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CONTENTS

Road Traffic Research

THE heavy toll of accidents on the roads in Great Britain, averaging at present about 20 fatal accidents and 590 non-fatal accidents a day, has at last thoroughly aroused public opinion, and the recent imposition of a speed limit of 30 miles an hour in built-up areas is the latest attempt to reduce the appalling toll of these accidents. Important as the question of accidents may be, it is not the crux of the road traffic problem, and as Mr. Mervyn O'Gorman pointed out in his lecture to the British Science Guild last December, which has recently been made available as a pamphlet*, an approach to the problem from this angle may lead to serious if not highly dangerous errors.

The critical factor is the relation of road accidents to the magnitude and importance of road transport as a whole. The figures supplied by Dr. K. G. Fenelon in his paper to the Royal Statistical Society on February 19 show that in the sixteen years since the War, road transport has developed out of all recognition, and has had repercussions on the whole economic and social structure of Great Britain. It is already one of our major industries, providing a livelihood for 690,000 persons. In 1933, more than 2¼ million motor vehicles were in use ; something like a quarter million workers were employed in the construction and repair of motor vehicles ; exports produced by the motor industries amounted to about twelve million pounds sterling ; 5,400 million passenger-journeys were undertaken on public service road vehicles which operated some 1,300 million vehicle miles. About fifty-four million pounds sterling were expended on highways and bridges, and nearly sixty-nine million pounds gross were raised from motor taxation of all kinds.

Motor transport is thus firmly established as an essential and co-ordinate part of our national transport system, and not as a mere subsidiary or auxiliary of the older forms of transport. It is as much a public utility service as water supply or drainage, but as yet there has been no corresponding expenditure from the revenue raised from the industry on the scientific research essential for determining the adequate quantity of roads, their economic lay-out or the wise control and guarding of the traffic. Mr. O'Gorman's plea for the scientific study of the traffic problem gives a

* Bringing Science into the Road Traffic Problem. By Lieut.-Colonel Mervyn O'Gorman. Pp. 36. (London : British Science Guild 1935.) 1*s*.

picture of the services which science can render and of the dangers which attend legislation based on unscientific or haphazard experiment.

The tragic position of the road traffic problem at the moment and the sterility of all attempts to diminish accidents, whether by motor control, registration, insuring, licensing or deterrent enactments, are due primarily to the omission to base legislation on scientific experiment and definite facts. In the absence of such study, well-intentioned legislation is apt to have consequences and repercussions widely different from or even opposed to those for which it was designed. It is no longer rational to regard road transport as mainly competitive with the railways. It is a complementary system providing a flexibility of paramount importance to certain classes of goods and industry, and any attack on the accident problem which impairs the efficiency of road transport as a whole might well be a national disaster.

Despite the attention directed to road transport in the last few months, opinions as to the goal at which we are aiming or the improvements to be effected are often confused, and agreement as to what constitutes improvement has yet to be secured. The subject is often discussed as if the mere reduction of accidents, irrespective of the volume of road traffic, were an end in itself, even if achieved by driving all traffic off the roads. No more important point was made by Mr. O'Gorman than his suggestion that our objective is to obtain an ever-diminishing fatality ratio, and only to achieve this under conditions or rules which will not block whatever expansion of safe road traffic the economy of the State may require from time to time.

In the wide field for investigation which road traffic offers, certain subjects such as the examination of drivers, dazzle road illumination, skidding, noise, vibration, emission of dangerous fumes, are patently subjects for study by experiments conducted under disinterested scientific guidance, and investigations in this field are already being fostered by the Department of Scientific and Industrial Research at the Road Research Station and elsewhere. In many problems, however, even the technique for acquiring data has yet to be evolved, and when the requisite data have been acquired there is the problem of securing uniform action on the part of the many authorities concerned, so that the advantages of a scientific policy may be secured for the whole country and not endangered by a recalcitrant or backward minority.

At the present time, the acquisition of data is the first necessity. The existing expenditure on road research, amounting to the very inadequate sum of £30,000, is devoted to road construction and materials; the cost of the research really required should be considered in relation not merely to the magnitude of road transport alone as a major industry, but also in regard to the estimates of the cost to industry as a whole of road transport accidents, loss in traffic delays, etc. The cost of the committee and experimental work visualised by Mr. O'Gorman would be infinitesimal in comparison with the outlay on research in the expenditure of any well-run factory if its income was scaled up to £71,000,000. For 1933, the loss to the community through the 191,782 road casualties is estimated at £30,000,000, and for London alone it is estimated that traffic delays cause a loss of £20,000,000 a year.

It is in the light of such figures as these that the community must assess its capacity for expenditure on the fundamental research, and it should be noted that the solution of many of the more pressing problems is intimately related to questions of taxation, whether in the form of differential duties on heavier or lighter road vehicles or on land valuation and urban development. Moreover, the unmixing of experiments which direction by a competent committee would ensure, and the planning of investigations to relate particular results with particular factors, would eliminate a good deal of the present waste of effort and money on experiments in which numerous factors are being varied simultaneously.

To take only one example of these relations, a sound decision on the taxation of 12-ton lorries in favour of 3-ton vehicles depends on the effect on road safety of the increased traffic density induced thereby, the effect on the general fluidity of road transport, whether additional road construction is necessitated by the increased traffic density and the difference in road wear due to the 12-ton lorry in comparison with the 3-ton lorry. The answers to such questions are urgently demanded to-day, and they involve measurements of the effect of increments of traffic density on accident incidence and traffic flow, as well as that of total vehicle weight and speed on road maintenance. Cardinal to them is an instrument and a system for recording increments of traffic flow, and until we have set our hands to the evolution of scientific methods

for measuring and recording traffic flow, traffic density and traffic accidents, our efforts at accident prevention are likely to revolve in a vicious circle with more and more serious effects on our national economy.

Almost the whole of our expenditure, national and local, on the control of cross-road traffic, on ribbon building along arterial roads, or on traffic regulation whether of lighting, orderliness or speed, including the punitive question, is liable to be fruitless for absence of the groundwork of definite facts on which to base wise decisions. It is possible of course for sound decisions to be taken fortuitously in the absence of such knowledge. It is equally possible for disastrous mistakes to be made, and no scientific worker can rest content with a situation in which wise or foolish action is determined by blind chance when the means for acquiring the fundamental information are to hand.

It is, of course, idle to pretend that the establishment of such a committee as that urged by Mr. O'Gorman would immediately yield even a fraction of the data required. Probably twenty-five years would be required before the full data were available to justify or condemn the many so-called experiments at legislative control in operation to-day. None the less, systematic work under a scientific programme would assuredly yield results capable of practical application and increasing in value as accurate knowledge was built up of the laws of traffic flow. Mr. O'Gorman's plea for accurate measurements in this mode of road traffic and for their scientific correlation and analysis is one which should have the insistent support of every scientific worker.

Reviews

The Problem of Chemical Linkage

The Electronic Theory of Chemistry: an Introductory Account. By Prof. Robert Fergus Hunter. Pp. vii+125. (London: Edward Arnold and Co., 1934.) 8*s*. 6*d*. net.

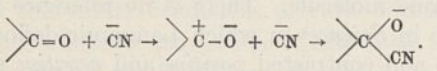
IN contrast to a recent paper by Hunter and Samuel[1], which has been criticised even more adversely by physicists than by chemists[2], Prof. Hunter's book on "The Electronic Theory of Chemistry" is a trustworthy guide to modern views on the theory of valency, since it is very largely descriptive in character, and is more concerned with chemical facts than with physical theories. The chief fault that can be attributed to the book is a lack of historical perspective, which gives to it a flavour of immaturity. For this fault, geographical limitations may perhaps be held responsible. Thus it is unlikely that the *Zeitschrift für anorganische Chemie* for 1893 is readily available in Aligarh, and it is difficult to discover evidence that the author had this volume before him when he wrote his account of Werner's theory of co-ordination, which is there expressed much more clearly than in his subsequent book. The author also omits to point out that the ideas of stable shells of electrons, and of chemical combination between atoms resulting either from electron transfer or from electron sharing, were introduced by J. J. Thomson[3] in 1907, and that their development in 1916 by Kossel and by G. N. Lewis respectively did not depend directly on the introduction of the nucleus atom in place of Thomson's model, but was an immediate sequel to Moseley's experimental determination of atomic numbers, which provided a firm arithmetical basis for the two conceptions which Thomson had already introduced.

Prof. Hunter is also apparently not aware that the term "intramolecular ionisation", which he uses at the beginning of chap. iii, was introduced by J. J. Thomson[4] in 1914 to describe dipolar molecules in which the centroids of the + and − charges do not coincide, and was afterwards applied by the reviewer[5] to those cases in which integral charges can be postulated on different atoms on the same molecule. There is no reference to the article in *Science*[6] in which Langmuir defined the *duplet* and contrasted *positive* and *negative valence* with *covalence* (the term covalency was *not* used by Langmuir). It is, therefore, perhaps not surprising that the author fails to attribute to Langmuir some of the fundamental ideas of the electronic theory of co-ordination, which were afterwards included in Sidgwick's theory; for example, the formation of a bond by the sharing of a duplet between platinum and ammonia, and the development in the compounds of the transition elements of large 'negative' valences, corresponding with Sidgwick's conception of 'effective atomic numbers'. No reference is given to the introduction of the terms 'ionotropy' and 'prototropy' in 1923, although a corresponding reference is given to the introduction of the terms 'anionotropy' and 'kationotropy' in 1931.

Whilst the main feature of the "electronic theory of chemistry" must always be the recognition of two main types of valency, as described

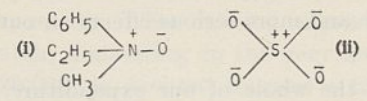
in the second chapter of the book now under review, five central chapters are devoted to possible variants on these two types. The ball was set rolling by the reviewer[7] in 1922, when he first suggested that a 'mixed double bond' could be formed by superposing an electrovalence on a covalence, as represented by the symbol $\overset{+}{\underset{-}{\rightleftharpoons}}$ or $\overset{\rightarrow}{\rightleftharpoons}$, where the barb represents the direction of the field of force of the electrovalence. Mixed triple and quadruple bonds were also postulated; but whilst the reviewer was responsible for *both* these symbols, Sugden alone was responsible for describing the preceding special case as a 'semi-polar double bond'. Sidgwick afterwards used the symbol $\leftarrow$, with an arrow pointing in the opposite direction to the barb, to represent the formation of this type of linkage (which he described as a 'co-ordinate link'), by using the 'lone pair' of electrons of a 'donor', to make good the deficit of electrons of an 'acceptor', by sharing them between both atoms. The reviewer's barb and Sidgwick's arrow are not inconvenient when applied to molecules, although an equation on p. 40 (in which two identical arrows mean quite different things) provides an excellent illustration of the more lethal character of Sidgwick's weapon; but in the formulation of ions, the scheme of localised + and − charges is the only one that is really convenient and quite free from ambiguity.

'Mixed' or 'semi-polar' double bonds were first postulated in 1922 in a paper on "The Polarity of Double Bonds"[7], as characteristic of the reactive forms of unsaturated organic compounds; and there is still no clearer method of formulating Lapworth's cyanhydrin reaction than by writing the equation:



The curved arrows, now generally used to express such processes as these, provide a convenient subterfuge for those who are shy of introducing ionic reactions into organic chemistry; but they are less easy to interpret, as any novice may discover by attempting to read an equation at the top of p. 103, which looks like a long-chain molecule with an assortment of lateral substituents.

Localised electric charges in the same molecule have long been familiar in the betaines, $\overset{+}{\text{N}}\text{Me}_3.\text{CO}.\overset{-}{\text{O}}$, and in the *o*-, *m*- and *p*-sulphanilic acids, $\overset{+}{\text{N}}\text{H}_3.\text{C}_6\text{H}_4.\text{SO}_2.\overset{-}{\text{O}}$, as an alternative to the use of grotesquely elongated bonds, running like telephone wires from one atom to another; but opposite charges on contiguous atoms in stable systems were first suggested in a paper on "Intramolecular Ionisation", published in 1923[8]. Charges of this kind were then postulated (i) in molecules such as the amine oxides and (ii) in ions such as the sulphate ion, for example:



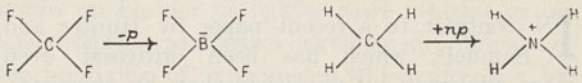
The most interesting of these oxides are those which illustrate Langmuir's theory of isosterism, since this theory enables us to pass easily and safely from the formulæ:

$$\text{N}\equiv\text{N} \quad \text{and} \quad \text{O}=\text{C}=\text{O} \quad \text{to} \quad \overset{-}{\text{C}}\ \overset{+}{\text{O}} \quad \text{and} \quad \overset{-}{\text{N}}=\overset{+}{\text{N}}=\text{O}.$$

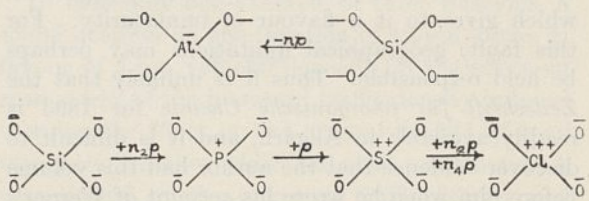
Since the electronic shells in isosteric molecules are identical, these formulæ can be derived from one another by a process of *nuclear substitution*,

$$^{12}_{6}\text{C} + {}^{16}_{8}\text{O} \rightleftharpoons 2\ {}^{14}_{7}\text{N},$$

in which a neutron and a proton are transferred from one nucleus to the other, thus giving rise to the local + and − charges shown in the second pair of formulæ. In the same way, the borofluoride ion can be derived from the molecule of carbon tetrafluoride, by *removing* a proton from the carbon nucleus, whilst the ammonium ion can be derived from the molecule of methane by *adding* a proton and a neutron to the nucleus, which thus acquires a negative or positive charge respectively.



The same method can be applied to the giant molecule of silica and to the silicate ion, in order to justify the assignment of localised charges to the aluminium atoms of the aluminosilicates and to the central atoms of the phosphate, sulphate and perchlorate ions.



As Sidgwick has shown in the case of carbon monoxide[9], this nuclear substitution is not necessarily accompanied by the development of dipoles or quadripoles of equivalent magnitude, since the electronic system is flexible and can adjust itself, at least in part, to the new distribution of nuclear charges. The system of localised charges thus arrived at has been adopted on other grounds by Pauling and has been applied to crystal structures by W. L. Bragg and others, in a form in which, for example, a quarter of the field of the oxygen

atoms of the phosphate ion is directed inwards to balance the charge on the nucleus, so that only a net field of $-\frac{3}{4}e$ is available to balance the external positive ions. The author's statement that "the theory of the co-ordinate link lacks the sound physical basis which has been provided for normal covalency by wave mechanics" is therefore only partially justified; and recent work by Penney has removed the last justification for this discrimination in the case of the mixed bonds of the sulphate ion, where the distribution of charges derived from wave mechanics has been shown to correspond closely with that postulated by the reviewer in 1922.

It is a curious anomaly that the new ideas and formulæ of the electronic theory of chemistry, which the author describes so clearly and convincingly in the present volume, have been the subject of recantation in a recent paper by Hunter and Samuel, where a reversion to pre-electronic formulæ is urged "on the basis of wave-mechanics and band spectra". Since, however, the suggested theoretical basis for these retrograde proposals is regarded as inexact by those well qualified to judge, students may be advised to buy and read the present volume without risk of being misled by doing so.

T. M. LOWRY.

[1] *J. Chem. Soc.*, 1180–1186; 1934.
[2] NATURE, **134**, 971, Dec. 22, 1934.
[3] "The Corpuscular Theory of Matter" (Constable, 1907), Chapter vi, pp. 103–141.
[4] *Phil. Mag.*, (vi), **27**, 757; 1914.
[5] *Trans. Faraday Soc.*, **18**, 285; 1923.
[6] *Science*, 59–67; July 22, 1914.
[7] *J. Chem. Soc.*, **123**, 822; 1923.
[8] *Trans. Faraday Soc.*, **18**, 285; 1923. *Phil. Mag.*, (vi), **45**, 1105; 1923.
[9] *Proc. Roy. Soc.*, A, **144**, 521; 1934.

Physics Teaching in Germany and Italy

(1) *Lehrbuch der Physik in elementarer Darstellung.* Von Arnold Berliner. Fünfte Auflage. Pp. vii+736. (Berlin: Julius Springer, 1934.) 19.80 gold marks.

