.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. E. T. Whittaker: Present Conceptions of the Cosmos.

THURSDAY, MARCH 24.

FULHAM CENTRAL PUBLIC LIBRARY, at 8.—W. H. Hempsall: The Wonders of the Bee-Hive.

SATURDAY, MARCH 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Wild Life in Meadow, Stream, and Wood.

SUNDAY, MARCH 27.

GUILDHOUSE (Eccleston Square), at 3.30.—Very Rev. Dr. J. H. Hertz (Chief Rabbi): Fundamental Ideals and Proclamations of Judaism.

CELEBRATION.

MARCH 18 TO 20.

MATHEMATICAL ASSOCIATION (Yorkshire Branch) (at Grantham).—The Two-Hundredth Anniversary of the Death of Sir Isaac Newton.

March 19, at 10 A.M.—Bicentenary Scientific Meeting in the Old School, King's School, Grantham, with addresses by:—
Sir J. J. Thomson: Newton's Work in Physics.
Sir F. Dyson: Newton's Work in Astronomy.
Dr. H. Lamb: Newton's Work in Mechanics.
Prof. G. H. Hardy: Newton's Work in Pure Mathematics.
Dr. J. H. Jeans will preside and give an address on Isaac Newton.
At 2.—Pilgrimage to Woolsthorpe Manor House (Newton's birth-place) and visit to Stoke Rochford, where Mr. C. Turnor will speak on Newton's Countryside.—At 7.30.—Celebration Dinner at the George Hotel, Grantham. Chairman: Sir J. J. Thomson. Speakers: Prof. H. H. Turner, Prof. E. T. Whittaker, the Bishop of Birmingham, and the Bishop of Lincoln.

March 20, at 11.15 A.M.—Bicentenary Service at the Parish Church, Grantham. Preacher—The Bishop of Birmingham.

CONFERENCE.

TUESDAY, MARCH 22.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30 A.M.—Conference on Cultivation: What the Farmer aims at and how he does it. Chairman: Lord Bledisloe.
H. Drewitt: Cultivation on the West Sussex Chalk and Brick Earth.
J. Joyce: Spring Cultivation in Western England.
J. H. Spilman: Cultivation Operations on the Yorkshire Wolds.
J. Steel: Spring Cultivation in an Eastern County.
Dr. B. A. Keen: Cultivation: The Art and the Science.

CONGRESSES.

APRIL 20 TO 24.

JOURNÉES MÉDICALES MARSEILLAISES ET COLONIALES (at Marseilles).—Prof. Cantacuzène: The Rôle of the Streptococcus in the Etiology of Scarlet Fever.—Dr. Mayer: Recent Advances in the Treatment of Cancer.—Prof. Ottolenghi: Malaria.—Dr. N. Bernard: Beri-beri.—Prof. Imbert: Bone-grafting.

APRIL 25 TO 28.

GERMAN SOCIETY FOR INTERNAL MEDICINE (at Wiesbaden).—Discussions on Psychotherapy, introduced by Gaupp and Fleischmann; Results of Recent Functional Investigations of the Stomach and Duodenum, introduced by G. Katsch.—A joint meeting with the German Röntgen Society will be held on April 28, with a discussion on the Significance of Röntgen-ray Examination of the Lungs and Mediastinum for Internal Medicine (excluding Tuberculosis), introduced by Dietlen, Assmann, Haenisch and Lorey, and Fleischner.

Supplement to NATURE

No. 2994 MARCH 19, 1927

Our Bookshelf.

Racial Evolution.

The Pedigree of the Human Race. By Prof. H. H. Wilder. Pp. xiv + 368. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 12*s.* 6*d.* net.

In this "Pedigree of the Human Race," the author writes as a professional zoologist "investigating the history of a single animal species which has become universally distributed." His style is one to which readers of books on early man on the eastern side of the Atlantic are little accustomed; it has much of the austerity of a text-book for the schools. There is great gain in clearness by this method of treatment, especially in the early stages, where the author deals far more fully than is usual with the data of palæontology.

As a zoologist the author is inclined to pay less attention to what he regards as the *amour propre* of man. He holds that the differentia of man are insufficient to place him in a separate family. He also puts forward a new system of ethnological classification based upon the view that racial evolution proceeds from an indifferentiated non-specialised stock towards differentiation and specialisation. This method, however, is not new in its conception, but rather in the detailed application in which it has here been worked out. The undifferentiated, least specialised race is, naturally, the Australian, the protomorph, followed by two metamorphic races, Caucasian-Mongolians and Ethiopians. Then come the archimorphs, proto-Caucasian, proto-Mongolian, and proto-Ethiopians. The classification is obviously of great interest, but in detail seems open to criticism. It is necessarily given in skeleton, and before criticising it, it would be desirable to know how the author has handled the data on which it is based. His treatment of the Malay, for example, does not seem entirely satisfactory. "The most singular coincidence in anthropological history" to which the author directs attention, by which Pithecanthropus was brought to light in the year of Haeckel's sixtieth birthday, 1894, he must abandon, no doubt with regret, as that discovery was made in 1891–92, as correctly given on a previous page.

The Formation of the Greek People. By Prof. A. Jardé. Translated by M. R. Dobie. (The History of Civilization Series.) Pp. xvi + 359. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 16*s.* net.

This volume of the "History of Civilization" Series is an attempt to explain the Greek 'miracle,' meaning, as Mr. Henri Berr says in his preface—not a miracle in the sense of Christian mysticism, but an object worthy of admiration, with an implication of contingency. M. Jardé has given his readers an analysis of the course of events in the various city States in their external relations *inter se* and with other peoples, of their political, social, and intellectual development, of Hellenic expansion and the development of Hellenic unity, which is little short of brilliant. Yet it is difficult to characterise the book as a whole, and gauge its success in achieving its object, for it is a paradox, both as a whole, as the author acknowledges, and also in its parts.

Both anthropologist and geographer may feel that notwithstanding M. Jardé's admirable account of geographical conditions and racial elements, in turning aside to find the answer to his problem in the efforts of man which "turn possibilities into realities," he has perhaps missed the subtler factors of the solution. If to find an explanation in tracing the historical course of events in each State up to the unification of Greece under Macedon be a paradox, it is even more paradoxical to regard the course of events as unconditioned excepting so far as causally connected in succession one to another, when once they have been set in train. After this comment—for it is scarcely a criticism—it is perhaps unnecessary to say that M. Jardé's contribution to the series is both interesting as an analysis of city State history and stimulating, if not provocative, as an exercise in historical method.

Primitive Culture in Italy. By Prof. H. J. Rose. Pp. ix + 253. (London: Methuen and Co., Ltd., 1926.) 7*s.* 6*d.* net.

Mr. Rose's companion volume to his "Primitive Culture in Greece," if introduced into schools, might well serve to eliminate much of the dreariness which teachers of the classics have too often succeeded in introducing into the study of Roman religion and social organisation. Postulating a primitive culture and religious belief in which *mana* is the predominant element—*mana*, Mr. Rose points out, is a conception to which *numen* is closely akin—he shows that in classical Italy religion — the gods, worship, and magic — the calendar, the conceptions attaching to priests and kings, and the organisation of the family and the clan, the ideas underlying the law relating to crimes and torts, property, etc., on analysis yield an element referable to certain primitive conceptions; in other words, that much in the observances of classical times is explicable only as survival from prehistoric times. Mr. Rose's treatment of religion is particularly illuminating, and his suggestion that the practical aim of ritual and

observance was essentially occasional and intended to direct *mana* into profitable channels does offer a reasonably sound explanation of the Roman deities, which stand apart from the circle of deities obviously imported from outside.