(2) *Fisica Generale e Sperimentale.* Per Prof. Eligio Perucca. Vol. 1: *Meccanica, Calore.* Pp. xvi+647. 85 lire. Vol. 2: *Ottica, Elettricità e Magnetisme.* Pp. xv+870. 110 lire. (Torino: Unione Tipografico-Editrice Torinese, 1932–1934.)

(1) THERE has too often been a tendency in the past among writers of elementary textbooks of physics to present the subject in a fragmentary form, to discuss isolated details with great care but to avoid a discussion of the broad principles, as if this would endanger the sanity of the student by bringing him into contact with philosophy. Prof. Berliner deserves our thanks for defining at the very outset of his well-known textbook the mechanistic basis on which he afterwards builds, and he wisely devotes great attention and considerable space to the underlying principles of mechanics. For him, a physical law is a formula which describes rather than prescribes the behaviour of physical objects. He explains why we find it expedient to seek the 'forces' that give rise to observed phenomena and points out the fundamental part played by motions. Although the efforts to obtain a mechanical interpretation of electromagnetic phenomena have failed, a study of mechanics is still as essential to the student physicist as is a study of Bach to the aspiring modern musician.

Early in the book, the student is introduced to the ideas of world-point and world-line, but the way in which they were originally applied by Minkowski is left over to a later section, where there is an illuminating account of the idea of physical relativity, both special and general. The claims (on p. 133) concerning the confirmation of the general theory of relativity are stated with exemplary caution. It is doubtful whether there is in existence another elementary book of physics in which the background of the subject, to use Sir James Jeans's apt expression, is so carefully kept in view. For a parallel we should have to turn to the far more advanced books of Planck. Goethe has wisely said: "es gibt Bücher, durch welche man alles erfährt und doch zuletzt von der Sache nichts begreift". The student who works through the present book, however, should have no difficulty in grasping the fundamentals of his subject.

New features in this fifth edition include the geometrical structure of solid bodies and the properties of X-rays. The final chapter is entirely new, and is intended to serve as an introduction to atomic physics. The author mentions in his preface that since this subject does not properly belong to a textbook for beginners, he has not passed beyond the picturable Rutherford-Bohr model of the atom, as this may still be regarded as the threshold over which the student may later pass into the stately but rather forbidding mansion of quantum and wave mechanics. At the end of the text there is a record, covering fourteen pages, of the most famous names in physics, together with dates and discoveries.

Compared with our English textbooks of the same standard, Prof. Berliner's book contains remarkably few calculations, although even the Poinsot motions of a rigid body and Coriolis motions are discussed in a descriptive way. The emphasis is laid throughout on the physical aspect. For teaching purposes the book would gain by the addition of a set of carefully chosen illustrative examples and problems, the absence of which is

rather common in foreign textbooks. Prof. Berliner's book may be highly recommended.

(2) Prof. Perucca's two volumes on general and experimental physics illustrate again the remarkable improvement that has occurred in recent years in the teaching of elementary physics. The standard attained in the present case is about that of an English general degree. These volumes represent the substance of a two years course of lectures to students at the Royal College of Engineering at Turin, but they should meet the requirements of pure science students equally well. Italian students are, indeed, fortunate in having so excellent an expositor as Prof. Perucca, whose knowledge of every part of the subject is uniformly deep and accurate. The mathematical treatment is always simple, elegant and sufficient. Engineers have a particular fondness for neat and clear diagrams. The author has been unusually indulgent in this respect, as the diagrams are in many cases excellent; for example, the *p-v-T* diagram on p. 526 of vol. 1, or the earlier figures relating to forced oscillations. In the second volume special praise must be accorded to the chapter on capacity and dielectrics. The volume ends with short accounts of the photo-electric, photo-voltaic, Compton and Raman effects.

The printing and production of the two volumes are of the highest order. In view of the many English translations of foreign books on physics that have recently appeared, we may well ponder whether Prof. Perucca's work has not an equal claim in this respect for a textbook of this standard.

H. L. B.

The Prehistory of Scotland

The Prehistory of Scotland. By Prof. V. Gordon Childe. Pp. xv+285+16 plates. (London: Kegan Paul and Co., Ltd., 1935.) 15*s.* net.

SINCE Prof. Gordon Childe went to Edinburgh, he has made himself master of the ascertained facts regarding Scottish prehistory, and has brought a mind saturated with comparative data to a synthesis such as has not yet been forthcoming in book form. In Scotland the main outlines were long ago drawn in by Dr. Joseph Anderson, but since his day a vast amount of information has accumulated, and a great deal has been learned in quite recent times. Much remains yet to be done, so that while the body of fact is impressive, conclusions regarding origins and relations must necessarily be provisional. As the author himself writes in his preface, "The data are incomplete, and the conclusions it [the synthesis] offers are provisional or even premature". The conclusions set forth in this volume have authority as coming from one possessed of a wide and varied knowledge of European archæology, and the book will be of value not only to general readers, but also to workers in the field. If it increases general interest in Scottish archæology and stimulates research, it will do a notable service, and will be very welcome.

The book opens with a useful and necessary chapter on the geographical and climatic conditions of prehistoric Scotland. It is quite impossible in a short notice such as this to deal in any detail with the vast amount of archæological data contained in the book. The meagre evidence for a settlement or settlements of peoples in the epipalæolithic phase is presented, and Azilian, Tardenoisian and Baltic elements are recognised. The local Neolithic and early Bronze (in which the author includes the English middle bronze) phase are already fairly fully known, and the current theories of a south-western (Iberian, to use the old term) origin for the people and culture of the chambered tombs, and a Central European origin for the short cist people with their beaker urns, are accepted, discussed and defined in view of recent discoveries. Regarding the collective tombs, the author presents a case for the recognition of a type of corbelled tomb in Caithness, apparently belonging to an advanced phase of chamber building, as the earliest importation of the architectural idea from the Iberian peninsula, the segmented chambers of south-western Scotland, of simpler construction, being of later date and rather different origin. The effect on the architectural features of the tombs of differences in the building materials available in different districts is pointed out, but perhaps not given quite sufficient weight. For some time now it has been supposed that the Beaker folk settled, not at a single but at a number of points on the east coast, and the author analyses the Beaker pottery from this point of view. While he admits the origin of the food vessel from the older neolithic bowl, he suggests as a possibility a settlement of food vessel folk, as an alternative to the entirely local origin of this class of pottery. The evidence from graves makes this more than doubtful.

The bronze age in Scotland lasted for a long period, and the early Iron Age is represented, so far as funerary relics are concerned, by about six graves only. Certain of these indicate some connexion with the graves of the Arras group of chariot graves in Yorkshire, and one can be definitely dated to the first century A.D. The culture was then definitely La Tène, and a colonisation from the south has been admitted about this time. The overlap from bronze to iron has been a dark epoch in Scottish archæology. The urn field and Hallstattian cultures of the Continent are only vaguely represented, and the evidences for local

development, influenced of course by trade, are weighty. The author recognises Hallstattian influences in certain of the fictilia of the late bronze age and argues for a definite settlement of people practising the culture on the evidence of sherds of pottery with Hallstatt features in Aberdeenshire, Morayshire, Shetland and some other localities. Owing to the practice of cremation, no anatomical evidence for this is available, and the conclusion must be regarded as tentative. The same must be said of the theory regarding the Broch builders—but this is too large a question to be included in this review. All the author's conclusions will stimulate research and discussion, and are welcome on that account.

The descriptions throughout the book are not too technical, and are happy in the way they seize on the essential points. The maps of distribution, which have involved intensive work, are of much value.

Short Notices

De Venarum Ostiolis 1603 of Hieronymus Fabricius of Aquapendente (1533?–1619). Facsimile edition with Introduction, Translation and Notes by Dr. K. J. Franklin. Pp. viii+98+2 plates. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1933.) 13*s.* 6*d.*

AN important early work by Fabricius has now been published by the History of Science Society with the aid of funds contributed by the Carnegie Corporation. All English readers who would fully understand the discovery of the circulation of the blood must, after studying the immortal "De motu Cordis", refer to the work of Harvey's precursor and teacher, Fabricius of Aquapendente, "De Venarum Ostiolis", and to that of his successor R. Lower, "De Corde". By his scholarly translations of both of these works, Dr. Franklin has now completed the early trilogy of the circulation—complete in facsimile and translation and with all the original plates. Discovery and publication were too often divided by long years. The first unintelligent glimpses of valves by Canano 1541, Estienne 1545, Sylvius 1541 and Colombo seem to have been unknown to Fabricius in 1574 when he first made his discovery, and another twenty-nine years elapsed before he published it. The salient points in his life are well indicated, and the construction of the anatomy theatre at Padua, where he lectured, is illustrated with architectural plans for the first time. The eight fine full-page engravings of the original have been well reproduced, but we regret that the folding plate, pages 10 and 11, was not mounted clear of the stitching. R. T. G.

Müller–Pouillets Lehrbuch der Physik. Elfte Auflage. Herausgegeben von A. Eucken, O. Lummer, E. Waetzmann. In 5 Bänden. Band 4: *Elektrizität und Magnetismus.* Teil 3: *Elektrische Eigenschaften und Wirkungen der Elementarteilchen der Materie.* Herausgegeben von Arnold Eucken. Pp. xviii+828. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1933.) 54 gold marks.

THE present volume of this well-known series of handbooks consists of the following parts: the free electron (cathode rays), by Gerthsen and Kossel; positive rays, passage of electrons through matter, by the same authors; discharges through gases, by Steenbeck; electrical structure of atomic nuclei, by Kirsch and Teller; atomic and molecular forces, by Dunkel and Wolf; dielectric polarisation of atoms and molecules, and pyro- and piezo-electricity, by Wolf. The subject matter is treated simply throughout. Many useful numerical data are found scattered over the various sections. It is a particular merit of the volumes of this series that every effort is made to avoid rendering the reading irksome by inserting unnecessary formulæ or calculations. The physical argument is clearly presented and references to original papers are given in abundance in footnotes.

Earth, Radio and the Stars. By Dr. Harlan True Stetson. (Whittlesey House Publication.) Pp. xvii+336+9 plates. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 10*s.* 6*d.* net.

THERE is always a peculiarly individual and peculiarly American quality about the work of Dr. Harlan True Stetson, and the present work is difficult to sum up on that account. The linkages amongst the rather diverse topics treated are somewhat slender and sometimes artificial, but as topics all are very interesting. Variations in longitude and latitude, the internal structure of the earth, sunspots in relation to terrestrial magnetism and radio reception, problems of the ionosphere, solar, lunar and stellar effects on radio transmission, cosmic clouds, cosmic rays, are parts of a science, more attractive than the name 'cosmecology' which the author attaches to it, dealing with the relation of the earth to its cosmic environment. The book is often stimulating, sometimes irritating; it contains much that is difficult to find elsewhere, and it should be read.

Sound: a Physical Text-Book. By Dr. E. G. Richardson. Second edition. Pp. vii+319. (London: Edward Arnold and Co., 1935.) 15*s.* net.

WHEN Dr. Richardson's book first appeared in 1927, it was described in a full review in these columns as "a well-balanced account of the present state of knowledge in experimental acoustics" (NATURE, **120**, 760; Nov. 26, 1927). Since then, much new work has been done on such subjects as sound-recording, echo-sounding, supersonics, architectural acoustics, limits of audibility, analysis of sounds, and so on; and the book has been expanded from 286 to 319 pages to take these and other advances into consideration. There are new chapters on impedance, supersonics, and the reproduction of sound.

Scientific Investigation of Works of Art

In the field of the fine arts, it is axiomatic that the history of style cannot be separated from the history of technique: and critical study of the latter depends upon two sources of information. Of these, documentary evidence is the more obvious and the less readily accessible. Some such manuscripts are of classical importance, and have been frequently edited and translated: probably the best known are the fifteenth century "Libro dell' Arte" of Cennino Cennini, and the much earlier "Schedula Diversarum Artium" of Theophilus Presbyter, of which first-class translations, critically edited and most copiously annotated, have recently been published. Numerous other early and medieval texts dealing with all phases of contemporary craftsmanship have been intensively studied, such as the Lucca "Compositiones" and the fourteenth century "De Arte Illuminandi", while many unpublished sources have yet to receive due attention. But comparatively few craftsmen have thus placed on written record their workshop methods: and it can therefore scarcely be too strongly emphasised that detailed analytical study of actual surviving works of art constitutes a second potential source of information of the very highest importance.

Obviously, such sources are much more frequent than purely documentary evidence on the history of medieval craftsmanship: and the technique whereby a specific work of art was fashioned, be it painting, bronze, pottery or textile, may often be detected by the trained and discerning eye. It cannot be done in a day. Many tricks of medieval craftsmanship are still stubborn secrets: and though scientific methods of investigation, applied with reserve and artistic appreciation, have of recent years unravelled a good many such problems, yet the unwritten secret of, for example, the brothers Van Eyck, still continues to be 'discovered' at fairly regular intervals.

The names of a good many pioneer workers are intimately associated with this intensely interesting field where science and the fine arts overlap. It is perhaps invidious to particularise: but Prof. Eibner and his collaborators at Munich, and Prof. A. P. Laurie in Great Britain, among many other workers, have contributed classical researches to the corpus of available knowledge. It should not be forgotten, further, that many museums, galleries, private research workers, and picture-restorers such as Dr. de Wild, have all made use of scientific methods for the examination of works of art. But all have admitted the disadvantages inherent in the general absence of a co-ordinating centre of research, though of recent years this deficiency has to some extent been remedied by the excellent work of one or two research departments. The laboratory of the Fogg Art Museum, at Harvard University, for example, has systematised many lines of research, and has provided by its quarterly publication, *Technical Studies in the Field of the Fine Arts*, a journal devoted exclusively to disseminating knowledge in this field. Further, the invaluable work carried out at the Research Laboratory of the British Museum has led to excellent publications on the constitution and care of museum pieces and works of art of various kinds. While paintings have, generally speaking, received little treatment at this latter centre, systematic investigation of such problems, particularly as applied to Russian icons and Byzantine wall-paintings, has been carried out in Moscow at the Institute of Archæological Technology and the Restoration Workshop. The results achieved there are not so widely known as they should be, however, largely owing to the language difficulty.

The recent establishment, by the University of London, of a Scientific Department at the Courtauld Institute of Art, has focused attention upon this field once more. The urgent need for the foundation of a centre where systematic investigation could be carried out into the physical character of works of art, and into the problems connected with their conservation and restoration, was made very clear at a Conference on Ailing Pictures convened by the Department of Scientific and Industrial Research on October 20, 1931. Full tribute was there paid to the work of the British Museum Research Laboratory, and of private investigators: but it was felt that an independent and preferably academic centre would have great advantages over any existing institution, not only in carrying out research, but also in co-ordinating work already being conducted elsewhere. The new laboratory marks the fulfilment of the views expressed at this meeting: it is now fully equipped, and work is in progress. In addition to its research and educational activities, the laboratory is prepared to make scientific investigation into works of art of any type submitted by their owners, both public and private, reporting on their physical constitution and condition, and advising on questions of conservation and restoration.

Reports are, however, limited very strictly to matters of scientifically ascertainable fact: questions of attribution to a particular master are not taken up. The technique of a Holbein or a Rembrandt cannot yet be expressed as a mathematical function of the materials employed, nor can the *impasto* of a Rubens at present be differentiated

from that of his pupils by any quality or quantity accurately measurable in absolute units.

It is significant of the recent increased interest in such problems in Great Britain that the National Gallery has installed specialised equipment for the physical investigation and characterisation of its pictures : and this almost simultaneous establishment of two such research departments in London can scarcely fail to have an important bearing on this field of investigation.

The results previously obtained have, perhaps inevitably, given rise to a certain amount of sensational publicity in the Press. This is very regrettable : for not only has it led to popular misconceptions, and to the making of extravagant claims for certain scientific weapons, but also it has tended to suggest that all manner of questions, including the thorny problem of attribution, can be settled rapidly and with certainty by scientific means. The publicity accorded to the occasional detection of art forgeries by examination with X-rays, and with ultra-violet and infra-red radiation, has led many a layman to believe that such methods invariably reveal hidden features of deep significance. In actual practice, nine out of every ten paintings, on X-ray examination, show nothing of significance—or, at least, nothing which can with certainty be interpreted at the present stage of our experience. The outstanding difficulty in investigations of this kind is that of establishing a satisfactory control experiment—a norm for comparison. It should never be forgotten that a work of art, of practically any kind, has to be regarded as a 'living' system, in a state of physico-chemical equilibrium which can be radically altered by factors at present almost unknown—as witness the sudden disintegration of certain Italian frescoes, without warning, after centuries of healthy 'life'. The independent variables controlling such a system are so numerous that it is doubtful whether any given work of art will ever be defined by a set of specific and reproducible conditions. Its very nature is so intensely individual that the cleverest forgery in existence would be an unsatisfactory control for experiment on the original. To generalise on a few striking cases is, if possible, even less permissible here than in the exact sciences : and significant progress will be obtained only after long-continued experiment under carefully controlled conditions. P. D. R.

Origin of the British Flora

LIKE all other biological phenomena, the British flora is determined by two classes of factors, those of history and constitution on one hand, and those of environment on the other. It is obvious that only those species which can at least tolerate the climate of these islands can continue to live here : the discussion held at the Royal Society on March 28 was concerned mainly with the problem of how and when they came. Light was thrown on this subject by contributions not only from taxonomists and students of the geographical distribution of species, but also from ecologists, meteorologists, geologists and archæologists, though it cannot be said that the problem taken as a whole is very close to solution despite the intensified field-work of recent years. We are in fact no farther than the beginning of the laborious collection and analysis of detailed facts which alone can eventually lead to general agreement.

Mrs. E. M. Reid opened with a paper on "British Floras antecedent to the Great Ice Age". In dealing with the Tertiary floras, she showed that that of the London clay has a large preponderance of tropical, mostly Indo-Malayan forms, which she explained by supposing migration to north-western Europe along the shores of the Tethys Sea—that greatly extended 'Mediterranean' which persisted through so many geological ages. The evidence is that some existing British genera, absent from the London Clay, existed in these regions in earlier times (before the London Clay was laid down) and were presumably driven out by this invasion of tropical climate and flora from the south-east, but the floras of later deposits (subsequent to the London Clay) show a steadily increasing percentage of living British genera, culminating in the late Pliocene with 97 per cent. It is generally accepted that the climate and flora of the Cromer Forest bed at the top of the Pliocene were roughly equivalent to those of to-day, and may therefore be taken as the real starting point of the modern flora.

Then came the cold of the Pleistocene with the advance of the great continental ice-sheet from Scandinavia and the formation of glacial systems in the mountains of Great Britain. It is obvious that these conditions must have exterminated or driven southward most of the existing flora, since the ice advanced at one time to the northern edge of the Thames Valley, and later to South Wales. It is now established, however, that there were four successive glaciations in England—though these do not necessarily correspond at all closely with those of the Continent—and correspondingly three interglacial phases. Prof. P. G. H. Boswell, whose work has greatly increased our knowledge of the Pleistocene period in Britain, sketched the

history of these successive glaciations. The second reached farthest south in the east (Thames valley), the third and fourth in the west (Bristol Channel). The floras of the interglacial phases when the ice retreated were touched upon by Miss M. E. J. Chandler. During the second (middle) interglacial phase, much of our existing flora was present in eastern England, which was at that time joined to the Continent owing to general elevation of the land. Of the others little is known, and there is no evidence that any interglacial was much warmer than the present climate. 'Nunataks' (ice-free areas surrounded by ice) no doubt existed during the glaciations, but according to Prof. Boswell it is uncertain whether any of these were continuous throughout the Pleistocene, and could thus possibly afford a permanent refuge for Pliocene plants. According to Dr. Raistrick, there were 50 square miles of such ice-free areas in the Pennines, though none in the Lake District mountains. But there is still some difference of opinion on this point. The most generally accepted view is that at any rate the great bulk of the existing flora came into Great Britain from the Continent after the final retreat of the ice.

The main issue of controversy on the effect of the ice age on the British flora lies in the question whether practically the whole vegetation north of the Thames and Bristol Channel was wiped out, except such as could survive in the comparatively narrow strip south of the ice-sheets, or whether a substantial portion at least survived in ice-free 'sanctuaries', and in the south-west from interglacial or even from Pliocene times. In the discussion, Dr. A. J. Wilmott was the protagonist of the latter, Prof. E. J. Salisbury of the former view. Dr. Wilmott's evidence is (1) the occurrence of certain endemic species which are regarded as relics of Pliocene or a warm interglacial period and are very unlikely to have originated in post-glacial times; (2) the aggregations of rare and local species in unglaciated areas south of the ice-sheet such as Brean Down in Somerset and Torquay, or in unglaciated areas surrounded by ice such as Teesdale and Arran. It seemed to him "inconceivable" that such species would have migrated separately to these areas in post-glacial times, avoiding intervening and equally suitable habitats. They must rather be regarded as relicts which have survived in these places. Prof. Salisbury, on the other hand, argued that these collections of rare species have occupied such areas in post-glacial times because the local conditions are particularly suitable for them. He does not believe that the cumulative effect of very cold conditions during a glacial phase would permit the survival of such species within the boundaries of or in proximity to an ice-sheet, or that any bounds can be set to the post-glacial migration of species within the British Isles, provided the conditions of existence are suitable for their establishment.

The view that relict species surviving the last glaciation may probably be fairly numerous in the British flora was supported by Prof. G. E. Du Rietz, of Uppsala, who gave many examples of species concentrated and isolated in two mountain areas, one in the north and the other in the south of the Scandinavian peninsula; these can only be interpreted as relict areas, since the nature of the habitat does not in any way explain this localisation of species. He also described Norwegian coastal areas which were free of ice during the Pleistocene and possess remarkable collocations of species, and particularly one in Novaya Zemlya in proximity to the existing ice-sheet and known as "flower hill". These instances taken together greatly strengthen the case for survival close to the ice. Furthermore, he instanced a species of tropical rain forest lichen still found in south-west Ireland, the presence of which he is only able to interpret as a survival from a pre-glacial tropical climate. Prof. Du Rietz confessed himself "rather an extreme advocate" of the theory of survival of pre-glacial relicts, believing that a great part of the oceanic (Atlantic) flora survived in the south-west of the British Isles, though he did not oppose Prof. Salisbury's contention that the distribution of very many species followed the differentiation of climate, and was thus determined by existing environment rather than by the more remote history of the species. Dr. W. Watson cited several examples of Scottish liverworts and lichens occurring in isolated positions in southern England, both in the west and in Norfolk, interpreting these as glacial relicts.

There certainly seems a good deal of evidence derived from the existing distribution of particular species, not only in the British Isles but also on the Continent and in America, for the survival of relicts in particular places, doubtless in more or less specially suitable habitats, from various earlier periods, surrounded by a flora of which they do not form an integral part. But we are still very far from being able to write a convincing history of the extremely complex changes which must have occurred since the Pliocene. Our ignorance of the climates which actually existed in proximity to the ice-sheets is almost complete. We cannot assume that all the unglaciated parts of the British Isles must have been arctic tundra. The evidence from southern Sweden and Esthonia is that the forest zone there came very close to the ice; and, for all we know, quite mild conditions may have existed in our own south-west, enabling the survival of many 'Atlantic' species, among which

may be reckoned the so-called 'Lusitanian' flora, species which occur in south-western Ireland or in south-west England and also in the Iberian peninsula—some being present in and some absent from western France—among which the strawberry tree (*Arbutus unedo*) is perhaps the best known.

Several speakers—for example Miss Chandler, Prof. Boswell, Dr. W. B. Wright, Mr. Butcher and Dr. Hamshaw Thomas—emphasised from different points of view the extreme complexity of the changes and the wide fluctuations of climate and other conditions which must have occurred during the Pleistocene. Other speakers, again, directed attention to factors which are probably of great importance but are often ignored—Dr. Thomas to the importance of precipitation and accompanying humidity of the air, in addition to temperature; Dr. A. S. Watt to soil development, different soil phases limiting the spread of particular species and favouring that of others; Dr. W. B. Turrill to 'ecotypes' within an aggregate species which may all have a general superficial resemblance but in reality differ greatly, both in genetic constitution and in ecological requirements.

Dr. H. Godwin gave a lucid account of the application of the modern technique of pollen analysis to the interpretation of the post-glacial history of the British flora, showing that the succession of forest types in Britain agrees very well in a general way with that recorded from the Continent. It is difficult to judge the time of the first appearance of the dominant trees, but the order in which they spread and attained dominance can be determined with some certainty. The earliest post-glacial forest phase (Boreal) shows dominance of birch and pine and the entry of elm, oak and lime. Later came the alder, and the next climatic period (Atlantic) saw mixed oak-forest and alder dominant. It is now certain also that beech, on the native place of which doubts have been cast, was present in pre-Roman (probably Iron Age) times; and hornbeam has a similar status. Both these records agree well with the late post-glacial spread of the two trees on the Continent. There is also evidence of a second pine forest maximum between the early Bronze Age and the Roman period, and this perhaps corresponds with the Sub-boreal pine maxima in Ireland, Scandinavia and other parts of Great Britain. Not very much is certainly known of the pollen of British interglacial beds, but the presence of spruce—now extinct—has been established, so that extermination of some species at least during the later glaciations appears to be demonstrated.

A. G. TANSLEY.

The Alkali Industry

IN the Hurter Memorial Lecture to the Society of Chemical Industry (*Chemistry and Industry*, 54, 121; 1935), Dr. J. T. Conroy gave a very interesting review of the development of the manufacture of sulphuric acid, alkali, chlorine and allied products since about 1890. This period has seen the disappearance of the Leblanc process and its replacement by electrolytic processes, the Castner and Hargreaves processes developed in Great Britain having features embodied in most successful modern cells except those of the gravity type. The possibility of operating these processes was almost entirely dependent on power production. The original rocking mercury cell has given way to a trough type with many times the capacity of the original unit, and the use of Acheson artificial graphite for the anodes was a material improvement. The high degree of purity of the caustic soda produced by the Castner cell, fitting it for the electrolytic production of metallic sodium, was very helpful to its development. The sodium is the starting material for the manufacture of cyanide. For the last fifteen years the chlorine produced in Great Britain has been electrolytic in origin.

In the ammonia-soda process, improvement in plant and operation has been effected, and processes for the production of sal ammoniac and calcium chloride from appropriate tower and still liquors have been developed.

Although the Leblanc cycle has been superseded, some intermediate products are still important. Sulphuric acid is made by the chamber process, in the operation of which some mechanical improvements have been effected, and on the chemical side the use of nitre has been replaced by ammonia oxidation. Concentration of acid in platinum pans has given way to other types of apparatus and finally to the contact process. It is only with large installations and a demand for high strength acid, such as is necessary in the dyestuffs industry, that the contact process is economical. The use of sulphur has replaced that of pyrites to a large extent since the exploitation of the American deposits by the Frasch process.

The manufacture of saltcake (sodium sulphate) has declined considerably, partly because saltcake is now largely displaced by ammonia soda ash in glass manufacture and partly because the export market demands have been largely met by the recovery of sodium sulphate from residual

liquors from the recovery of natural potash at Kaiseroda and Borbach, from which on refrigeration Glauber's salt is obtained, yielding saltcake of high purity on suitable heat treatment.

The Weldon chlorine process had been displaced by the Deacon process as improved by Hasenclever. The production of 1 ton of bleaching powder by the Weldon process required 50 cwt. of salt; in the Deacon process appreciably less than 20 cwt. was used. Kynaston found that the undecomposed hydrochloric acid washed from the chlorine was almost free from arsenic and contained but little SO_3, so that this acid could be sold and the costly Hasenclever process, degassing the condensed acid for return to the decomposer, could be avoided. A revolution in the manufacture of hydrochloric acid came with the production of synthetic acid from the hydrogen and chlorine gases from the electrolytic cell, and a high proportion of the acid is now produced synthetically.

In the manufacture of bleaching powder, the use of the Hasenclever plant, in which mechanically hydrated lime is pushed through horizontal superimposed cylinders in counter current to the ascending chlorine, has been modified by the omission of the propelling blades and the use of a single enlarged rotating cylinder for the smaller units (Moore and Rudge). The chlorine from the electrolytic cells is diluted with air before use, and by suitable regulation of the process and control of temperature in particular zones of the cylinder by water cooling, a high strength bleaching powder possessed of stability in hot climates can be produced. Calcium hypochlorite containing more than 70 per cent available chlorine, and sodium hypochlorite solutions containing up to 15 per cent available chlorine are produced for water purification, sanitation, laundry work and other purposes.

The production and sale of liquid chlorine for water purification and the preparation of intermediates in the dyestuffs industry is another notable achievement. Chlorate production is now also electrolytic and is carried out in countries such as Sweden and Canada where cheap waterpower is available.

In the caustic soda industry, the carbonate from the ammonia soda process is causticised with lime, the calcium carbonate in granular form being removed by rotary filters and used as agricultural lime, in 'stone dusting' in coal mines and, when carefully dried and air-separated, in other industries. Regeneration of lime from the lime mud has more recently been accomplished. The caustic soda liquor is concentrated in multiple effect evaporators and further in steam-heated units, the product being of high strength, 70 per cent Na_2O being normally attained, whilst with the mercury electrolytic cell a product approximating to 100 per cent NaOH is obtainable. New forms of caustic soda known as flake, petal and powder, are made by breaking down thin sheet; they are easy to handle and much purer than the old stick form.

Purity of the modern products is due partly to the basic change of process, for example, contact process for sulphuric acid and synthesis of hydrochloric acid, and partly by the possibility of installing purification plant owing to economy resulting from greater output per unit of plant. Fuel economy has been largely effected by the development of the tubular boiler and the steam turbine. The use of control instruments and better working conditions on the plant, as well as the introduction of metals and alloys capable of resisting corrosive liquids and gases, have all played a part in the improvement of the industry. Dr. Conroy emphasised that the continuous high efficiency now ruling can only be maintained and ensured by continuous scientific control.

Obituary

Prof. E. Paternò

THE death of Emanuele Paternò removes a leading Italian chemist and a genial collaborator from the international councils of chemistry, where he regularly represented his country. Prof. Paternò passed away on January 18 in his native city of Palermo, where he was born on December 12, 1847. His father had to leave Sicily soon after his birth, having taken an active part in the revolt of 1848, and Emanuele spent his early years in exile, in Alexandria.

Having graduated in physics and chemistry, Paternò returned to Palermo, replacing in 1872 the famous chemist Cannizzaro, who had just left for Rome. In 1893 he was called to the chair of applied chemistry in Rome, and on the death of Cannizzaro he became director of the Chemical Institute.

Paternò's scientific contributions over nearly half a century are numerous and varied. He began his scientific career with the discovery of dichloraldehyde, and made a special study of the halogen isomers of ethane, the synthesis of fluorbenzene, fluortoluene, etc. Passing on to physical methods, he made numerous cryoscopic studies in connexion with the determination of molecular weights, and later in life investigated colloidal phenomena and the influence of light upon chemical reactions.

Paternò was the first to point out, in 1889, the emulsion-like nature of colloidal solutions, and to note that a substance may be colloidally dispersed

in one solvent and molecularly dispersed in another. In the photo-chemical field he obtained by elegant methods condensations of hydrocarbons with aldehydes and ketones; he succeeded in preparing a number of synthetic alkaloids and was able to throw light on the probable mechanism by which plants produce many of these compounds.

In addition to his research activities, Paternò excelled as an organiser. He founded and edited the *Gazetta Chimica Italiana*. In Palermo he was both principal of the University and mayor of the City, and in Rome he occupied many Government positions. A gold medal was founded in 1923 in his honour, to be given every three years for the most notable discovery in chemistry, the first award being made in the same year to Dr. F. W. Aston. Prof. Paternò was elected an honorary fellow of the Chemical Society in 1920.

Sir William Morris, K.C.M.G., C.B.

We regret to record the death of Sir William G. Morris on February 26, in North Wales. He was a man beloved by all who had the privilege of knowing him. Born in 1847, he entered the Corps of Royal Engineers in 1867. After various home duties he went to Mauritius in 1871 and remained there until 1874, the year of the transit of Venus expedition to that island, with which the names of Lord Lindsay and Sir David Gill are so intimately associated. This appears to have marked the beginning of that collaboration with Gill which was later to have such useful results in South Africa; for after a spell of two years at the Staff College and later at home duties—particularly as assistant instructor in survey at the School of Military Engineering, Chatham, from 1877 until 1882—he was acting on special duty in 1882–83 under the Transit of Venus Committee at home and abroad.