Origins of Education among Primitive Peoples: a Comparative Study in Racial Development. By W. D. Hambly. Pp. xx + 432 + 79 plates. (London: Macmillan and Co., Ltd., 1926.) 25*s.* net.

Contrary to popular impression, little boy and girl savages do not live quite a care-free existence, even though they are often more spoiled by their parents than the child of civilisation. The medium of their education often disguises the fact that they are being educated. As with all animals, the early stages of education, largely but not entirely physical, are almost wholly carried on through the play activities—among the boys, mimic hunting, fighting, and care of cattle; among the girls, care of dolls, and simulations of women's work in the field and home. Sometimes instruction may be even more organised and the father will take the boys as his helpers, while the mother requires the assistance of the girls in her work, an appropriate task to be learned at each age. The subject of education among primitive peoples has not been adequately studied, and Mr. Hambly's book serves a useful purpose in gathering together the facts as they have been recorded by travellers and ethnographers. He has brought out very clearly not only the value of the instruction imparted in puberty and initiation ceremonies, but he also emphasises what is apt to be overlooked, namely, the importance of the environmental influence by which the ethical code of the community forcibly, if imperceptibly, impresses itself upon the individual.

Elementary Botany.

Elementary Botany: an Introduction to the Study of Plant Life. By Dr. W. Watson. Pp. viii + 368. (London: Edward Arnold and Co., 1926.) 6*s.* 6*d.*

The number of elementary botanical text-books published in England and America is now so large that it is perhaps not hypercritical to expect that any addition to their number should contribute originality either in substance or in treatment. The text-book before us departs from the conventional type chiefly in its omissions. Thus, although the reader will find the elaters of the liverwort described both as to their structure and function, the fibrous layer of the angiospermic anther receives but passing mention, and incidentally is erroneously figured. Similarly, though the reader will find details of the microscopic structure of the thallus of Xanthoria, he will not grasp those details of the stoma of the flowering plant upon which its action depends.

The description is simple and direct though at times a trifle colloquial, and not infrequently the phraseology does not sufficiently guard against the perpetuation of common errors. Such a statement, for example, as that "respiration is merely a method whereby oxygen can be supplied to the tissues in the working part of the body and the waste carbon dioxide taken away," will, despite the context, probably lead to grave misconceptions in the student's mind. Again, in the description of the tissue elements, in the explanation of Mendel's results, and elsewhere, there appears to be a lack of appropriate emphasis on essentials.

Suggestions for experimental work of a simple character are interspersed in the text, and the physiological and histological aspects are appropriately interwoven with the morphological treatment.

A Practical Introduction to the Study of Botany. (Specially intended for the Use of Indian Students.) By Sir J. Bretland Farmer and Dr. Haraprasad Chaudhuri. New edition. Pp. viii + 300. (Calcutta, Bombay and London: Longmans, Green and Co., Ltd., 1926.) 3 rupees.

It is some years since the original edition of this book appeared. Since then considerable advances in our knowledge have been made which are not adequately reflected in these pages. It is true that the trend of modern botanical progress is recognised by the inclusion of a chapter on ecology and one on evolution and heredity, but, to employ the jargon of the diplomatist, these amount to little more than 'gestures,' since ecology is disposed of in five pages chiefly devoted to an enumeration of Warming's habitat classes, whilst evolution and heredity furnish the subject matter of barely four pages, of which two deal with the familiar Mendelian segregation.

The chief modifications from the earlier edition concern the substitution where necessary of Indian for European types and appropriate modifications in the families considered. Several errors of the original edition remain uncorrected, as, for example, the figure of the vascular system of the dead-nettle, in which the four main bundles are shown in duplicate, and the figure of *Sonchus crispus* which appears as *Sonchus oleraceus*. We may note, too, the absence of ligules from Fig. 154 purporting to represent a longitudinal section of a Selaginella cone. There are also several irritating if minor misprints, and one cannot but regret that the occasion was not taken to revise the work completely and bring it up-to-date.

The Story of the Plants. By Grant Allen. (Hodder and Stoughton's People's Library.) New edition, fully revised and annotated, and with a Biography of the Author by Marcus Woodward. Pp. 200. (London: Hodder and Stoughton, Ltd., n.d.) 2*s.* 6*d.* net.

Grant Allen's "Story of the Plants" is a work which had a considerable vogue at a time when popular books on botanical subjects were comparatively few. In the present abridged edition, although the original text remains unchanged,

except for deletions, the editor has wisely prefaced each chapter by a short introduction correcting some of the errors of which the author was guilty, and placing the text in relation to modern knowledge. There is, indeed, so much at the present day to modify, either in fact or inference, that the interest of the work is largely historical. Grant Allen took considerable licence as to his manner of expression, whilst some of his statements were not always too well based, but the merits of his writings must be judged by the available knowledge at the date of publication. The time has fortunately long since passed when accuracy of description was incompatible with popular appeal, a position which we owe in no small measure to the activity of natural history societies and the growing recognition that a real understanding of biology is an essential part of a liberal education. Many will therefore welcome the opportunity of becoming acquainted at small cost with a work which played a part in the popularisation of natural science some thirty years ago.

Plant Products.

Gum Arabic: with Special Reference to its Production in the Sudan. By H. S. Blunt. Pp. 47 + 22 plates. (London: Oxford University Press, 1926.) 10*s.* 6*d.* net.

THE author, who is assistant conservator of forests to the Sudan Government, states in the preface that he has been persuaded to place on record some of his observations on gum arabic carried out during five years' work in one of the main gum-producing districts of southern Sudan. A perusal of the book gives the reader quite a vivid impression of the local conditions of collection and cultivation, as well as details as to markets, freight, royalties, water supply, etc., and as a more or less informal record of observations made on the spot it will be read with profit by those interested in the gum-arabic trade. The book cannot, however, be regarded as a serious contribution to the scientific aspects of the question. For example, the opening sentence of the section on chemical properties—"Gum may be regarded as a potassium and calcium salt of gummic or arabic acid of the general formula ($C_6H_{10}O_5$)"—scarcely inspires confidence. Reading on, one finds a detailed account of how to dissolve gum arabic in water for the purpose of determining its viscosity, but there is no indication as to how the measurement is made, and, moreover, the figures given to represent the viscosity appear to show that in five cases out of six the viscosity of a 20 per cent. aqueous solution is less than that of a 10 per cent. solution. Again, a paragraph on p. 43 states that "The author has seen and isolated a bacillus both from a solution made from branches of the tree and from the gum itself. In each case the bacterium seen was exactly the same. The organism appeared to be rod-shaped and was extremely mobile." One is inclined to wonder what a bacteriologist would think of such an identification.

In view, however, of the fact that the author modestly states that he is cognisant of the incompleteness of his work, he would probably lay no claim to writing a scientific treatise, but that is all the more reason for either avoiding scientific aspects or else subjecting the manuscript to critical revision by experts. The numerous illustrations at the end of the book add greatly to the interest of the text, though, strange to say, they are but rarely referred to there.

Plant Products. By S. Hoare Collins and George Redington. (Industrial Chemistry Series.) Pp. xiii + 262. (London: Baillière, Tindall and Cox, 1926.) 10*s.* 6*d.* net.

THIS is the second edition of the first author's "Plant Products and Chemical Fertilisers"; the title has now been abbreviated, as the chapters dealing with artificial fertilisers have been slightly curtailed, the subject having been more fully treated in the companion volume, "Chemical Fertilisers." The general arrangement of the book is much the same as before, but the third part has been extended somewhat to include a short account of the main factors operative in the process of photosynthesis, while the fourth part has been modified considerably by the inclusion of modern conceptions of the values of food materials.

Taken as a whole, the book will be found to be most readable and to contain a great variety of interesting information, but in many cases the treatment is distinctly scrappy, and it is to be regretted that some of the facts concerning pectins and mucilages have not been brought up-to-date. The indexing also is very poor; in one case the name Hokkaido of the Japanese University in that place is given as a reference to a paper on acid mineral soils by three authors of entirely different names. It is to be hoped also that the large number of misprints of names of authors, etc., will be corrected in any future edition.

Horticulture.

(1) *The Principles and Practice of Horticulture.* By A. S. Galt. (Text-Books on Agriculture.) Pp. viii + 240. (London: University Tutorial Press, Ltd., 1926.) 3*s.* 6*d.*

(2) *Fruit Growing.* By Prof. W. H. Chandler. Pp. xv + 777. (London, Bombay and Sydney: Constable and Co., Ltd., n.d.) 21*s.* net.

HORTICULTURE is one of the most ancient industries, yet as a science it is a mere babe. Not a few who are engaged in the industry have yet to awake to the existence of the science. Here are two books which should speed up that awakening.

Though written by teachers well known in the horticultural spheres of England and the United States, these two books are in every other respect as different as, let us say, chicory from cherries. (1) Mr. Galt's book is quite in the traditional style (and English, not American, tradition at that), founded mainly on long-established practice, with all too few references to the results of recent research. Even these few are not always so accurate as might be wished; it is to be hoped that

if a second edition is called for, the table on p. 194, vitally influencing as it should the practice of fruit-planters, may at least be corrected. Again and again one is pulled up short by question-begging statements, based sometimes on observation, often merely on long-cherished opinions. How often these traditional views and practices have had to go by the board is shown in the second of these books.

(2) Prof. Chandler has produced as comprehensive a review of agricultural and horticultural research, in their bearing on fruit-growing, as the most exacting reader could demand. His title, however, is somewhat misleading. Though fruit-growers as a body are far more alive and interested in research than they were twenty, or even ten, years ago, there are still very few in whose hands this book could be placed with some hope of its being adequately studied. That it is directed primarily towards those engaged in research is shown in the introduction, which plunges forthwith into a detailed discussion of the reliability of field experiments, the probable error, and other mathematical concepts used by up-to-date research workers, but meaningless to a very large proportion of practical fruit-growers.

Yet much of this book would be easily assimilable by the average fruit-grower if only he could be persuaded to give his mind to the study of it. The author is far from ignoring current practice, but shows wherever possible to what extent it is justified by the results of research; and he is not afraid to show how frequently the results obtained by different workers are contradictory. He even gives more or less satisfactory explanations of these contradictions, and is always careful to give the reader some indication of the probable reliability of each result. The book is concluded by an admirably arranged and most comprehensive bibliography.

Farm Management.

(1) *Farm Calculations and Accounts, including a Thorough Treatment of Agricultural Calculations and of the Business Transactions of the Farm.* By Dr. Arthur G. Ruston and C. Vivian Dawe. (Text-Books on Agriculture.) Pp. x + 222. 3*s*. 6*d*.

(2) *Farm Measurements: a Practical Treatment of Problems in Mensuration.* By Dr. Arthur G. Ruston and C. Vivian Dawe. (Text-Books on Agriculture.) Pp. x + 163. 2*s*. 6*d*.

(3) *Agricultural Surveying, including Mensuration, Road Construction and Drainage.* By John Malcolm. (Text-Books for Agricultural Students.) Pp. vii + 313. 5*s*. 6*d*.

(London: University Tutorial Press, Ltd., 1926.)

The importance of accurate figure work in agriculture, as in costings accounts and measurements of various types, is reflected in the production of text-books specially adapted for the use of farmers and agricultural students.

(1) In "Farm Calculations and Accounts" the preliminary chapters are devoted to a simple exposition of the arithmetical rules, fully illustrated by examples drawn from ordinary farm life. These rules are then applied to such items as household and commercial accounts, valuation and purchase of manures, calculation of costings appertaining to crops, foodstuffs, and livestock. The value of graphs for the diagrammatic representation of facts is indicated, with examples of the various ways in which a graph can be projected. A specially useful feature is a short chapter on the writing of business letters, a matter in which much haziness prevails as to the correct order of procedure.

(2) In their other book referred to above, Dr. Ruston and Mr. Dawe deal with the methods used in obtaining lengths, areas, and volumes associated with farm practice, attention also being given to brickwork and building construction and to matters connected with water supply, work, and power. Measurement of standing timber, spreading of farmyard manure, and estimation of weight of roots per acre are among the special items dealt with in some detail.

(3) Mr. Malcolm's work covers a somewhat different field from the foregoing, in that it includes mensuration, road construction, and drainage. An excellent description is given of methods of field surveying, a point specially to be commended being the mention of many details the knowledge of which makes for smooth and accurate working. The use of the various instruments is well described, and the book should be valuable not only for surveying students connected with agriculture, but also for others.

Estate Accounts. By C. S. Orwin and H. W. Kersey. Pp. vi + 45. (Cambridge: At the University Press, 1926.) 3*s*. 6*d*. net.

The object of estate accounting is to assist in management quite as much as to act as a check to expenditure, but very few books are available which describe desirable methods to be adopted. The present volume aims at presenting a system of estate book-keeping which entails the minimum of clerical labour, and provides the maximum amount of detailed and analysed information. The method suggested is very elastic, and is exemplified by a full year's working of one particular estate, showing all the necessary associated accounts, with the subsidiary books and records in the hands of subordinate workers.

A picture of the financial history of an estate is not easy to visualise from a consideration of the account books for several consecutive years, but it is clearly portrayed by means of graphical representation of the different accounts. Illustrations are given of graphs showing such items as rental, property tax and super tax, tithe rent charges and improvement rent charges, which demonstrate how useful such a method of delineation may be in the hands of estate agents and property owners. It indicates clearly the effect of changes of estate policy, of public policy, and of economic conditions on the fortunes of the estate.

Oil and Ore Deposits.

The Location of Mineral Fields: Modern Procedure in the Investigation of Mineral Areas and the Subsequent Verification of their Extent, etc. By M. H. Haddock. (Lockwood's Manuals.) Pp. vii + 295. (London: Crosby Lockwood and Son, 1926.) 9*s*. 6*d*. net.

THE outstanding merit of this book is that it co-ordinates much useful and practical information scattered through a number of other works. Dispensing with any introductory matter, the author commences to deal with certain geometrical properties of mineral deposits, as dip, strike, depth and thickness of strata, and the determination of these by calculation and by geometrical methods. Two chapters follow on contouring and the form of outcrop and mineral mapping practice. Under borehole surveying, both early and modern methods are discussed; the determination of the dip and strike of a seam by means of three boreholes is taken as a typical practical example and dealt with in all its possibilities. Faulting and folding is treated with the aid of many explanatory figures, and the determination of fault data by calculation is discussed.