At this juncture, Sir David Gill, who was then H.M. Astronomer at the Cape of Good Hope, had succeeded in persuading the Governments of Cape Colony and Natal to undertake a geodetic survey of their territories. To carry out this work Gill naturally turned to Morris, who after two months work on special duty under the Colonial Office, became the leader of the Geodetic Survey of the two Colonies, an undertaking which absorbed his energies for ten years. Officially he was noted for special duty under the Government of Natal, which was the first of the two Colonies to support Gill's proposal for the geodetic survey. This work, indissolubly associated with the names of Gill and Morris, was the beginning of the Great Arc of the 30th Meridian which last year was carried to the Belgian frontier of the two provinces of Ruanda and Urundi.

On his return home, Morris received the C.M.G. for his services on the geodetic survey of the Cape and Natal. He next went to Chatham and in the period 1895–98 was assistant commandant of the School of Military Engineering; but South Africa was calling, and he returned there in 1898 as Colonel on the Staff, C.R.E., acting as district engineer during the South African War (1899–1902). He was twice mentioned in dispatches and received various honours and the C.B. After the war an occupation doubtless more congenial to his nature was in store for him: in 1902 he became officially superintendent of the Geodetic Survey of the new territories, and in 1906 completed the principal triangulation of the Orange River Colony (as it then was) and the Transvaal. He retired from the Army on half pay in 1904 and for the last thirty of his long spell of eighty-eight years lived very quietly on a mountain-side overlooking Bettws-y-Coed. Visiting him there about three years ago, the present writer found that his mind had apparently drifted beyond South Africa, the scene of his former triumphs.

Gill and Morris built up in South Africa a fine school of geodesy. Supported by able assistants, they established a tradition which has not been without effect on the world at large. Mr. Victor A. Lowinger, one of these assistants, writes: "Morris was devoted to his work and inspired all who worked under him with the value of thoroughness and accuracy. He chose his men carefully and trusted them to get on with the job, while at the same time he was always ready to resolve any difficulties that arose. He was of a very reserved nature and, though a little intolerant of human weaknesses, very just in his judgments—a man with whom one has been proud to have been associated in one of his great practical contributions to geodesy." G. T. M.

Mr. M. V. Portman

We regret to record the death of Mr. Maurice Vidal Portman, which occurred at Axbridge, Somerset, on February 14, at the age of seventy-four years. Mr. Portman was well known as an authority on the natives of the Andaman Islands as they existed fifty years ago. He was appointed "Officer in charge of the Andamanese", with headquarters at Port Blair, in 1879, and remained in the Andamans until 1899, when he was sent home on account of ill-health. Throughout his term of duty he was in constant and intimate touch with the life of these tribes of shy, difficult and sometimes dangerous, little people. As a result of his care for them and his disregard for the risks he ran in getting into touch with them, he acquired knowledge of their customs and beliefs which made him the equal, if not indeed the superior, as an authority, of E. H. Man, although the latter won the wider reputation through his books. Mr. Portman was a contributor of papers on Andamanese matters to the publications of learned and scientific societies, and made a remarkable collection of photographs of the Andamanese and their articles of material culture.

We regret to announce the following deaths:

Sir John Rose Bradford, K.C.M.G., C.B., C.B.E., F.R.S., emeritus professor of medicine in University College, London, president of the Royal College of Physicians in 1926–31, on April 7, aged seventy-one years.

Prof. E. Cannan, emeritus professor of political economy in the University of London, on April 8, aged seventy-four years.

News and Views

Planning in Industry

Planning in industry was debated in the House of Commons on April 3, following a motion by Mr. A. H. E. Molson calling for the establishment of a Departmental Committee to consider the measures of industrial reorganisation necessary for the fullest use of modern methods of production and distribution in Great Britain. Mr. Molson urged the necessity for dealing with the industrial position of the country as a whole and not by Departments of State or the like singly, and referred particularly to the reduction of costs of production and the question of cheap distribution. Organisation of industry on a national basis was regarded by Mr. C. U. Peat as essential, both for the older and the newer industries; thus organised self-government would have avoided the present desperate redundancy problem in the canning industry. The essence of the proposal was that the majority of an industry should have the opportunity of putting their case before an independent tribunal, and on satisfying the tribunal that re-organisation was in the interests of producers, consumers, wage-earners and other allied industries, statutory authority should be given to the reorganisation scheme without delay, so that the industry should be organised on the most efficient basis it could suggest. Mr. H. Macmillan said further that the question was not one of Government interference with industry but the giving by Government of certain rights to industry by permissive legislation to undertake its own reorganisation. Under certain safeguards, majorities should have the right to govern.

During the debate, Mr. G. Le M. Mander advocated the establishment of a committee of national development to formulate a consistent and comprehensive policy for the development of our national resources and to co-ordinate the work of different Departments of State. Sir Herbert Samuel, referring to the dangers of bureaucracy, emphasised the importance of management. The ablest leaders of industry, he said, are themselves in favour of larger measures of reorganisation for the industries in which they are engaged. The opposite point of view was voiced by Mr. R. Assheton in a brilliant plea for independence and the adventurous spirit in industry on which progress primarily depends, and which is liable to be stifled by rigid organisation. The dangers of eliminating small enterprises were real and Mr. Assheton feared the effect of planning on business confidence. Mr. W. Runciman, for the Government, emphasised the success of voluntary schemes of industrial reorganisation and referred to some of the failures in rationalisation. He expressed the opinion that the reorganisation of all the great industries of Great Britain cannot be achieved by one and the same effort. The motion was by leave withdrawn.

Development of Colonial Forest Resources

The Secretary of State for the Colonies has set up an organisation under the Colonial Office for the development of colonial forest resources. By consent of the Department of Scientific and Industrial Research, two of its technical officers have been transferred to the new organisation, namely, Major F. M. Oliphant, lately assistant director of the Forest Products Research Laboratory, Princes Risborough, and Major J. R. Cosgrove, lately in charge of the Section of Utilisation at the Laboratory. Major Oliphant, as forest economist, will deal mainly with the organisation of production, and will spend much of his time in the Dependencies concerned, while Major Cosgrove, as market development officer, will be engaged in market promotion work, with reference to the United Kingdom market and other markets, both British and foreign. The organisation will be chiefly concerned with timber development, but will also interest itself in other forest products, such as wood pulp, fibres, gums and resins and the like. In both directions it will co-operate with the Imperial Institute. It will also work, of course, in close co-operation with the Forest Products Research Laboratory. The Laboratory, as a research institution, will henceforward confine itself to questions involving scientific investigation and tests, while the new organisation will take over the market promotion work, including commercial service trials, which the Laboratory formerly carried out under temporary arrangements on behalf of the Empire Marketing Board. The organisation will for the present be quartered at the Imperial Institute. Inquiries should be addressed to the Colonial Forest Resources Development Department, Imperial Institute, London, S.W.7.

Statistics of Industry in England and Wales

Statistics of industry derived from the 1931 census of England and Wales have recently been published (London: H.M. Stationery Office, 32*s*. 6*d*.), and as the analysis is on a more comprehensive scale than any hitherto published, the volume is of exceptional interest. A valuable feature is the rough comparison with previous censuses, examples of which are given in the following table:

Industry	1911	1921	1931
	Persons (in thousands)		
Coal Mining	971	1,133	1,030
Iron and Steel	166	239	198
Building, Decorating	861	758	1,048
Agriculture	1,230	1,124	1,018
Cotton	628	596	571
Electrical Apparatus, etc.	80	166	268
Chemicals, Paints, Oils	133	198	211
Hosiery	59	80	110

In certain industries, for example, coal mining, iron and steel, engineering and shipbuilding, exceptional expansion took place during the War, but this was followed by a considerable readjustment during the last decennium. In others, for example, building, personal service, boots and shoes, there was a marked decline, but recovery followed after the War. The numbers engaged in agriculture, cotton and lace have declined in each census since 1911, though in poultry

farming there has been an increase from 12,200 persons in 1921 to 27,700 in 1931. The manufacture of electrical apparatus, chemicals, paints and oils; hosiery; food; printing and bookbinding; road transport; and a number of other industries have expanded considerably in both census periods since 1911. An interesting fact recorded in the latest census is a great increase in the number of male commercial travellers, from 81,347 in 1921 to 120,212 in 1931.

Economic Study of Japan's Population Problems

"CONFLICT and Co-operation, Economic and Political, in the Pacific" formed the theme of the Cawthron Lecture, 1934, delivered by Mr. Frank Milner, at Nelson, New Zealand (Nelson, N.Z.: Cawthron Institute, 1934). There are, he said, ominous explosive potentialities in Japan's growing population pressure with its increase of more than one million per annum. Her population density is now 437 persons to the square mile, and though this is exceeded by Java, Belgium, England and Holland, the situation is complicated by the fact that only 16 per cent of the land is arable. With 2,774 persons living on each square mile of such land—not a foot of land being wasted—Japan has reached the point of complete saturation. Half the farms are less than $1\frac{1}{2}$ acres in extent and three-quarters less than $2\frac{1}{2}$ acres. The Japanese are not an emigrating people, and there are only about 635,000 living abroad. The only feasible solution of the basic population problem of Japan is the development of manufacture and trade, though inadequate resources of coal, iron ore, petroleum and other raw materials handicap her industrial expansion. Moreover, Manchuria, according to scientific experts, cannot provide coal or iron ore of the type needed for Japanese blast-furnaces. The shift from an agricultural to an industrial economy is far from complete, and at present less than 10 per cent of the population work in factories employing more than five persons. Japan to-day is the real problem of the Pacific, and her isolation is breeding an ugly mood in her militarists. The solution may involve regional allocation of raw materials and markets to Japan involving heavy sacrifices, but such co-operative effort must be made if a cataclysm is to be avoided.

François Emmanuel Fodéré

THE centenary of the death of François Emmanuel Fodéré, who was born on January 8, 1764, is to be celebrated on April 12 at Strasbourg, where he was professor of medical jurisprudence from 1814 until 1834. His "Traité de médecine légale et d'hygiène publique ou de police sanitaire", of which the first edition was published in 1798 and the second in 1813, was the standard work in medical jurisprudence in France during the early part of the last century. In 1819 he was appointed lecturer in the history of epidemic diseases and hygiene at Strasbourg, his lectures being afterwards published in four volumes in 1822–24. His other works included "Traité du goître et du crétinisme, précédé d'un discours sur l'influence de l'air humide sur l'entendement humain" (1790), "Essai historique et moral sur la pauvreté des nations, la population, la mendicité, les hôpitaux et les enfants trouvés" (1825), "Recherches sur la nature, les causes et le traitement du Choléra-morbus" (1831) and "Essai sur les diverses espèces de folie" (1832).

Moses Maimonides

THE January issue of *Medical Life* is a Maimonides number containing an account by Prof. Louis Gershenfeld, of the Philadelphia College of Pharmacy and Science, of the Hispano-Jewish physician, astronomer and theologian, Moses Maimonides or Abu Amran Musa Ben Maimon, on the occasion of the octocentenary of his birth. Born at Cordova in Spain on March 30, 1135, he studied under Averrhoes, and in 1160 left Spain for Fez, finally settling in 1165 at Cairo, where he died on December 13, 1204. His best-known medical work is a collection of 1,500 aphorisms from Galen's writings with forty-two critical comments. His other chief medical works are a treatise on diet and personal hygiene written at the request of Saladin's eldest son, who suffered from melancholia, and a book on poisons and antidotes. In a work on astronomy, he recognised the limitations of astrology, and declared that all works on the subject were the products of fools. He differentiated between astrology and astronomy, maintaining that in the latter only was to be found true and necessary knowledge. His most famous work, however, was the "Guide for the Perplexed", which was not intended for popular consumption, but claimed to be written by a philosopher to the philosophically minded, his purpose being to reconcile Aristotelian philosophy with Jewish theology and the doctrines of Judaism.

Water with Heavy Oxygen

THERE has recently been erected in the Chemistry Department of the University of Manchester an apparatus of the type first described by Hertz (*Z. Phys.*, 79, 108; 1932) and afterwards modified by Harmsen (*Z. Phys.*, 82, 589; 1933) for the separation of gaseous isotopes by diffusion. The immediate object is to prepare oxygen containing an excess over the normal of the O^{18} isotope. For this purpose it is convenient to diffuse water vapour rather than oxygen itself. The abundance of H_2O^{18} is approximately 1 : 500 and the ratio of the vapour densities of the 'heavy' and 'normal' water is 10 : 9. The apparatus was designed to yield water containing about one per cent of H_2O^{18}. The process of separation is very much slower with water vapour than with permanent gases owing to the adsorption of the vapour on the walls of the porous tubes used for the diffusion. This adsorption is large even at 100° C. A trial run just completed has yielded about 20 mgm. of water the density of which is greater than normal by about 25 parts per million, which is scarcely if at all outside the experimental error of the density measurement. The apparatus is now being modified somewhat to allow of faster working, and it is hoped that it will yield about 20 mgm. a day of water

containing 0·5 to 1 per cent of H_2O^{18}. The water so obtained (or the oxygen prepared from it) will be used as an 'isotopic indicator' in reactions involving oxygen. A specimen of such water prepared by Hertz has already been used to investigate the mechanism of saponification of esters (Polanyi and Szabo: *Trans. Faraday Soc.*, 30, 508; 1934.)

The Naturalist in the Laboratory

SIR FREDERICK GOWLAND HOPKINS delivered the Bacot Memorial Lecture entitled "The Naturalist in the Laboratory" before the London Natural History Society on April 2. Sir Frederick pointed out that early biology was limited to study of the physiology and morphology of plants and animals (chiefly vertebrates), the causes which affected them being largely conjectural; the chemist provided means of elucidating these problems. Observation of the bombardier beetle and its explosive excretion first attracted Sir Frederick's notice to these matters fifty-seven years ago, and despite this first experiment proving fruitless, it was this which led to his taking up biochemistry. The work of the biochemist in comparing the action of catalysis with enzymes has established the processes at work which enable both plant and animal to digest and transform food materials into substances suitable for oxidation to enable life to continue. But it does not stop there, for it has shown the relationship between species by the parallel processes carried on in similar species, and that each species may have its own process. A further stage has been to show the necessity for certain substances to allow the full utilisation of food supplies. Known as vitamins, they provide the means for the body to obtain enough fuel to supply full growth and reduce vulnerability to disease. Although systematic, taxonomic, morphological and physiological research must continue, and the biochemist can still open new avenues for exploration, there is every scope for wide co-operation between all branches of natural history from an ecological point of view. Finally, although exact chemical reactions in plant and animal can be ascertained and reproduced experimentally, and although living tissues can be made to function under artificial conditions, the origin and nature of life is a matter which scientific research has yet to explain.

A New Wind Tunnel

THE new 24-ft. wind tunnel at the Royal Aircraft Establishment, Farnborough, opened by the Secretary of State for Air on April 5, is the largest in Great Britain. It can contain a complete aeroplane, all of the machine except the outer portions of the wings being in the air stream and under observation. Air speeds equivalent to 115 miles per hour are obtained. The principal immediate use of this type of tunnel is the investigation of 'interference' between various bodies in juxtaposition, such as airscrews and engine cowlings, which cannot be studied precisely upon small-scale models. Such problems cannot be examined as fully as is necessary in actual flight owing to the uncertainty of the steadiness of the air at the moment of taking an observation, and moreover, such experimental flying with new and untried design ideas involves considerable risk, and often delay, in bad weather. This tunnel is not the largest in the world, there being a 60 ft. × 30 ft. one at Langley Field, United States, and a 50 ft. span one in France (see NATURE, Feb. 16, 1935, p. 252). It is interesting to note that one of the first machines to be investigated in this channel will be a new one that has exceeded its anticipated performance in certain respects by so much as to shake confidence in the accepted methods of estimating the total air resistance of combinations of differently shaped bodies.