The chapter on applied geophysics, a subject on which a separate book is long overdue, deals with the chief physical methods employed for the location of ore bodies, the instruments used, and some applications of these. This chapter is perhaps one of the best available summaries, in English, of the practical details and significance of geophysical methods. It is, however, difficult to see why Germany and Sweden should be persistently regarded as the only countries in which progress in geophysical methods of investigation and prospecting has been made since 1918; important research has been carried out in England, particularly with regard to the Eötvös torsion balance. Chapters on spherical trigonometry and astronomical methods in so far as they concern surveying, and on triangulation, are sound and replete with practical information. The correlation of surface and underground surveys occupies the last chapter.

This book does not concentrate on the theoretical aspects of the problems involved, but attacks each subject from the practical point of view; it is a thoroughly practical disquisition and should commend itself to mining students and others.

E. R. F.

The Geology of Oil, Oil-Shale and Coal. By Dr. Murray Stuart. Pp. ix + 104. (London: Mining Publications, Ltd., 1926.) 7*s*. 6*d*. net.

AN ambitious title, a few bold theories, some sweeping deductions based, perhaps, on slender evidence, the forging of a few weapons of attack for the oil geologist's armoury, one or two critical causeries: these constitute the chief features of this unorthodox little volume. Impressed by the fact that oil deposits "retain no fossil evidence of the origin of the oil" (?), the author is led to the conclusion that in such cases it has probably been deposited along with the sediment according to generally accepted principles of deposition; this, the first hypothesis. Turning next to coal, "each little layer . . . represents an individual sedimentary stratum." This implies that coal does not represent a state of carbonisation of vegetable matter *in situ*, but rather the consolidation of black mud directly transported by rivers from freshwater swamps and laid down normally with sedimentary detritus: thus the second theory, originally formulated by Jukes, resuscitated by the late Charles Lapworth in the course of a lecture in 1906, from which the author acknowledges inspiration in his preface.

Petroleum in dolomitised limestones *ipso facto* disposes of the theory of its sedimentary deposition in such cases; hence these special circumstances are examined and the conclusion reached that foraminifera with specific bacterial aid are the influential contributors, fossils of bottom-living forms being absent. A further hypothesis concerns Burma petroleum and suggests the silicified wood of Dipterocarpus as a possible mother-substance, a theory which has recently engaged the critical attention of L. Dudley Stamp. Thus we reach the author's 'six points' for the oil geologist, wherein attention is directed to dolomitised limestones, as above outlined, to foraminiferal or diatomaceous shales minus bottom-living fossils (diatoms have lately been discounted by American geologists as being fundamental in the mother-substance of the really classical example, the Monterey Shale of California), the lateral variation of coal seams through torbanite to oil-shale or into liquid petroleum (given suitable carbon ratios and geological circumstances), the fossil wood origin of petroleum theory, and lastly, the association of oil with dynamically disturbed marine coals.

A penultimate digression discourses on oil in Great Britain (an unhappy subject), future development in Burma, possibilities in north-west India and Australia. The valedictory is, curiously, on "Speculative Geology." But surely the whole book is essentially this? At all events, given a similar frame of mind, the reader will probably not find his time wasted.

Popular Astronomy.

Modern Astronomy: its Rise and Progress. By Dr. Hector Macpherson. Pp. viii + 196. (London: Oxford University Press, 1926.) 6*s*. net.

THIS little book consists of a series of ten lectures delivered by the author as Thomson lecturer in natural science for the session 1925–26 at the Aberdeen United Free Church College. The subject matter of modern descriptive and physical astronomy is treated historically, particular attention being given to those ideas of earlier times from which modern ideas have most directly developed. The period covered by the survey extends from the time of Copernicus up to the present day. Prominence is given to the views, not only of the recognised leaders in the subject, but also of some of those whose conclusions are less widely accepted and have, perhaps, not

received the attention which they deserve. Quotations occur frequently throughout the book.

The treatment is lucid, interesting, and in the main accurate, and the book should prove useful, especially to amateurs with little time for a detailed study of the subject. Those with a slight previous knowledge of astronomical ideas and nomenclature will receive the greatest benefit from its perusal. There are a few mistakes which are not of the first importance, but should be removed in possible future editions. Thus on p. 96 it is stated that Lebedeff verified the *law* of radiation pressure, and on p. 123 Eddington's theoretical researches are said to have *confirmed* the pulsation hypothesis of Cepheid variation. The book is well produced and pleasant to handle, but would have been much improved if the proofs had been read more carefully. There are several misprints which make meaningless the sentences in which they occur, and in one instance at least (p. 110) a false meaning is given when the distance of 61 Cygni is recorded as about forty million (instead of billion) miles. On the whole, however, the book is substantially trustworthy, and can be recommended to those requiring a book of its type.

(1) *The Romance of Comets.* By Mary Proctor. Pp. xiii + 210 + 16 plates. (New York and London: Harper and Bros., 1926.) 7*s.* 6*d.* net.
(2) *Legends of the Sun and Moon.* By Mary Proctor. Pp. 159. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 1*s.* 3*d.*

(1) "The Romance of Comets" is essentially a book for leisure reading, and is written primarily for those possessing little or no knowledge of elementary astronomy. Throughout, considerable space is devoted to anecdotes and reminiscences, most of which contribute materially to the readableness of the book, although one or two are interpolated rather unnecessarily. The titles of the nine chapters indicate the scope of the contents, as, for example, (1) comets as portents, (4) comets in distress, (6) return of Halley's Comet in 1910, (8) meteor streams. Chap. ii., "Comet-Hunting as a Hobby," which contains a delightful account by the late Prof. Barnard of "The house that was built with comets," should win more than one reader to the ranks of amateur astronomers.

In spite of the use of simple language and several helpful analogies, some passages are obscure or convey a wrong meaning (pp. 15, 83-84, 95, 121). The introduction of "Hints for Amateur Photographers," pp. 83-91, is somewhat pointless, as the reader on perusal will be led to infer that the equipment required for cometary photography lies far beyond his means. A few misprints have been passed, the most important being in the footnote on p. 125—*for* 1965 *read* 1985. The type is pleasant to read, and the illustrations are good. On the whole, it may be said that this book will be read with pleasure and interest by those who wish for a simple account of these remarkable objects to which astronomers have devoted so much study and patient observation since the time of Edmund Halley.

(2) In "Legends of the Sun and Moon" Miss Proctor has produced for young readers an interesting collection of myths, superstitions, and customs relating chiefly to the sun and moon.

Relativity.

(1) *Readable Relativity: a Book for Non-Specialists.* By Clement V. Durell. Pp. vii + 146. (London: G. Bell and Sons, Ltd., 1926.) 3*s.* 6*d.* net.
(2) *From Kant to Einstein.* By Hervey de Montmorency. Pp. iii + 39. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1926.) 2*s.* 6*d.* net.

(1) The title of Mr. Durell's book is somewhat misleading. The book is readable only to those whose familiarity with algebra approaching matriculation standard is very intimate, for it abounds in simple mathematical formulæ. However, for such inquirers it is certainly very readable, and is one of the best expositions of its kind that we have seen. The fundamental principles of the theory are very clearly explained, and almost every general statement is illustrated by a good numerical example, for which many readers will be very grateful. Each chapter concludes with a number of test questions, of which the answers are given at the end of the book. The treatment in parts is perhaps too detailed; thus the deduction of the Fitzgerald-Lorentz equations of transformation occupies eleven pages, although mathematical symbols are used and all the necessary preliminary ground has previously been covered. This tends to obscure rather than to illuminate.