Shortt Clock at the Science Museum

A SHORTT free pendulum clock has recently been installed at the Science Museum, South Kensington, and is now at work controlling the main public dials of the Museum. The Shortt clock was perfected by Mr. W. H. Shortt in 1921 as a result of a long period of experimental work in association with Mr. F. Hope-Jones and the Synchronome Company; the first clock was set up at the Edinburgh Royal Observatory in 1921, and Prof. R. A. Sampson's report on its first year's run aroused great interest among astronomers, as it had proved to have surpassed all previous clocks in its accuracy. A Shortt clock was adopted as the sidereal standard at Greenwich at the beginning of 1925, and has proved itself capable of measuring time to an accuracy of a few thousandths of a second per day, or better than 1 in 10^7. The clock now exhibited in the Science Museum is identical with these observatory clocks except that the usual exhausted copper case for the free pendulum is replaced by a dust-tight glass cylinder: the clock is mounted on the wall of a public gallery with its slave clock by its side. The delicate method of imparting an impulse to the free pendulum and the action of the hit-and-miss synchroniser can thus be studied in detail.

Excavations at Jericho, 1934–35

DURING the season which has just closed, Sir Charles Marston's archæological expedition to Jericho, of which Prof. John Garstang is field director, has penetrated to the neolithic levels of earliest occupation which, it is found, cover a considerable portion of the site, under deposits of the Early Bronze Age measuring 27 ft. thick. In the neolithic levels, forming a layer 18 ft. deep, were found sealed deposits in the form of a series of superimposed house structures, in which the floors had been plastered, coloured red, and burnished. There is evidence to show that the walls of these structures had been treated in a similar fashion. One of the most interesting finds, according to a dispatch reporting the results of the excavation in *The Times* of April 4, is the head of a cult image of human form made of unbaked clay, in which the eyes are represented by shells. It was found in association with sherds of Thessalian painted pottery and fragments of primitive local ware immediately below the Early Bronze Age levels. The flint

industry of the neolithic levels is of the characteristic Palestinian type. Although Palestine is not likely to rival Iraq in the number and intrinsic value of its archæological finds, the sense of its importance grows as further exploration brings to light cumulative evidence of the part it played as a meeting place of cultural influences from a diversity of directions.

Portrait of Owen at the Natural History Museum

THE Trustees of the British Museum have received by the bequest of Mr. Cyril B. Holman-Hunt, who died last year, the portrait of Sir Richard Owen, which was painted in 1881 by his father, the well-known artist, William Holman-Hunt, O.M. It has been hung on the east pier near the main entrance in the Central Hall of the Natural History Museum. The picture was in the possession of the artist's daughter, Mrs. Joseph, but she readily acceded to her brother's wishes as expressed in his will, and arranged for its transference from the Athenæum, where it was temporarily on loan. In the picture, Owen is depicted in Hunter's gown seated in an armchair. The position in the Central Hall is far from suited to a glazed picture, but it is the best at present available in the building; the trustees have, however, undertaken to provide one more satisfactory whenever the public part of the Museum is extended. It is fitting that the portrait should find a place at South Kensington, because Owen was superintendent of the Natural History Departments of the British Museum from 1856 until 1884. He had therefore a great say in the planning of the new building and the allocation of space in it to the several departments, and was in control when the building was opened to the public, on April 18, 1881. Incorrectly but justifiably, he is usually known as the first director of the Museum. In addition to the distinction of the subject, the picture has considerable interest as a work of art, because the eminent artist seldom engaged in portraiture, and only about five examples of that side of his work are known.

British Empire Cancer Campaign

AT the fifty-fourth meeting of the Grand Council of the British Empire Cancer Campaign held on April 10, it was announced that a grant at the rate of £350 a year for the year 1935 has been made to Sir Leonard Hill for the services of Dr. T. Reiter whilst continuing his research work on short wave therapy in the laboratories of the St. John Clinic and Institute of Physical Medicine. On the recommendation of the Physical Sub-Committee of the Scientific Advisory Committee, a grant of £1,000 a year for two years has been made to the North of England Council of the Campaign, to be placed at the disposal of Prof. W. E. Curtis, of the Armstrong College, Newcastle, and Dr. F. Dickens, research director of the Cancer Research Institute of the North of England Council, for the purpose of conducting an exhaustive scheme of research in short wave therapy. A grant of £700 has been placed at the disposal of the Scientific Advisory Committee for a special investigation, under its supervision, of the biological reactions of monochromatic radiations of various wave-lengths. The Grand Council has decided to continue to offer from time to time a prize and medal for the best essay submitted on a set subject concerning cancer research; gold medals will also be awarded from time to time to those in the British Empire who have carried out and published contributions to cancer research of outstanding merit.

New Mount Everest Expedition

THE Mount Everest Committee announces that another Mount Everest Expedition will take place during 1935–36, with the consent of the Tibetan Government. Mr. Hugh Ruttledge, who led the 1933 expedition, has been offered, and has accepted, the leadership. The Committee, the chairman of which is Sir Percy Cox, will in due time make an announcement of plans. The first Mount Everest expedition under Col. H. Bury was in 1921. This was followed by a second expedition under General C. G. Bruce in 1922, and a third under Lieut.-Colonel E. F. Norton in 1924. On that expedition, Mr. G. A. Leigh-Mallory and Mr. A. C. Irvine lost their lives in the last thousand feet of the ascent, but it is not improbable that they reached the summit. The fourth expedition, in 1933, met with exceptionally bad weather conditions and was forced to abandon the attempt when success seemed to be within sight. In 1933, the Houston Mount Everest expedition made a flight over the summit and secured photographs.

Field Trials of Agricultural Crops

FURTHER reports of the field trials carried out in Great Britain under the auspices of the National Institute of Agricultural Botany have been published in its *Journal* (vol. 3, No. 3. 2*s*. 6*d*.). As before, stress is laid on the necessity for carrying out the experiments at several centres simultaneously, and for repeating them for three consecutive years, before really reliable recommendations can be made. The results of the trials of cereals in Essex (1927–29) are now complete. 'Yeoman' and 'Yeoman II' proved by far the best of the winter wheats, and all autumn sown varieties were on an average £3 per acre more valuable than those sown in the spring. As regards barley, 'Plumage Archer' was the most generally grown, although 'Spratt Archer' gave quite as satisfactory yields. Autumn sowing if successful was profitable, a gain of £2 per acre being obtained, but the risk of bad winter conditions has, of course, to be taken into account. 'Grey Winter' proved the hardiest and best yielder of the winter oats grown, but both standing and yielding capacity were lower than desired. Spring oats generally gave a higher yield than winter varieties. In every case the advisability of early sowing is emphasised, not later than the middle of November for autumn sowing, and during February for the spring varieties. The growing of named, rather than unknown, varieties is also of the first importance, as it may mean a difference of as much as £3–£4 per acre in the value of the return. Results from potato and sugar beet trials are also given, and

the publication concludes with the fourteenth annual report of the Official Seed Testing Station for England and Wales.

Humane Slaughter

IN the thirteenth annual Benjamin Ward Richardson Lecture which was delivered before the Model Abattoir Society on November 27 and has just been published, Sir Leonard Hill, who had chosen for his subject "Electric Methods of Producing Humane Slaughter", maintained that Richardson's aim for humane slaughter was fulfilled by the introduction of the electric stunning instrument, which was a safe process and free from the objections made against shooting. The current is obtained from the usual 200 volt 50 cycle A.C. lighting current, and is reduced to 50 volts by a transformer. The electrodes, which are at the ends of the jaws of a tong-like instrument, are applied for 5 seconds in the case of pigs and for 20 seconds in the case of cattle, after soaking in 20 per cent saline, one on each side of the jaw of pigs, and between the eyes and ears of calves and sheep. The old method of electrocution, which caused violent contractions and even rupture of and hæmorrhage into the muscles, is avoided by this process, and no spilling of blood occurs.

Geographical Methods and Earth Stucture

THE Pontifical Academy of Sciences of the Vatican City announces the offer of a prize of 10,000 lire, to be awarded for an original, unpublished thesis dealing with the utilisation of geophysical methods in the investigation of the interior of the earth. Scientific men of all nationalities are invited to submit theses, five typewritten copies of which, in French, Italian or Latin, should reach the Academy before November 1 of this year. No ordinary member of the Academy, whether resident in Rome or elsewhere, is eligible to compete. The name of an author may be appended to his thesis or, alternatively, the authorship may be indicated by a motto or sign. In the latter event, the name of the author should be enclosed in an envelope marked outside with the motto or sign. A special committee, nominated by the Academy, will judge the theses submitted, and the award will be presented to the successful author at the first meeting of the next session of the Academy, to be held in December.

Fifty Years of Chemical Theory

THE Liversidge Research Lecture delivered before the Australian and New Zealand Association for the Advancement of Science in January by Sir D. Orme Masson dealt with "Crucial Advances in Chemical Theory during the last Half-Century". The lecture gave a brief summary of the initiation of the theory of solution and electrolytic dissociation, the discovery of the inactive elements, X-rays, radioactivity, atomic numbers and the nuclear theory of the atom, isotopes, positive rays and a generalised formula for the structure of all atoms proposed by the lecturer in 1921. The latter states that, if p is a proton, e an electron, N the atomic number and A the true integral mass of the atom, with n (necessarily integral) equal to the difference $A - 2N$, then every neutral atom may be represented by the formula $[(p_2e)_N\ (pe)_n]e_N$, in which the nucleus is enclosed in the square bracket and the external electronic system is outside it. In the case of hydrogen, $n = -1$. The groups pe and p_2e have since been discovered in the neutron and the heavy hydrogen nucleus, respectively.

The Ray Society

AT the annual general meeting of the Ray Society on March 20, the following officers were re-elected: *President*, Sir Sidney Harmer; *Treasurer*, Sir David Prain; *Secretary*, Dr. W. T. Calman. Prof. F. E. Weiss was elected a vice-president, and Mr. R. Adkin, Dr. Stanley Kemp, and Mr. E. A. Robins were elected new members of Council. In the report of the Council it is announced that the second and final volume of Prof. Stephenson's work on British sea anemones is about to be issued, and it is stated that the publication of this finely illustrated and costly work has been rendered possible by contributions from the Government Grant Fund of the Royal Society, and from several private donors, among whom Mr. J. Spedan Lewis is specially mentioned. It is announced that the issue to subscribers for the current year will be the first volume of a work on British Neuroptera by Mr. F. J. Killington.

Thunderstorm Survey

MR. S. MORRIS BOWER, of Langley Terrace, Oakes, Huddersfield, informs us that the annual survey of thunderstorms in the British Isles which he has instituted will be continued during the coming summer. Mr. Bower will be glad to receive details as to the place, date and time of the occurrence of thunder, lightning or hail. Records of damage by lightning will also be especially welcome. The space and time distribution maps of thunder have recently thrown useful light on the question of storm travel, and on its association with meteorological and geographical considerations. The areas of greatest damage by lightning are not necessarily those of maximum storminess, and in view of the value of the determination of such areas in electric power transmission, it is proposed to pay particular attention to this aspect of the survey.

Benefaction for Research into Short-wave Therapy

THE Medical Research Council has agreed to act as trustee in administering a benefaction of £4,000 provided by the Stock Exchange Dramatic and Operatic Society and named in honour of the secretary of the Society, Mr. Hugh S. Quekett. The purpose of the gift is the promotion of research into the value of short-wave radiation in the treatment of disease. The money will be used by the Council to meet the cost of assistance and special apparatus in experimental and clinical investigations to be made at the London Hospital under the direction of Prof. D. T. Harris, Dr. E. May, and Sir Robert Stanton Woods.

First Shipment of Petrol from Billingham

PENDING the completion of the erection of the plant for the direct hydrogenation of coal, the first

shipment of petrol, some 300,000 gallons, produced by the hydrogenation of creosote at the Billingham plant of Imperial Chemical Industries Ltd., has been loaded into the s.s. *Otterhound*, at Billingham. The petrol is being delivered to the Shell-Mex-B.P. Company which, with the Anglo-American Company, are undertaking distribution on behalf of the producers. This delivery initiates regular traffic between Billingham and east coast ports of Great Britain.

Announcements

PROF. F. G. DONNAN, professor of general chemistry in the University of London, has been elected an honorary member of the Chemical Society of Rumania. Prof. Donnan has also been invited by the Danish Natural Science Association to give three lectures in Copenhagen during the week beginning May 20.

HIS MAJESTY THE KING has approved the award of the Royal Medals of the Royal Geographical Society as follows: Founder's Medal to Major R. A. Bagnold, for his journeys in the Libyan Desert; Patron's Medal to Mr. W. Rickmer Rickmers, for his long-continued travels in the Caucasus and Russian Turkistan culminating in his leadership of the Alai-Pamir Russo-German Expedition of 1928. The Council has awarded the Victoria Medal to Mr. E. J. Wayland, for his work on the Quaternary geology of Uganda and the Rift, and its relation to man.

THE Gold Medal of the Institution of Mining and Metallurgy has been awarded to Mr. Alfred Chester Beatty, in recognition of his distinguished services to the mining industry in the development of mineral deposits, with particular reference to the copper resources of Northern Rhodesia. The following awards have also been made: the Consolidated Gold Fields of South Africa Ltd. Gold Medal to Dr. David Williams, for his geological researches and for his paper on "The Geology of the Rio Tinto Mines, Spain"; the consolidated Gold Fields of South Africa Ltd. Premium of forty guineas to Mr. William Henry Wilson, for his paper on "The Tri-dimensional Projection of Mine Workings"; the Arthur Claudet Students Prize of ten guineas to Mr. Charles Patrick McMillan, for his paper on "Milling Methods and Costs at the Alaska Mine Flotation Plant of the Southern Rhodesia Base Metals Corporation, Limited, Southern Rhodesia"; the William Frecheville Students Prize of ten guineas to Mr. James G. Traill, for his paper on "The Relation between Width and Cost in Narrow Stopes".

MR. B. H. ST. JOHN O'NEIL has been appointed inspector of ancient monuments for Wales. He has been assistant inspector of ancient monuments for Wales since 1930.

THE following have been elected officers of the Royal Aeronautical Society for 1935–36: *President*, Lieut.-Colonel J. T. C. Moore-Brabazon; *Vice-President*, Mr. H. E. Wimperis; *New Members of Council*, Major T. M. Barlow, Major G. P. Bulman, Dr. H. Roxbee Cox, Prof. G. T. R. Hill, Dr. N. A. V. Piercy; *Honorary Treasurer*, Major D. H. Kennedy; *Honorary Librarian*, Mr. J. E. Hodgson.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. F. C. Jessop, to be adviser in animal husbandry, Department of Agriculture, Malta; Mr. J. B. Polding, to be veterinary pathologist, Malta; Mr. R. N. Twisleton-Wykeham Fiennes, to be veterinary officer, Uganda; Mr. H. C. King (late assistant conservator of forests, Ceylon), to be assistant conservator of forests, Mauritius; Mr. F. B. Wade (senior assistant geologist), to be Government geologist, Department of Lands and Mines, Tanganyika; Mr. E. B. L. Colborne, to be engineering chemist, Public Works Department, Gold Coast.

IT is probable that the Challenger Society will be making further grants in aid of research during the year 1935–36. The General Committee is prepared to consider applications for small grants in aid of research in marine biology at a recognised laboratory during the current year. Applications, accompanied by details of the proposed research, should reach the Honorary Secretary, Mr. J. R. Norman, British Museum (Natural History), S.W.7, before the end of April.

THE original autograph manuscript of Alcide d'Orbigny's celebrated work "Foraminifères" which formed part of Ramon de la Sagra's "Histoire Physique, Politique et Naturelle de l'Île de Cuba" (Paris, 1839), has been acquired for, and added to, the Heron-Allen Library of Foraminiferal Research at the British Museum (Natural History).

PROF. A. Wolf's work on the beginnings of modern science and technology will be published shortly by Messrs. Allen and Unwin, Ltd., under the title "A History of Science, Technology and Philosophy in the Sixteenth and Seventeenth Centuries". The book is a comprehensive account of one of the most interesting scientific periods in the world's history, and is profusely illustrated from old prints.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Engineers for the Building Research Station, Garston, and two junior scientific officers at the Road Research Laboratory, Harmondsworth—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 17). A teacher of mechanical engineering in the Ipswich School of Engineering—The Secretary for Education, Tower House, Ipswich (April 18). A lecturer in zoology in the University of Capetown—The Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (April 30). An assistant lecturer in mechanical engineering in the University of Sheffield—The Registrar (May 3). An analyst and demonstrator at the Harper Adams Agricultural College, Newport, Shropshire—The Principal. A director of pathology and Lyle research scholar at Queen Mary's Hospital for the East End, Stratford, E.15—The Secretary.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 587.

Correspondents are invited to attach similar summaries to their communications.