We must dissent from Mr. Durell's statements that the progress of modern astronomy "is due entirely to the successive aids that inventions have given in supplementing the powers of naked eyes and naked hands" (p. 8), and that whenever the separation between two events is real, "there is some causal connection between the events" (p. 77). On the whole, however, the book has given us great pleasure, and can be confidently recommended as a trustworthy and interesting guide to Einstein's theory. This applies particularly to the account of the restricted theory of relativity, to which about five-sixths of the book is devoted.

(2) Mr. de Montmorency's book appears to be a not wholly intelligible attempt to judge Einstein's theory of relativity by the standard of Kant's philosophy. As he puts it: "Kant's doctrines may serve as a canon for judging Einstein's propositions." The chief point seems to be that time cannot be "subordinate to space," as Minkowski and Einstein are said to make it. Mr. de Montmorency insists upon the fact that Einstein is not a metaphysician (without, however, apparently realising that his theory is a scientific and not a metaphysical one); he states that if he were, "he would choose his language with more care," and asserts that "many of Einstein's arguments are open to criticism and contain internal evidence of carelessness." These remarks, however, fail to carry much weight when their author tells us that "Newton accounts for the orbit of a planet

thus: its path is the resultant of two forces; (1) the force from which its initial velocity was derived; (2) the force of gravity pulling it towards the sun." When, a little later, we read that plane Cartesian equations "are always in two unknown quantities and of the second degree," and that by introducing a third co-ordinate we can form the equation to a spiral which "will be in three unknown quantities and of the third degree," our respect for his criticism dwindles to vanishing point. The book concludes with an appendix consisting of "a few Lorentz-Einstein equations of transformation." H. D.

Laboratory Physics.

High Vacua. By Dr. G. W. C. Kaye. Pp. xii + 175 + 4 plates. (London: Longmans, Green and Co., Ltd., 1927.) 10*s.* 6*d.* net.

Vacuum technique is becoming as popular a subject as relativity, but it offers less scope for originality of treatment. Dr. Kaye's book, containing his Cantor Lectures, is later than the others, and therefore contains a few things that his predecessors omit; it is shorter, and therefore omits many things that they contain. It seems to be equally accurate; the section on vacuum pumps—not in our opinion the most important aspect of the subject—is especially complete. The question whether it meets any demand not yet adequately met is one for the publishers rather than for the reviewer.

Notes on Practical Physics: for Junior Students. By Prof. C. G. Barkla and Dr. G. A. Carse. Second edition. Pp. xii + 119. (London and Edinburgh: Gurney and Jackson, 1926.) 6*s.* 6*d.* net.

The second edition of the "Notes on Practical Physics" used by junior students in the University of Edinburgh does not differ greatly from the first. Some experiments have been added in the section on electricity, and corrections have been made. There is an interesting section on treatment of observations and determination of error—a somewhat unusual feature in a book of this standard, but one which is to be welcomed. The tables of physical constants at the end of the volume might well be revised and brought up-to-date.

General Physics for the Laboratory. By Prof. Lloyd W. Taylor, William W. Watson and Prof. Carl E. Howe. Pp. vi + 247. (Boston, New York and London: Ginn and Co., 1926.) 2.40 dollars.

The feature of this attractive volume which first compels the reader's attention is the excellent series of half-tone illustrations from photographs, showing the apparatus set up, ready for use, including all minor auxiliary instruments. The authors point out that this plan does away with the necessity for a detailed description of the apparatus.

The book forms a text-book of practical physics containing nearly fifty experiments covering a course such as might be followed by a student working for a pass degree in Great Britain. An account of the theory of each experiment is given, and the laboratory instructions are formulated in an unusually specific and detailed way. This method is defended by the authors, who point out that even instructions such as these are not too easily followed by a student entering on an unfamiliar field of manipulation. One question, however, suggests itself: Does the carefully drilled student turned out from a modern highly equipped and carefully organised laboratory possess the initiative and resource of his less fortunate predecessor, who was 'thrown in at the deep end'? Granting the position assumed by the authors, the book is excellent and well planned, containing many novel and ingenious experiments. Special mention may be made of an experiment for finding the acceleration due to gravity by means of a freely falling weight, the position of which is registered on a strip of paper by electric sparks jumping at regular intervals.

The statement on page 211 that the Nicol prism was invented by "the German physicist Nicol" requires correction. William Nicol of Edinburgh, who describes himself as a lecturer on natural philosophy, published a description of his polarising prism in the *Edinburgh New Philosophical Journal* in 1829.

General Inorganic Chemistry.

General Inorganic Chemistry. By Prof. M. Cannon Sneed. Pp. vi + 674. (Boston, New York and London: Ginn and Co., 1926.) 12*s.* net.

The author has made an excellent attempt to "reach a proper balance between descriptive and theoretical matter" in this work, and although undue prominence is given to the work of the American Chemical Warfare Service, the book provides a good introduction to the subject. The description of the commoner elements, though not overloaded with detail, deals with essential points, and the simple diagrams, especially those of industrial processes, are admirable. Brief accounts are also given of many of the rarer elements. This descriptive work is relieved at intervals by short historical notes, with excellent full-page portraits of outstanding personalities, and by chapters on such topics as electrolytic dissociation, the structure of the atom, thermochemistry, ionic equilibria, colloids, chemistry in living processes, radioactivity, etc. The beginner may be confused by the use of the two units of volume, the cubic centimetre and the millilitre, and by the inaccurate *definition* on p. 125 of atomic weight as the least weight of the element in a molar volume. Nor will he easily grasp the difference between an ordinary current of positive electricity and the current of electrons on p. 642, but on the whole the style is clear.

No misprints have been noted, but there are a few grammatical faults, *e.g.* 'there are a great variety of them' (p. 480). Such words as 'typal,' 'inhomogeneous,' and 'reactant' have an unfamiliar sound. Aluminium and niton have been re-named aluminum and radon, whilst elements

Nos. 43, 61, and 75 are boldly called masurium, illinium, and rhenium respectively, and a formula is given for the still unknown carbonate of aluminium.

A Text-Book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. (Griffin's Scientific Text-Books.) Vol. 3, Part 2: *Beryllium and its Congeners.* By Joshua C. Gregory and Dr. May Sybil Burr (née Leslie). Pp. xxvi + 342. 18*s.* net. Vol. 7, Part 3: *Chromium and its Congeners.* By Reece H. Vallance and Arthur A. Eldridge. Pp. xxvi + 380. 18*s.* net. (London: Charles Griffin and Co., Ltd., 1926.)

THE two new sections of Dr. Friend's "Text-Book of Inorganic Chemistry" deal respectively with (i) beryllium, magnesium, zinc, cadmium, mercury, and (ii) chromium, molybdenum, tungsten, and uranium. They conform so closely to the pattern already established by earlier volumes of the series that very little special comment is called for. It may, however, be said that the type to which the successive volumes conform with increasing definiteness is that of a work of reference, which contains an array of facts which makes it almost impossible for the casual reader to discover any sections which can be read consecutively with any degree of enjoyment. For this reason, indeed, it appears likely that many of those who appreciate at their full value the merits of the "Text-book" will put the new volumes in their appropriate places on the shelf without attempting to 'read' them, but with the definite object of referring to them when a suitable opportunity arises. It may perhaps be regretted that the general editor of the series has discouraged his contributors from 'letting themselves go,' since the whole work might have been transformed by the introduction of a number of chapters in which the individuality of the authors was allowed to stand out, especially when dealing with the more exhilarating topics.