Radiopotassium and other Artificial Radio-elements

In a letter published in Nature of January 19, it was shown that the bombardment of scandium with neutrons leads, beside the formation of an active scandium isotope[1] $_{20}Sc^{46}$, to the formation of a new potassium isotope $_{19}K^{42}$ having a half-life value of about 16 hours and emitting β-rays the intensity of which is reduced to one half of its initial value by an aluminium foil of approximately 0·7 mm. thickness. We were recently successful in preparing this potassium isotope K^{42} by the bombardment of calcium by neutrons according to the equation :

$$_{20}Ca^{42} + {}_0n^1 = {}_{19}K^{42} + {}_1H^1.$$

Calcium carbonate, after being exposed to neutrons produced by a mixture of 200–300 mgm. radium emanation and beryllium powder, was dissolved in dilute hydrochloric acid, 150 mgm. sodium chloride added and the calcium precipitated as oxalate. The filtrate was found to be active and the measurement of both the rate of decay and the absorption of the radiation emitted has shown the presence of $_{19}K^{42}$. The yield of K^{42} from calcium is a low one, which is due chiefly to the fact that the isotope Ca^{42} is only present to the extent of 0·8 per cent in the mixed element calcium. It is now possible to produce the potassium isotope K^{42} by each of the following reactions :

$$(1)^2 \quad {}_{19}K^{41} + {}_0n^1 = {}_{19}K^{42};$$
$$(2) \quad {}_{20}Ca^{42} + {}_0n^1 = {}_{19}K^{42} + {}_1H^1;$$
$$(3) \quad {}_{21}Sc^{45} + {}_0n^1 = {}_{19}K^{42} + {}_2\alpha^4.$$

When applying neutrons slowed down by Fermi's device by reflection by hydrogen nuclei, an active calcium isotope was obtained which decays with a period of 4 hours, the formation of which is due to one of the following two reactions :

$$_{20}Ca^{40} + {}_0n^1 = {}_{20}Ca^{41};$$
$$_{20}Ca^{44} + {}_0n^1 = {}_{20}Ca^{45};$$

the latter being the more probable one.

We investigated also the action of neutrons the velocity of which was reduced by the use of paraffin, on zirconium and hafnium, and found that the active zirconium obtained decays with a period of 40 hours, the intensity of the β-rays emitted being reduced to one half of its initial value by an aluminium foil of 0·5 mm. thickness. The disintegration of the active hafnium is much slower than that of zirconium, half of the activity acquired being lost only after the lapse of a few months. Radio-zirconium is presumably formed according to the equation

$$_{40}Zr^{96} + {}_0n^1 = {}_{40}Zr^{97}.$$

In the case of hafnium, every place between the mass numbers 176 and 180 being occupied by a known stable isotope, the formation of the active hafnium isotope can only be due to the process :

$$_{72}Hf^{180} + {}_0n^1 = {}_{72}Hf^{181}.$$

On emitting β-rays, according to the equation,

$$_{72}Hf^{181} = {}_{73}Ta^{181} + \beta,$$

the active hafnium isotope becomes the only stable isotope of tantalum known.

G. Hevesy.
Hilde Levi.

Institute of Theoretical Physics,
Copenhagen.
March 15.

[1] cf. G. Hevesy, *Proc. Roy. Danish Acad.*, Feb. 3, 1935.
[2] Amaldi, D'Agostino, Fermi, Pontecorro, Rasetti and Segrè, *Ricerca Scientifica*, Dec. 2, 1934.

Extension of the Ultra-Violet Wave-Length Limit

The best light source for the spectroscopy of the extreme ultra-violet region is the hot spark. In the spectroscopic work at this Institute, the electrodes of the spark are usually connected through short straight leads to four condensers having a capacity C of 0·4 μF. together. These are charged to a tension V = 50–70 kv. The discharge through the spark is periodic with a period T of about 8 μ sec. (corresponding to a wave-length of 2,400 metres). The maximum current in the spark is

$$i_{max.} = V\sqrt{\frac{C}{L}} = 2\pi\frac{CV}{T}.$$

If in our case, V = 50 kv., we have $i_{max.}$ = 16,000 amp. If we wish to increase the current in the spark we have to increase the tension V, which is possible only to a certain extent. Further, we can increase the capacity C, but this gives a rather slow increase in i. Finally, we can decrease the inductance in the circuit.

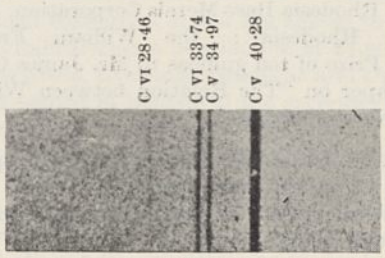


Fig. 1. Spectrum of spark between carbon electrodes. Time of exposure ½ hour. Focused at about 30 A.

Now the straight leads from the condensers to the spark do not give the minimum inductance. In fact, if we 'cable' the leads so that the current flows in the interior of a cable in one direction and returns

on the outside of the cable, the resulting inductance decreases considerably.

We have connected each of the four $0{\cdot}1\,\mu F$. condensers through three cables to the electrodes of the spark. This diminishes the resulting inductance to almost 0·1, so that the period decreases to one third and the maximum current increases three times. At 50 kv. we then have $i_{max.} \sim 47{,}000$ amp. (if the discharge is still periodic).

We have investigated the spectroscopic effect of this increase in the spark current with the help of a concave grating spectrograph having the plate at right angles to the Rowland circle[1]. The grating had a radius of 1,800 mm. and was ruled at this institute with 288 lines a millimetre. The angle of incidence was 1·65°.

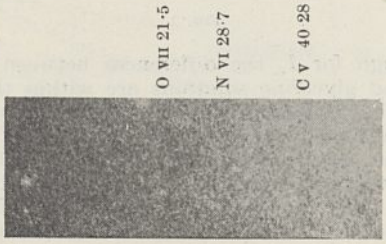


FIG. 2. Spectrum of spark between carbon and carbon + lithium nitrate electrodes. Time of exposure 2½ hours. Focused at about 20 A.

With the condensers connected in the usual way, we have obtained with graphite electrodes the C V-line at 40 A. rather well. The C V-line at 34 A. and the C VI-line (the first line of the Lyman series) at 33 A. were faint but visible after half an hour's exposure.

When the condensers were 'cabled', the intensity of these lines increased very much, especially the C VI-line. Moreover, the second Lyman line of C VI at 28 A. was detected.

When some lithium nitrate was placed in one of the carbon electrodes, the first N VI-line at 28 A. and the first O VII-line at 21 A. became visible after about 1 hour. With aluminium electrodes, some Al XI-lines down to 38 A. appeared.

Thus the short wave limit of the ultra-violet has been extended from 33 A.[2] down to 21 A.

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Feb. 20.

[1] M. Söderman, Diss., Uppsala, 1934.
[2] Manne Siegbahn and M. Söderman, NATURE, **129**, 21; 1932.

Magnetic Properties and Critical Currents of Supra-conducting Alloys

IN previous papers[1] we reported that, in the stable state of supra-conducting lead, the induction B is always zero. We shall now discuss measurements carried out with a lead–thallium alloy corresponding in composition to $PbTl_2$ and an alloy of 65 per cent lead and 35 per cent bismuth. The measurements were made at various temperatures with the method we have previously described (method No. 2)[2].

In Fig. 1 is shown the relation between induction B and field-strength H for $PbTl_2$ at $T = 2{\cdot}11°$ K. The experiments show that:

(1) Up to a definite critical field-strength H_{k_1}, which depends on the temperature, B remains nearly zero. In this region the behaviour of alloys and pure metals is the same.

(2) In the field interval from H_{k_1} to H_{k_2}, the induction increases with the field-strength, gradually approaching the value characteristic for the non-supra-conducting metal. Electrical measurements carried out on wires from the same melt showed that the potential difference remains equal to zero right up to the field-strength H_{k_2}. In the field interval from 0 to H_{k_2} the induction is independent of time.

(3) At the second critical field-strength H_{k_2}, which is 1700 gauss at $T = 2{\cdot}11°$, the alloy loses its supra-conductivity. The magnetic properties undergo no change at this point.

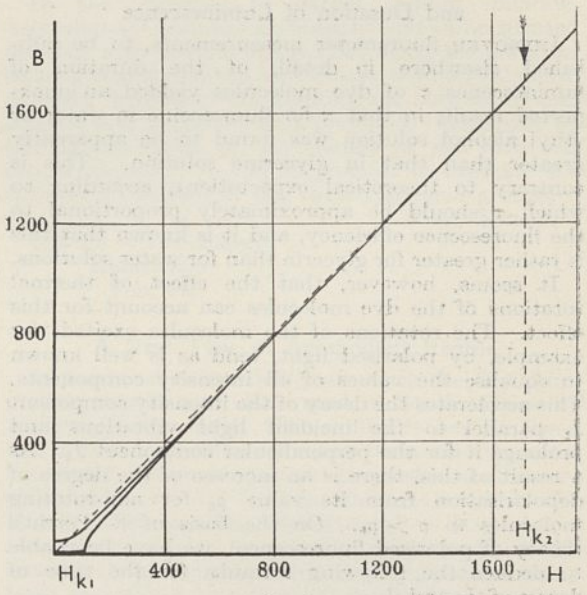

FIG. 1.

(4) When the field-strength is then decreased, a slight hysteresis is observed and at zero field-strength a small residual magnetisation remains, which does not depend on time.

The critical temperature was determined by measuring the electrical conductivity and the magnetic properties, and was found in both cases to be 3·75° K. At all temperatures below T_0 the relation between B and H corresponds to Fig. 1. Above T_0 the magnetic permeability is unity, which denotes that there are no nuclei of free lead in the alloy.

The experiments with the Pb–Bi alloy gave qualitatively similar results.

We have already published measurements on the specific heat of the lead–bismuth alloy[3] showing that no appreciable jump in the specific heat was observed at T_0. Thus the specific heat and the magnetic measurements are not in agreement with Gorter's theory[4].

Finally, we can report on some measurements of the critical electric current in the $PbTl_2$ alloy which destroys supra-conductivity. Wires of this alloy 0·71, 0·33 and 0·26 mm. in diameter were prepared. The appearance of a resistance was observed as the current was gradually increased. The experiment

was performed at various temperatures. We found that supra-conductivity is destroyed when the magnetic field at the surface of the wire reaches a definite critical value. The critical field-strength caused by the current is slightly less than H_{k1}.

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Kharkov.

[1] J. N. Rjabinin and L. W. Shubnikow, *Sov. Phys.*, **5**, 641; 1934. NATURE, **134**, 286; 1934. *Sov. Phys.*, **6**, 557; 1934. NATURE, **135**, 109, Jan. 19, 1935.
[2] J. N. Rjabinin and L. W. Shubnikow, NATURE, **134**, 286; 1934. *Sov. Phys.*, **6**, 557; 1934.
[3] L. W. Shubnikow and W. J. Chotkewitsch, *Sov. Phys.*, **6**, 605; 1934.
[4] C. J. Gorter, *Arch. Mus. Teyler*, **7**, 378; 1933.

Thermal Rotations of Fluorescent Molecules and Duration of Luminescence

IMPROVED fluorometer measurements, to be published elsewhere in detail, of the duration of luminescence τ of dye molecules yielded an unexpected result, in that τ for fluoresceine in water or ethyl alcohol solution was found to be apparently greater than that in glycerine solution. This is contrary to theoretical expectations, according to which τ should be approximately proportional to the fluorescence efficiency, and it is known that this is rather greater for glycerin than for water solutions.

It seems, however, that the effect of thermal rotations of the dye molecules can account for this effect. The rotations of the molecules excited, for example, by polarised light, tend as is well known to equalise the values of all intensity components. This accelerates the decay of the intensity component I_1 parallel to the incident light vibrations and prolongs it for the perpendicular component I_2. As a result of this, there is an increase of the degree of depolarisation from its value ρ_0 for non-rotating molecules to $\rho > \rho_0$. On the basis of F. Perrin's theory of polarised fluorescence[1], we have been able to deduce the following formulæ for the time of decay of I_1 and I_2:

$$I_1 = \frac{I_0}{3}\left[1+2\rho_0+2\,(1-\rho_0)\,\exp.\left(-\frac{3\,(\rho-\rho_0)}{\tau\,(1-\rho)(1+2\rho_0)}\,t\right)\right] \cdot \exp.\left(-\frac{t}{\tau}\right), \quad (1)$$

$$I_2 = \frac{I_0}{3}\left[1+2\rho_0-(1-\rho_0)\,\exp.\left(-\frac{3\,(\rho-\rho_0)}{\tau(1-\rho)(1+2\rho_0)}\,t\right)\right] \cdot \exp.\left(-\frac{t}{\tau}\right), \quad (2)$$

where I_0 is the value of I_1 for $t = 0$. The full argument will appear elsewhere.

From equations (1) and (2), it appears that the rates of decay are not exponential, but that they are a sum or a difference of two exponential functions. Only for $\rho = 1$ or $\rho = \rho_0$ are they exponential and corresponding to the mean life period of the excited molecules. In all other cases, for $\rho_0 < \rho < 1$, I_1 decays faster and I_2 slower than $e^{-t/\tau}$. As mentioned above, experiments have shown that for I_1 the observed time of decay $\tau_{obs.}$ of fluoresceine in glycerine solution is smaller by about 20 per cent than that for a water solution where $\rho = 1$. For I_2, however, the difference between the $\tau_{obs.}$ for water and glycerine solutions is within experimental errors, which were about 5 per cent.

Fig. 1 shows $\tau_{obs.}$ for I_1 and I_2 for fluoresceine as a function of ρ in different glycerine – water mixtures.

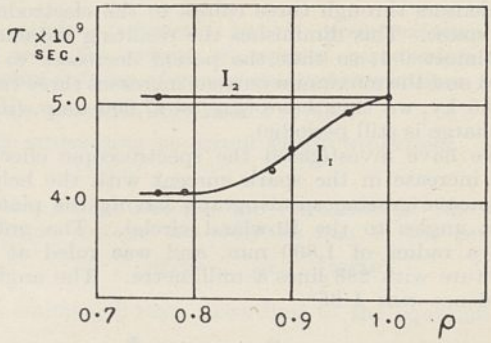

FIG. 1.

Although for I_2 the differences between $\tau_{obs.}$ for water and glycerine solutions are within the limits of experimental error and therefore cannot be at present detected experimentally, it seems that the hypothesis put forward above can give at least a qualitative explanation of the phenomena observed.

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Jan. 25.

[1] F Perrin, *J. Phys.*, VI, **7**, 390; 1926.

Polymerisation of Formaldehyde

EXPERIMENTS on the autoxidation of gaseous formaldehyde (at 100° C.) in the light of the mercury arc showed the existence of a rapid induced polymerisation, which continued unabated as a dark reaction on switching off the light. No oxidation occurred during this 'dark reaction'.

The cause was traced to the formation of formic acid in the illumination period. It was then found that the addition of small amounts of formic acid vapour to pure formaldehyde gas precipitated a rapid and complete polymerisation of the latter, the rate of which was uninfluenced by light. The pressure – time curves showing the progress of the polymerisation with varying concentrations of added formic acid are compared in Fig. 1. Whereas, even at so high an initial pressure of formaldehyde as 500 mm. of mercury, the thermal polymerisation normally proceeded only at a rate of about 16 mm. per hour, when 34 mm. of formic acid was present, the pressure fell at an initial rate equivalent to 2,295 mm. per hour—some 140 times as fast.

The apparatus used for these experiments contained a stopcock and a ground joint connecting the quartz reaction vessel to the glass portion of the system (which was electrically heated). Neither of these could be directly heated, and it was observed that the solid polymer separated mainly at the cold part. Experiments performed in a completely heated glass system, however, confirmed the observations made in the first apparatus—except that in this case there was a residual pressure, due probably to the presence of a gaseous polymer, and the solid polymer separated out on the hot wall.

The order of the reaction is approximately unimolecular over most of the range, and the rate is not appreciably affected by packing the vessel with

quartz tubes. The formic acid does not appear to be used up appreciably during the reaction, titration showing that practically as much remained at the end as was introduced initially.

Detailed considerations of these experiments have led us to the view that the polymerisation of formaldehyde, induced by formic acid, proceeds by a chain mechanism, in which the starting of reaction chains and also the branching are controlled kinetically by the formic acid.

The results suggest that it is probable that the stability of monomeric formaldehyde depends mainly upon its freedom from traces of formic acid vapour.