A Systematic Qualitative Chemical Analysis: a Theoretical and Practical Study of Analytical Reactions of the more common Ions of Inorganic Substances. By Prof. Geo. W. Sears. Second edition, revised. Pp. x + 165. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 10*s.* net.

THIS book commences with a brief account of the ionic theory of solution together with the laws of mass action and solubility products, and continues with the systematic analysis of cations and, finally, anions. The subject matter contains no new methods of analysis, but is based on the methods of Treadwell and similar standard works. The first section, dealing with mass action and solubility products, has been well written and is easily understood. The later sections, however, are in places somewhat confusing to the beginner. Statements such as "treat the filtrate by (10) and the residue by (2 c.)," or "treat the filtrate by (20). If there is a residue . . . treat by (7)," which are very common throughout the book, do not make the scheme of analysis easy to follow. The book does not seem to have any advantage either in price or subject matter over the numerous other works on this subject.

Organic Chemistry.

A Student's Manual of Organic Chemical Analysis: Qualitative and Quantitative. By Prof. J. F. Thorpe and Prof. M. A. Whiteley. Reissue with Appendix on New Methods of Organic Analysis, by H. ter Meulen and J. Heslinga. Pp. x + 250. (London: Longmans, Green and Co., Ltd., 1926.) 9*s.* net.

IT is an indication of the value of this work that a reprint has been required so soon. The new issue differs from the original volume reviewed in NATURE, Nov. 14, 1925, p. 707, in one particular only. At the end of the book there is added an appendix of 41 pages by H. ter Meulen and J. Heslinga on improved methods of ultimate analysis. These authors find that, if manganese dioxide is used instead of copper oxide, a lower temperature of combustion can be employed with resultant economy in tubes, etc. They describe a method whereby oxygen can be estimated by hydrogenation and absorption as water, allowance being made for unchanged carbon dioxide which is absorbed by soda lime. Nitrogen is estimated either by hydrogenation, using powdered nickel at 250° as a catalyst and titration of the ammonia produced, or by combustion with manganese dioxide and collection as nitrogen. Similarly, sulphur and the halogens are estimated by hydrogenation to the volatile acids. From the particulars given, several of the methods seem a considerable advance on those usually employed. The reviewer again recommends this book to all students.

Theoretical Organic Chemistry. By Dr. Francis Arnall and Francis W. Hodges. Part 1. Pp. xi + 372. (London: J. and A. Churchill, 1926.) 10*s.* 6*d.* net.

THIS book has been written on the usual lines of organic chemistry text-books, but suffers from a desire to include too much information in too small a space. An endeavour is made to teach organic chemistry from the beginning to pass degree standard in 360 pages. The result is that a certain amount of explanatory matter has been omitted and the student will probably fail to obtain a clear and intimate knowledge of the subject without further assistance. For students preparing for examinations it is, however, eminently suitable, since it is remarkably extensive in scope, contains nothing unessential, and is quite up-to-date. Not only are the principal types of organic compounds described with the reactions, identification, and commercial application of their simpler representatives, but also there are chapters on synthesis, isomerism, tautomerism, stereoisomerism, ultimate analysis, molecular weight determination and estimation of typical groups. We have noticed that while a description of synthol is given, no

mention is made of the more important commercial synthesis of methyl alcohol. The description of methylated spirits (p. 53) is inaccurate. Other errors noted are the formulæ of nitrolime (p. 98), phenyl isocyanide dichloride (p. 103), citric acid (p. 158), anthranilic acid (p. 318), while Liebermann is misspelt on p. 121.

Dyestuffs and Coal-Tar Products: their Chemistry, Manufacture and Application. By Thomas Beacall, Dr. F. Challenger, Dr. Geoffrey Martin and Dr. Henry J. S. Sand. (Based on Chapters appearing in "Industrial and Manufacturing Chemistry: Organic.") Fourth edition revised. (Manuals of Chemical Technology, 1.) Pp. xi + 168. (London: Crosby Lockwood and Son, 1926.) 16*s.* net.

This book forms one of a series of manuals of chemical technology compiled with the object of giving concise but sufficient information concerning the manufacture and utilisation of chemical products of great industrial importance. The first edition was produced during the critical year of 1915, when "the lack of an English book on the subject, the sudden stoppage of the supply of German fine chemicals, and the preparations of the British Government for the establishment on a large scale of the synthetic dye industry in this country, all combined to provide opportunity and justification for the appearance of the book." The authors were not disappointed in their object; the book met with a ready appreciation, and has now reached its fourth edition.

Within the limits of 156 pages a mass of valuable and accurate information is comprised dealing with: (1) coal tar and coal-tar products; (2) the synthetic colouring matters; (3) natural dyestuffs; (4) the dyeing and colour-printing industry; (5) modern inks; (6) saccharin and other sweetening chemicals; (7) modern synthetic drugs; and (8) photographic chemicals. Each of the eight chapters is prefaced by a list of the titles and authors of standard works on the subject dealt with therein, and contains a short historical or descriptive introduction, and usually also some statistical data.

In the preface to this edition the authors refer to the strenuous efforts that have been made since 1915 in Great Britain and other industrial countries to establish dyestuffs and allied industries on a scale commensurate with national needs; and they express the hope that this new position is reflected so far as is possible within the modest limits of their book. A critical examination of the new edition from this point of view is on the whole disappointing; many of the manufacturing processes described have long been obsolete, as, for example, the preparation of ketones (p. 22), of saccharin (p. 125), and of indigo (p. 51); and, further, no statistical data later than 1913 are included. But this book is evidently not written for the critical reader, otherwise the fairly numerous errors in nomenclature and formulæ that crept into the first edition could not have escaped correction in the fourth. M. A. W.

Clinical Laboratory Methods.

A Manual of Clinical Laboratory Procedure: for the Use of the General Practitioner. By Dr. Robert A. Kilduffe. Pp. 287. (London: Henry Kimpton, 1926.) 12*s.* 6*d.* net.

It is regrettable that the value of clinical laboratory investigations is not realised by many physicians; anæmia is sometimes treated for months without a blood-count having been carried out; dyspeptics are rarely given a test-meal before necessity compels them to be referred to hospital or consultant, and many cases of nervous and mental disorder reach a comparatively advanced stage before lumbar puncture is performed. It is easy to find the reasons for this neglect. The average general practitioner has little time to spare for the laboratory, and expense frequently prohibits consultation with a pathologist. There are, however, many laboratory tests which can easily and rapidly be carried out by the practitioner himself. The object of Dr. Kilduffe's book is to indicate those which are likely to be of value and to assist in the interpretation of their results. There could not be a better manual for the physician who is willing to devote a little time to laboratory work.

Of particular interest are the chapters on the equipment of the laboratory and home-made laboratory devices, though the limitation of the use of such an instrument as the home-made colorimeter must be borne in mind. The arrangement of the book is that usually adopted for laboratory manuals; there are chapters on urine, blood, gastric contents, cerebro-spinal fluid, etc., in which the appropriate tests are described. Few individual methods are given under each heading, the object being to indicate only those most likely to be of value to the practitioner. The discussion of the results and their interpretation is valuable, but more stress might have been laid on the association of the presence of lactic acid with achlorhydria in the diagnosis of gastric cancer. The indexing is not very complete, but a list of common diseases and clinical conditions with suggested laboratory investigations will be a useful guide to the physician.

Laboratory Outlines in Bacteriology and Immunology. By Prof. John F. Norton and Prof. I. S. Falk. Pp. viii + 114. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1926.) 10*s.* net.

The matter of this small book is in strict accord with its title; it is a programme of work for a course of instruction in bacteriology, serology, and immunology. Few details of actual work are given, and the book is essentially one for the teacher and may be a helpful guide to him, though of course any teacher worthy the name will arrange his own courses of instruction. The sections seem to be well devised and to cover most of the problems of pathological and medical bacteriology, but agricultural bacteriology is scarcely touched. The contents conform with American practice; thus, we find no mention of "carbolic acid coefficients"

under disinfection, or of the "Dreyer method" under agglutination. Directions are given for the preparation of the dye for Leishman's stain, which is now stocked by all dealers, and the impression is given that students are unrestricted in the performance of experiments on animals. A book of this kind must necessarily have a limited circulation, hence perhaps its high cost. R. T. H.

Technical Electricity.

Electric Circuit Theory and the Operational Calculus. By John R. Carson. Pp. ix+197. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s*. net.

THIS book is the outcome of a course of lectures given by the author in 1925 to the University of Pennsylvania. After a brief introduction to electric circuit theory, a critical exposition is given of the Heaviside operational calculus. It is pointed out that Heaviside's method is known to and employed by only a few specialists. This is partly due to the intrinsic difficulties of the subject and to obscurities in Heaviside's own exposition. In the present work the Heaviside rules are deduced from an integral equation.

The second part of the book deals with the propagation of current and voltage in transmission lines and wave filters. The simplest of the transmission systems is the non-inductive cable, the theory of which was given in Kelvin's early work on the possibility of trans-Atlantic telegraphy. In particular, the physical phenomena can be studied best, as the author shows, when we consider an infinitely long cable. We are sorry that the skin effect in cylindrical cables and the eddy current losses in them are not dealt with, as they give such an excellent illustration of Heaviside's methods.

The author considers that Heaviside overestimated the value of power series in solving problems. In particular he objects to Heaviside criticising those mathematicians who prefer solutions in the form of definite integrals. It is possible that power-series solutions have only a restricted utility in some cases and that definite integrals have proved useful when suitable tables are available. We think, nevertheless, that Heaviside's criticism was justified. Poisson, for example, expressed the capacity coefficients of two spheres as definite integrals, and Dr. Barnes, now Bishop of Birmingham, expressed them as double gamma functions, but when engineers want their values they use series formulæ or interpolate from Kelvin's tables. The book can be recommended to mathematical physicists.

Alternating Current Rectification and Allied Problems: a Mathematical and Practical Treatment from the Engineering View-Point. By L. B. W. Jolley. Second edition, revised and enlarged. Pp. xxii+472+27 plates. (London: Chapman and Hall, Ltd., 1926.) 30*s*. net.

WE were pleased to see that a second edition of this book has now been published. Whilst alternating current seems to be almost universally used in large power stations, there is a considerable demand for direct current for auxiliary and control circuits. To obtain this current it is now usual to employ some form of rectifying apparatus. The rectified current is generally pulsating, and it is necessary to know the magnitude of the ripple in it. The author, therefore, starts by giving an account of Fourier's theorem and the methods employed in practice to find the harmonics. From the engineer's point of view this chapter will be found very satisfactory.

Recent improvements in the design and manufacture of all kinds of rectifiers have been noted in this edition. There are also three new chapters on the installation of thermionic rectifiers, on radio supplies, and on inverters. It is pointed out that while the mercury rectifier is essentially a heavy current low-voltage device, the thermionic rectifier is a high-voltage device, and can only be efficiently used when the rectified voltage is of the order of thousands of volts.

The chapter on radio supplies will be of interest to all broadcast receivers. When the house is supplied by alternating current, a rectifier can be used to charge the batteries generally used with a receiving set. In most cases the interest per annum on the capital outlay of a rectifier is less than the cost per annum of charging the batteries by sending them to a local contractor. Where direct current supply is available, the charging can be easily done, but care must be taken not to earth the companies' mains. This can be provided against by inserting a two-microfarad condenser between the radio set and the earth.

Elements of Alternating Currents and Alternating-current Apparatus. By Prof. J. L. Beaver. Pp. 370. (New York and London: Longmans, Green and Co., Ltd., 1926.) 18*s*. net.

THIS book proves that alternating-current theory is settling down into orthodox lines. It is written partly to help the average student and partly to help the more ambitious student who is anxious to master the complete theory. Numerous examples are given at the end of many of the chapters which the ordinary student will not have much difficulty in doing. There is a 'snap' about some of these questions which we miss in Great Britain. For example, p. 67: "Prove that $L\frac{di}{dt} = \ldots = \text{what?}$" p. 213: "The exciting current is what per cent. of the name-plate current?"

The capacitance (capacity) of a conductor is defined, but the capacitance of a condenser is not. We do not agree with the author when he says that effective current, effective voltage, and average power are not ordinary algebraical quantities and cannot be handled by ordinary algebraical methods. We think that they are perfectly real numbers. If we want to combine alternating currents and voltages, we have to use the parallelogram law, but the effective values of the components and their resultants are real numbers. The author has been successful in simplifying considerably the theory of polyphase currents and machines. If we neglect

the 'losses' in a machine we get, as a rule, a clear idea of the principle of its working, and we can then gradually build up a more accurate theory. This method is to be commended.

Use of Electric Power.

Electric Trains. By R. E. Dickinson. Pp. xii + 292. (London: Edward Arnold and Co., 1927.) 16*s*. net.

THERE are few industries in such a rapid state of development as electric traction, and there are few in which the literature of the subject is, comparatively speaking, so small. Some of these books are quite out-of-date; others are too advanced, demanding a knowledge of mathematics that few possess; and others contain little beyond a great mass of statistics and data which, while useful to the specialist, are of little help to students and ordinary railway engineers. This book is specially written for the latter two classes and will prove helpful.

To meet the ever-growing competition of tramway and motor-bus traffic, it is necessary to speed up the trains on suburban lines. With steam-hauled trains the acceleration is rarely so great as "half a mile per hour" per second, whereas an acceleration of 1·5 m.p.h. per second can easily be obtained by electric traction. Slipping of the wheels takes place much more readily with steam-operated trains, owing to the pulsating nature of the tractive force. There is also much less wear of the rails when the trains are operated electrically.

The author's chapter on the mechanics of train movement can be readily understood by any one having an elementary knowledge of mechanics. The control systems and the methods of making rheostatic calculations are clearly described. Train resistance curves are given, so that even although this resistance varies considerably with local conditions, useful approximations can be made. It will be remembered that the Advisory Committee appointed by the British Ministry of Transport reported in favour of standardising the supply pressure at 1500 volts direct current. From the data given, it appears that in practice modern railway engineers prefer this system to the single-phase system.

The Use of Power in Colliery Working: a Treatise on Mining Costs and Machinery Designs and Management. By John Kersopp. Pp. xxviii + 580. (London: H. F. and G. Witherby, 1926.) 40*s*. net.