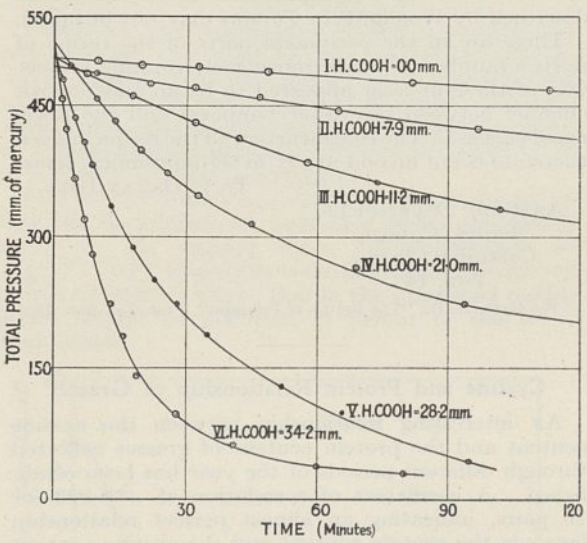

FIG. 1. Polymerisation of formaldehyde catalysed by formic acid.

We have found, further, that acetic acid is efficient as a polymerising agent, while preliminary experiments with acetaldehyde vapour at room temperature show that a similar polymerisation may be induced by formic acid. In this case the pure aldehyde appeared to be perfectly stable, but addition of 25·3 mm. of formic acid vapour to 298·2 mm. of acetaldehyde caused the pressure to fall at an initial rate of about 2 mm. per minute, and brought about a total diminution of pressure amounting to 162·7 mm. of mercury.

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Concentration and Ionising Tendency of Carboxylic Acid Groups in Cellulose and other Natural Products

CELLULOSE which has been subjected to oxidation with an alkaline oxidant is presumed to contain carboxylic acid groups, but does not show acid characteristics of the order usually associated with this group. The reason for this is that, whilst the carboxylic acid groups are ionised *within the cellulose phase*, the hydrions are unable to escape into external water, since the anions form part of the cellulose lattice.

A theoretical consideration of the ionic equilibria in the system 'oxycellulose' – dyestuff – water led to the expectation that the constraint on the movement of the hydrions would be overcome by the addition of a neutral electrolyte. Indeed, if the Donnan theory of membrane equilibrium is applicable, in presence of excess sodium chloride, the concentration of sodion, and therefore that of hydrion, in the external solution should become equal to the respective concentrations within the fibre.

A qualitative experiment showed in a striking manner the existence of this effect. A sample of 'oxycellulose', washed until the washings were neutral, was placed in water and methyl red (*p*H 4·2–6·3) added. The colour changed slowly towards a final *p*H of 5, on account of interchange between the indicator sodions (present in very low concentrations) and the carboxylic acid hydrions. When sodium chloride was added a very marked further change took place. Acid 'streamed' out the fabric and in a few seconds the colour indicated a *p*H below 4.

In the presence of excess sodium chloride, 'oxycellulose' becomes sufficiently acid to be titrated directly with sodium hydroxide, using an indicator turning slightly on the acid side of the neutral point. A ready method of determining the content of carboxylic acid groups is thus provided. Moreover, by the determination of the change of *p*H with salt concentration, it should be possible to evaluate the ionisation constant of the carboxylic acid groups.

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A New Type of Anomodont Reptile

IT is almost a hundred years since the first Anomodont reptile was discovered in South Africa by Andrew Geddes Bain. This skull was sent to Owen and in 1844 he described it under the name *Dicynodon lacerticeps*. Numerous other *Dicynodon* skulls were afterwards sent to London and are now in the British Museum (Natural History). The typical *Dicynodon* is very mammal-like in much of its structure, but is remarkable in having had a horny beak something like that of the tortoise, with in addition in the male a powerful permanently growing tusk in each maxilla and no other teeth.

During the latter half of the nineteenth century many species of *Dicynodon* were described, and a number of other genera more or less allied to it; and in the last thirty years our knowledge has increased so greatly that we now know about 130 species of *Dicynodon* and its allies. These are grouped in an order called the *Anomodontia*. Some have tusks in both sexes: some have no tusks in either sex. Some have a row or a number of rows of molar teeth. But all agree in that the premaxillaries are fused to form a beak, and hitherto no species has been known in which there are any teeth in the premaxillaries.

A couple of months ago I discovered in beds of the *Endothiodon* zone of the Karroo an imperfect little skull, which on being developed reveals a new type of palate in that there is a number of teeth on the premaxillaries. In many respects the skull resembles that of some of the small Endothiodonts, such as *Cryptocynodon* of Seeley, or *Prodicynodon* or *Emyduranus*; but the presence of at least seven teeth on each premaxilla separates it markedly from all previously known *Anomodonts*. These teeth are not like incisors, growing from the front of the

bone, but are fixed in the back of the fused premaxillaries as shown in Fig. 1.

This new type of Anomodont I propose to name *Eumantellia mirus*, after Gideon A. Mantell, one of the greatest of our early palæontologists, and chiefly remembered by his discovery of *Iguanodon*.

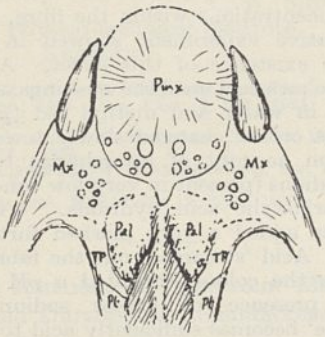

FIG. 1. Palate of *Eumantellia mirus*, g. et sp. nov. Natural size.

Though *Eumantellia* is too late in time to have been the ancestor of the Dicynodonts and the Endothiodonts, it must be morphologically very near to the common ancestor. The loss of the premaxillary teeth would result in a primitive Endothiodont such as *Prodicynodon*, and the further loss of the molars would result in a primitive Dicynodont. Possibly we may yet discover an earlier type with an unspecialised premaxillary, and incisor teeth in front.

It is manifest that *Eumantellia* must be placed in the Anomodontia, but it seems necessary to make it the type of a new family Eumantellidæ.

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Retinoscopy of *Loris*

IN connexion with a study on the affinities of the lorisiform Primates, I have had the opportunity, through the kindness of Prof. F. O'B. Ellison, of the Physiology Department of this College, of examining the retina of the living Slender loris with the aid of a Gullstrand large simplified ophthalmoscope.

An adult female animal was placed under very slight ether anæsthesia, sufficient to enable the head to be manipulated freely into the desired position. Two drops of 1 in 10,000 atropin solution were placed in one eye. This dilated the pupil fully in a few minutes, the other pupil remaining contracted in its normal slit-like condition. The instrument was easily focused on the retina and the animal did not move the eyeball about unduly during the examination.

The retina gave a very brilliant reddish golden reflex with minute scintillating spots due to the presence of a tapetal layer. This masked the detail somewhat, but was overcome by the use of a green filter. The optic disc consisted of a very darkly pigmented central area, surrounded by a paler ring and then by a marginal zone of lighter pigment. From the disc emanated six large vessels and some smaller delicate ones. There were three temporal vessels, upper, middle and lower, and likewise three on the nasal side. A fair-sized vessel corresponding in position to a macular artery arose from the disc between the middle and lower temporal vessels. This artery passed transversely outwards and divided into two branches, the upper of which crossed over a branch of the middle temporal vessel and then returned again. No spot where the retina was differentiated to form a macula could be seen. This does not preclude the possibility, however, that on microscopic examination of sections a primordium maculæ such as has been described by Woollard[1] in *Tarsius* may not be found.

There are in the peripheral parts of the retina of *Loris* a number of small transversely running vessels. One of these at least appeared to be an anastomotic channel between the lower temporal and the lower nasal vessels. The central artery of the retina in *Loris* therefore is not an end-artery in the anatomical sense.

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[1] Woollard, H. H., "The Retina of Primates", *Proc. Zoo. Soc.*, 1927.

Cystine and Protein Relationship of Grasses

AN interesting relationship between the cystine content and the protein content of grasses collected through different periods of the year has been established. A coefficient of correlation of + 0·923 for 10 pairs, indicating an almost perfect relationship between the protein content and the cystine content of the grasses throughout the year, is demonstrated. The accompanying curves (Fig. 1) show a marked fall in both the protein and cystine contents of the grasses through the winter months, with a corresponding rise of both during the commencement of the rainy season during September and October. As would be expected, the rainfall curve shows a fair correlation between protein and cystine contents.

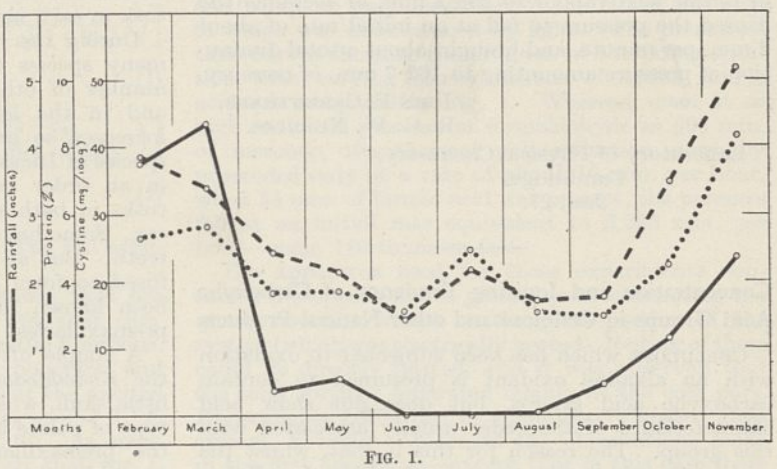

FIG. 1.

The grasses were collected at random during ten successive months from the University of Pretoria farm in 1932. The protein analyses were carried out by Mr. F. N. Bonsma at the University of Pretoria and the cystine analyses were undertaken at this

laboratory. The method for the latter was based on a modification of the cuprous-mercaptide precipitation described by Rossouw and Wilken-Jorden in the *Biochemical Journal*. All material was dried at 103° C.

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Interaction of Radio Waves

PRIOR to the observation of the interaction of radio waves[1], the study of the propagation of such waves through the atmosphere was concerned only with the effect of the ionosphere on them. The converse effect, namely, the influence of electric waves on the ionosphere, has already been considered by us in a theory of radio interaction[2].

One of the stated consequences of our theory is that the modulation M, impressed by the interfering wave on the wanted wave, is proportional to $1/\sqrt{(f^2+780^2)}$, where $f/2\pi$ is the modulation frequency of the interfering wave; that is, the impressed modulation should be distorted in favour of the lower frequencies.

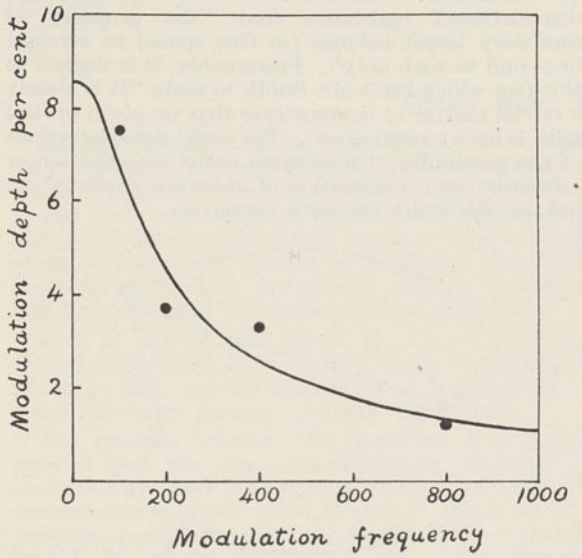

FIG. 1.

There were in Australia no stations sufficiently powerful to allow us to verify this prediction, but its truth has been since confirmed by many observers in Europe, notably Drs. B. van der Pol and J. van der Mark[3] and several members of the World Radio Research League.

The quantitative observations of Drs. van der Pol and van der Mark give strong support to our theory, as may be seen in the accompanying diagram (Fig. 1) where the black dots represent the observed values of the 'depth of modulation' with different modulation frequencies, and the smooth curve represents the formula $y=670/\sqrt{(f^2+780^2)}$.

The number 780 which occurs in the denominator is the product of two factors, G and ν, the values of which were derived by us respectively from the investigations of Townsend and Tizard on the motions of electrons in air and from the estimates made by Appleton and Chapman of the collision frequency ν in the Heaviside layer. Thus the observations of van der Pol and van der Mark are consistent with the conclusions of the above-mentioned investigators.

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Commonwealth Radio Research Board,
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[1] A. G. Butt, *World Radio*, April 28, 1933. B. D. H. Tellegen, NATURE, **131**, 840; 1933.
[2] NATURE, **133**, 218; 1934. *Phil. Mag.*, Aug. 1934.
[3] In a report presented to the Union Radio Scientifique Internationale and dated September 10, 1934.

Frequency of Collision of Electrons in the Ionosphere

WE were much interested in a recent communication[1] in which Mr. T. L. Eckersley described the way in which he had measured the collisional frequency of electrons in the F_1 region of the ionosphere by comparing the absorption coefficients and group retardations of returned echoes. It is a well-known fact that the effects of the F_1 region are only evident during the hours of daylight, and this presumably accounts for the fact that Mr. Eckersley's observations were made between 1550 and 1630 hr., that is, about one hour before sunset.

Recent experiments have led us to the conclusion that waves reflected from the F region are appreciably absorbed in the E region during the day, and that this E region absorption decreases rapidly near sunset. This view is not in agreement with that of Mr. Eckersley, who considers[2] that F region echoes are not appreciably absorbed in the E region. In accordance with our view, therefore, we do not consider that Mr. Eckersley is justified in neglecting the decrease of E region absorption during the course of his experiment, and it is our opinion that experiments of this kind should only be done at times when either (i) there is no absorption in the E region, that is, at night, or (ii) when the E region absorption is not changing with time, that is, about 1400 hr., the time of maximum E region absorption.

Working with these points in mind, we have been using a method of the same kind as that described by Mr. Eckersley to investigate the F_2 region, but we have restricted our observations to the two times mentioned above (for the F_2 region observations are possible at all times of day or night). In October of last year we found the average value of the collisional frequency to be $1{\cdot}6 \times 10^3$ per electron per second.

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J. A. RATCLIFFE.

Cavendish Laboratory,
Cambridge.
March 18.

[1] NATURE, **135**, 435, March 16, 1935.
[2] *Proc. Roy. Soc.*, **141**, 710; 1933.

Linkage of Chemical Changes in Muscle

WE should like to report some experiments which form an extension of those recently described by Parnas[1], and his colleagues. These workers, using muscle *brei* poisoned with iodoacetic acid, found that synthesis of creatine phosphate could go on, provided that phosphoglyceric acid was added to the *brei*. Breakdown of phosphoglyceric acid can only

proceed if adenylic acid or adenylpyrophosphate is present, and the synthesis of creatine phosphate was only observed during the short interval of time before the complete deamination of the co-enzyme in the iodoacetic acid *brei*.

Our experiments were carried out with dialysed muscle extracts, which have the advantage of containing no carbohydrate or carbohydrate breakdown products, so that the addition of poison is unnecessary in showing the phosphoglyceric acid effect. When phosphoglyceric acid (0·14 mgm. phosphorus per c.c. extract mixture), adenylic acid and creatine were added to such an extract of frog muscle (buffered at *p*H 7·2 with bicarbonate and phosphate), after 1 hour at 18° C., about 20 per cent of the phosphoglyceric acid phosphorus had appeared as creatine phosphate phosphorus, and about 60 per cent as inorganic phosphorus. Controls showed that no creatine phosphate and no increase in inorganic phosphate appeared in the absence of adenylic acid, whether or not creatine was present. Creatine cannot therefore dephosphorylate phosphoglyceric acid without the help of the adenylic compounds.

Results similar in most respects were obtained with rabbit muscle extract, which showed greater activity. Changes in pyrophosphate content were also estimated here. After 1 hour at 18° C., of 0·14 mgm. phosphoglyceric acid phosphorus added per c.c. of the extract mixture, 80 per cent had disappeared, 20 per cent appearing as phosphagen phosphorus, 25 per cent as adenylpyrophosphate phosphorus, and 20 per cent as inorganic phosphorus. In an experiment with a lower concentration of adenylic acid, as much as 44 per cent appeared as phosphagen phosphorus. Even after 2 hours standing at 37° C. and 6 hours dialysis at 0° C., addition of phosphoglyceric acid and creatine to the rabbit extract gave a small phosphagen synthesis, and breakdown of about 50 per cent of the phosphoglyceric acid. It is likely that this effect is due, not to the dispensability of adenylic acid, but to the extreme difficulty of removing it completely from rabbit muscle extract.