DURING the past twenty-five years, mining engineering has been revolutionised by the substitution of power for hand labour in the majority of the operations involved in the winning and working of collieries, and we seem to be within sight of the time when the pick and the shovel will have a place in the museum only. It is perhaps inevitable that the advent of machinery should have led to a slackening of physical effort on the part of the manual worker, so that the net result is that the output per man-shift has remained stationary. Some idea of the variety of machinery at the command of the miner is given by the book under review, but it is by no means an exhaustive treatment of the subject. For example, little or no reference is made to compressed air (an important omission) or to ventilating machinery. Nor is any attempt made to describe banking out or screening arrangements at the surface, amongst which certain modern devices such as decking machinery are of great interest at the present time.

Little attempt is made to explain the mechanics of the machinery described. The chapter on winding engines would have had more value had moment diagrams been given for the principal types of winding engines, and the chapters on pumping would have been similarly improved had the characteristic curves of the different types of pumps been illustrated. In the descriptions of electrical plant there is no reference to the synchronous induction motor, or to the cascade, or A.C. commutator motor. The book indeed appears to be largely a collection of catalogue descriptions and illustrations of a medley of types of apparatus. It contains a considerable mass of useful information badly digested. The use of many photographs showing external details only, and the lack of diagrams illustrating important features, militates against its usefulness. Moreover, the invidious practice of singling out the names of certain firms for special mention is to be deprecated.

At the end is given supplementary information on the various chapters, but it is difficult to understand why these were not included in the chapters themselves. Appendices giving useful information as to fluctuations in costs of materials, wages, etc., are given, but their connexion with the subject matter of the book is not clear. The book contains useful information but will have a limited utility. DOUGLAS HAY.

Miscellany.

Organised Publication: a Connected Series of Proposals relating to the Publication and Record of Scientific and Technical Information. By J. F. Pownall. Pp. 91. (London: Elliot Stock, 1926.) 5*s*. net.

MR. POWNALL'S work is a plea for the international standardisation of scientific literature in respect of page size, spacing of perforations of sheet or leaf, the definition of subject headings in terms of an international code, and the prefixing of the standardised subject headings to each article. Scientific literature, in short, is to be built up from standardised units to be circulated temporarily in volume form, but ultimately to be resolved into unit form and to be housed in temporary binders.

Within recent years some progress has been made in the direction of the standardisation of the pages of the higher class of scientific periodicals, both as regards the quarto and octavo sizes. As the movement appears to have slowed down, it is probable that scientific workers are content with the progress realised and that present methods of publishing the *Proceedings*, etc., of the learned societies are sufficient for economical filing. It is, of course, difficult to say precisely how far size standardisation should be pushed; but it is

tolerably clear that works of the same bibliographical type and dealing with the same or cognate subject matter should be issued in substantially the same size and style. The Patent Offices of the world have long accepted the imp. 8vo size for their specifications—with great benefit to their users; but trade catalogues continue to be issued in oblong folio and other strange sizes which defy classification and shelf arrangement. The trend of book classification is, no doubt, toward uniformity; but this is due, not to any great or general enthusiasm for uniformity on the part of librarians, but to their appreciation of the fact that advanced schemes of book classification—and nowadays elementary schemes are retained only in the smaller libraries—must emanate from libraries which possess the requisite material, training, and financial support. It is, however, doubtful whether these advanced schemes of classification are suitable for the analytical treatment of the contents of periodicals.

Mr. Pownall has, we think, concentrated his attention too closely upon the mechanics of classification. His proposals go far beyond the merits of the case which undoubtedly exists for further standardisation. Publishers have to consider the wishes and prejudices of their clients. No book-lover would accept a book which contained, in addition to the wounds inflicted by machine sewing, the standardised perforations of Mr. Pownall.

The Radcliffe Infirmary. By Alexander George Gibson. Pp. xi+316. (London: Oxford University Press, 1926.) 18*s.* net.

Dr. A. G. Gibson, who for many years has been attached to the staff of the Radcliffe Infirmary, Oxford, has given us in the present volume a lively and richly documented account of the history, management, staff, and activities of this institution. Founded in 1759, but not opened to patients until more than ten years later, the Radcliffe Infirmary has always been one of the leading provincial hospitals in England, and, owing to its association with the University of Oxford, occupies a prominent position in medical education. From the very first it was recognised that the Infirmary was to provide opportunities for the study of disease for the future medical graduate. In 1913 the teaching of pathology as a university subject was inaugurated by Sir John Burdon Sanderson, with the result that considerable improvement took place in the mortuary accommodation at the Infirmary. Since the War the whole of the medical staff of the Infirmary has contributed towards university teaching, including the Regius professor of medicine, who occupies the post of consulting physician.

To many the most attractive part of the work will be the biographies of the various members of the medical staff, which numbered among others John Kidd, James Ogle, Charles Daubeny, William Greenhill, Sir Henry Acland, George Rolleston, and Sir William Osler. From the concluding chapter we learn that within the last forty years several new departments have been added to the Infirmary, such as the Dental Department in 1886, the Dermatological and Ear, Nose, and Throat Departments in 1906, the X-ray Department in 1907, the Pathological Department in 1913, and the Orthopædic and Neurological Departments in 1918. The appendix contains, among other items, lists of legacies from 1761 to the present time, preachers of the Radcliffe Infirmary sermon from 1771 to 1862, and members of the committee of management from 1848 to 1921.

Shipbuilding and the Shipbuilding Industry. By J. Mitchell. (Pitman's Common Commodities and Industries Series.) Pp. xi+116. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 3*s.* net.

For the student of naval architecture and shipbuilding there are many text-books. With these this little volume is not intended to compete. It is written almost entirely for the layman who wishes to gain an insight into the position of the shipbuilding industry, the organisation of a shipyard, and the work involved in the designing, building, and fitting-out of ships. In many industries there are technical matters of general interest, and here the reader will find clear explanations of some of the methods of the drawing office and building slip.

The author is himself a shipyard manager and also a teacher, and the headings of some of the chapters indicate his method of treatment. After a brief review of shipbuilding statistics, he deals in turn with types of ships, the shipyard, the designing and the building, launching, and maintenance of ships. There are few more anxious moments than those prior to a launch. A mishap may be disastrous, as was the case of the *Independencia*, launched on the Thames in 1874. Mackrow, who launched so many fine ships at Blackwall, used to say that he never thought of a launch without the *Independencia* appearing like a phantom before his eyes. As Mr. Mitchell says, launching a ship is not a 'pretty-pretty' spectacle got up as an episode in its career, but "the real matter is the serious problem of shifting a weight of some thousands of tons through several hundred feet by means of innumerable pieces of wood and a few hundredweights of soft soap and tallow." His description of the methods employed is one of the most interesting things in the book.

The Book of the Aeroplane. By Capt. J. Laurence Pritchard. Pp. 255+24 plates. (London: Longmans, Green and Co., Ltd., 1926.) 7*s.* 6*d.* net.

Captain Pritchard's book is written with the advantage of a good deal of personal experience. It does not profess to deal in any detail with pre-War flying, but gives a very full account of the present position of heavier-than-air machines. Whether these will eventually be called 'airplanes' rather than 'aeroplanes' remains to be seen, though there is a tendency to substitute the former term in some quarters. The author makes an interesting forecast of future developments, which will, in his opinion, be eventually much more pacific than warlike. The book is profusely illustrated and contains a useful glossary.

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