None of the extracts showed any phosphagen synthesis when adenylic acid and creatine were added and phosphoglyceric acid omitted. In all cases, when phosphoglyceric acid phosphorus disappeared, the formation of pyruvic acid was observed.

The theoretical implications of these results have been discussed by Prof. Parnas. We ourselves incline at present to the view that reaction first takes place between adenylic acid and phosphopyruvic acid (formed as an intermediate between phosphoglyceric acid and pyruvic acid), and that the resulting adenylpyrophosphate then reacts with creatine (reverse Lohmann reaction), but further work is needed here. Adenylpyrophosphate apparently not only reacts with creatine, but also breaks down into adenylic acid and *free* phosphate, so that exhaustion of the phosphoglyceric acid supply would lead ultimately to the disappearance of adenylpyrophosphate, and of creatine phosphate also by Lohmann's reaction with adenylic acid.

We are indebted to Prof. O. Meyerhof for the specimen of phosphoglyceric acid used.

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W. E. van Heyningen.

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Feb. 28.

[1] Nature, **134**, 627; 1934. *ibid.*, **134**, 1007; 1934. *Biochem. Z.*, **272**, 64; 1934. *ibid.*, **275**, 74; 1934.

Interpretation of Fermat's Principle

In order to demonstrate the possibility that an optical path between two fixed points may be merely stationary, that is, neither maximum nor minimum, Mr. T. Smith[1] includes in the infinite number of paths with which an actual path is to be compared those which in one homogeneous medium are non-rectilinear. Thus in Fig. 1, if A' is the image of A due to the lens PQ, the actual path $APA'B$ is compared with the longer and shorter imaginary paths $APCB$ and $AQDB$.

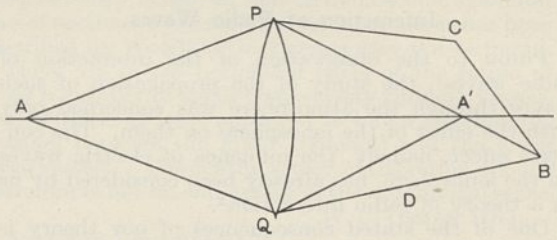

Fig. 1.

Fermat's Principle, stated in the form "The optical path of a ray from one fixed point to another is stationary", excludes from consideration all rays such as PCB which in one homogeneous medium are non-rectilinear. Hamilton[2], more than a century ago, demonstrated rigorously that "the property of *stationary length* belongs (in free space) to straight lines and to such only". Presumably, it is neglect of this fact which leads Mr. Smith to state "It is clearly a trivial matter to demonstrate that no given optical path is ever a maximum". The usual demonstrations of the possibility of maximum paths on reflection or refraction by consideration of aplanatic surfaces[3] are not, as Mr. Smith suggests, erroneous.

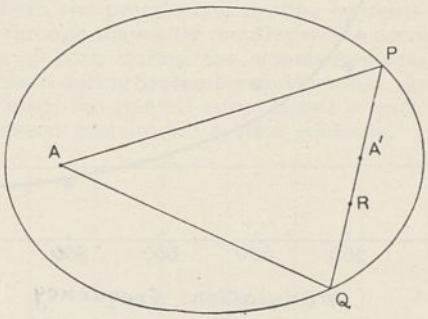

Fig. 2.

Mr. Smith states that the time happens to be a minimum when the path does not include an image of an end-point of the range considered, but if the path includes such an image, the time is neither a maximum nor a minimum—it is simply stationary. To this generalisation several objections may be raised. In the first place it is clear that, even if correct, it would apply only to reflection or refraction by aplanatic systems. Secondly, if in his Fig. 1, B is on the axis, his method of argument would not serve to show that the path $AA'B$ is simply stationary. Thirdly, the statement is not true in the case of reflection by an elliptical mirror of light from a point source at a focus. The path APR (Fig. 2) contains the image A' but it is not simply stationary, it is the maximum, and AQR is the minimum, of all paths from A via the mirror to R.

The application of Fermat's Principle to paths through non-aplanatic systems generally involves a lengthy mathematical procedure. A relatively simple case is that in which the end-points are on the axis of a refracting sphere. When the end-points are equidistant from the sphere, the actual non-axial paths are merely stationary while the corresponding axial paths are minima.

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[1] NATURE, **133**, 830; 1934.
[2] *Dublin Univ. Review*, p. 795, Oct. 1833. Mathematical Papers, 1, 311; 1931.
[3] Drude, "Theory of Optics", 9–11; 1902.

IN the wave theory of light, the 'geometrical' laws of optics—rectilinear propagation, reflection and refraction—and other results besides, rest on a single principle. The fundamental postulate is that any train of waves may be replaced by a sheet of sources of suitable intensities and phases, that is, paths such as APCB of Fig. 1 of Mr. Darbyshire's letter are to be taken into consideration equally with paths like AQDB. Of all possible paths, the 'rays' of geometrical optics are found to be stationary paths and so suitable for phase calculations; this is the essence of Fermat's Principle.

Of the specific objections Mr. Darbyshire raises, the first rests on an unnecessary restriction of 'image'. By this term we ought to understand any point where the wave system exhibits a singularity; this normally corresponds to the re-intersection of any two neighbouring rays arising from the same object point. As regards the second, I have *assumed* the stationary property throughout, and the reasoning used is, I think, generally applicable with a symmetrical system. As to the third objection, which has been mentioned by other physicists also, it may be observed that, according to geometrical optics, APR and AQR are the only possible paths between A and R for a single reflection, and the labelling of two isolated paths as a minimum and a maximum seems to me inappropriate in any case. Taking the more general view of the wave-theory, the mistake to which I directed attention is due to the neglect of the Jacobi test[1] for the existence of maxima and minima. The need for this test can be formally shown by considering the lengths AP and PR of Fig. 2, which, as Mr. Darbyshire mentions, are the minimum paths from P to A and R. The statement that the path APR is a maximum then takes the form

$$\text{minimum} + \text{minimum} = \text{maximum},$$

which is obviously false.

T. SMITH.

[1] Forsyth, "Calculus of Variation", pp. 26, 134, etc.

Points from Foregoing Letters

RADIOPOTASSIUM (atomic mass 42) has been made from potassium atoms of mass 41 and from scandium atoms of mass 45 by bombarding them with neutrons. It has now been obtained by Prof. G. Hevesy and Miss Hilde Levi, in the same manner, from calcium atoms of mass 42. These investigators have also prepared radioactive isotopes of calcium, zirconium and hafnium from the corresponding elements.

Prof. H. Alfvén and Mr. V. H. Sanner have obtained ultra-violet light of very short wave-lengths (down to 21A., on the borderland of X-rays) from a spark discharge between graphite electrodes.

The relation between the intensity of the field applied and the magnetic induction produced in lead-thallium and lead-bismuth alloys at very low temperatures (when their electrical resistance approaches zero) is described by Messrs. J. N. Rjabinin and L. W. Shubnikow. They show that above a certain field strength the alloys lose their 'superconductivity'.

Contrary to theoretical expectations, the duration of luminescence of fluoresceine in water and in alcohol was found to be greater than in glycerine. Dr. A. Jabloński and Mr. W. Szymanowski consider that this unexpected behaviour can be explained by the rotation of the molecules.

Mr. J. E. Carruthers and Dr. R. G. W. Norrish report that the presence of a small amount of formic or acetic acid quickens the condensation of gaseous formaldehyde to its solid polymer (known commercially as 'meta'). They act in a similar way upon acetaldehyde vapour.

Mr. S. M. Neale finds that the addition of salt to oxicellulose liberates its acidic hydrogen ion. The action can be made use of in the quantitative estimation of the acidity of oxycellulose.

The anomodont or dicynodont reptiles differ from all the other mammal-like reptiles, in having no teeth in the premaxillary bones. The discovery of a fossil type which has teeth in the premaxillaries is reported by Prof. R. Broom. It helps to bridge the gap between the several known families of reptiles.

Mr. S. D. Rossouw finds a close proportionality between the percentage of cystine and of protein in grass in South Africa throughout the year. The sulphur compound, cystine, is a constituent of sheep's wool.

Messrs. F. T. Farmer and J. A. Ratcliffe have determined the average frequency of collisions between electrons and molecules in the F_2 region of the ionosphere (about 300 km. high). Their experiments were carried out at times of the day when the absorption of the reflected waves by the E region (about 100 km. high) does not change with time, a precaution which, they state, Mr. Eckersley did not take when he measured the collisional frequency of electrons in the F_1 region (about 200 km. high).

Working with dialysed muscle extracts, Dr. D. M. Needham and Mr. W. E. van Heyningen confirm the findings of Prof. Parnas and his co-workers that adenylic acid and creatine are essential intermediaries in the reaction by which the muscle obtains its energy from the transformation of glycogen into lactic acid.

Mr. O. Darbyshire criticises the illustrations given by Mr. T. Smith, who has claimed that Fermat's principle requires an optical path to be stationary only, and not necessarily a maximum or a minimum. Mr. T. Smith, in replying, justifies his consideration of non-linear optical paths in his variational treatment, by reference to the extended Huygens' principle.

Research Items

Archæological Studies of Disease Introduction. The archæologist has always to press into his services the methods of other sciences, and Dr. John H. Provinse, assistant professor of archæology at the University of Arizona, according to a communication issued by Science Service of Washington, D.C., is utilising recent botanical studies in an interesting manner to check data upon the occurrence of disease among American Indians in prehistoric times. Dr. A. E. Douglass, astronomer of the University of Arizona, has developed very thoroughly the use of annual rings to determine dates over a period running back through many centuries, the western American climate having led to the formation, over wide regions, of growth rings that appear well correlated with varying climatic conditions. Dr. Provinse now attempts to match the growth rings in fragments of woods buried with diseased Indians with this well-established 'tree-ring calendar'. The tree-ring calendar has enabled the age to be determined of many pueblos and cliff dwellings, and Dr. Provinse now hopes to determine how far back various diseases that affect the skeleton can be traced. Among the diseases diagnosed in these early Indians are Pott's disease ; rickets ; osteomalacia, a nutrition disorder of adult women resembling rickets ; arthritis and Paget's disease. The origin of syphilis is in the minds of the workers, but its diagnosis on pathological bone characters appears uncertain. It is stated that so far there is no proof that it existed in America before the coming of Europeans.

Cultural History of Cook Inlet, Alaska. Dr. Frederica de Laguna's report on her expedition to Cook Inlet (University of Pennsylvania Museum, Philadelphia, 1934) covers the material collected during three seasons (1930–32) spent in Cook Inlet and Prince William Sound. The main objective of the expedition was to investigate the question whether an earlier population with an Eskimo culture had preceded the present Athabascan Indians. The evidence considered here is based mainly, though not exclusively, on material from Kachemak Bay. The Kachemak culture is interpreted as falling into four stages. The basis seems to have been a fairly generalised type of Eskimo culture which included a number of elements common to the Arctic and North Pacific areas. The stone industry of the earlier times is characterised by the relatively greater importance of chipping, including even the chipping of slate. Later, polished slate grows in importance and chipped stone becomes less important. In the second period notched stones appear in great abundance. In the bone industry, the importance of Thule Type 1 is to be noted in the First Period. Pottery and copper are rare and are restricted to the last phase of the Third Period. The Second and Third Periods alike have flexed burial with grave goods. The dismembered burial is peculiar to the Third Period. Artificial eyes and clay masks are characteristic of the Third Period. Scattered and broken human bones belong to all periods except the First. The house of the Second Period is partially built of stone and whalebone ; that of the Third Period is entirely of wood. Both are semi-subterranean. The Eskimo dog, fairly well represented in the First Period, declines in numbers throughout the development of the culture. The culture of the First Period has more points of resemblance to the Arctic Thule culture of Canada, while that of the Third Period, which is the best known in this investigation, shows development away from the more typical Eskimo pattern towards a more specialised local complex.

Education of Exceptional Children. In Pamphlet No. 49 of a series on "Teachers' Problems with Exceptional Children", published by the U.S.A. Education Office, Miss Elisa Martens deals with the children who, though not up to the normal standard of intelligence, are yet able to profit by training at an ordinary school. Here they grow up in a normal environment, and can be trained for useful citizenship. It is essential that the teacher should be interested in these children, and should study each case individually. The curriculum should be modified for them if necessary, and their physical fitness promoted by care and by training in health habits ; but above all they must be made happy, and this can best be done by giving opportunities for the expression of such talents as they possess in creative activity. Mentally retarded children need the same basic types of educational activities as do normal children, but the teaching should be as practical as possible. The pamphlet gives much practical advice on a subject which must concern all those who are in any way responsible for the young.

Preventive Inoculation against Diphtheria. In the spring issue of the *Fight against Disease* (**23**, No. 1), the journal of the Research Defence Society, Sir Leonard Rogers contributes an article on the effect of preventive inoculation on the incidence and severity of diphtheria in nurses and children. He concludes from an analysis of a large mass of statistics that the Schick testing for susceptibility and the preventive inoculation are quite harmless, and no serious or harmful effect, still less a fatality, has resulted among 150,000 individuals treated. Of 15,478 'protected' children, only 0·1 per cent were attacked, but no less than 22·5 per cent of 258 'unprotected' contracted the disease. Similarly, of 5,579 'protected' nurses treating diphtheria cases and exposed to grave danger of infection, only 1·86 per cent were attacked, but of 166 known 'unprotected' nurses, no less than 24·1 per cent contracted diphtheria. The average severity of the disease among inoculated persons attacked is also much less than among the uninoculated.

Indo-Australian Fishes. Dr. J. D. F. Hardenberg has discussed the species of the genus *Stolephorus* in *Treubia*, **14**, Livraison 3, 1934, and in the same journal he has two further papers on new or rare fishes of the Indo-Australian Archipelago and the fish fauna of the Rokan Mouth. *Stolephorus* is a genus the members of which are caught in coastal and estuarine waters. Breeding along the coasts, their eggs are rarely found out at sea, but the adults may live in the deeper open sea waters, and there is evidence of migration not fully understood. Many of them are good for food, the well-known red or Macassar fishes being coloured artificially with a fungus added during preparation. The author has discovered several new forms which he has studied

in great detail—nine species in all. He suggests from the results of these investigations, and in accordance with the embryological data found by Dr. Delsman, that the long slender forms of the open sea with a high total number of vertebræ and the anus having a backward position are more primitive than the higher coastal forms with fewer vertebræ and the anus farther forward. In agreement with this, he states that it might be concluded that there had been during the evolution of the genus a migration from the open sea towards the coast and into the tidal rivers.

Migrations of Mule Deer. The summer range of the Rocky Mountain mule deer, *Odocoileus hemionus*, lies along the higher ridges at elevations of 4,000–12,000 ft., but in winter it descends, as a rule, to the lower foothills, from 3,500 ft. near the lower limit of the yellow pine forest to 1,500 ft. in the oak-covered sides of the interior valley of California (Joseph S. Dixon in *California Fish and Game*, **20**; 1934; now published separately). Various factors contribute to this migration, the autumn and spring journeys of which may together cover one hundred miles. Food is an important item: if suitable food is available, some or all the deer may not migrate, and food considerations seem to outweigh the effect of low temperature. But a heavy fall of snow, by making food plants inaccessible, becomes a main factor in determining the autumn migration from the high ground. It also compels the deer to move to open hill-sides where they can move freely, and this may enable them to obtain a livelihood on a winter range where forage is relatively sparse; but, most important of all, it adds to their chances of escaping from their enemies, the coyote and the cougar. The deer appear to realise that they are at a disadvantage against these carnivores in deep crusted snow, and although in some such areas food, in the form of wind-broken branches, remained abundant, they were avoided by the deer.

Larval Trematodes in Terrestrial Molluscs. W. Adam and E. Leloup have brought together (*Mem. Mus. Roy. d'Hist. Nat. Belgique*, No. 62, 1934) the records in the literature on the larval trematodes found in terrestrial molluscs, and have added critical and explanatory observations on them. They point out that the trematodes belong for the most part to the subfamily Brachylaiminæ (= Harmostominæ), and that the determination of the larval stages is almost impossible because of defective descriptions. The authors summarise in tabular form the measurements and other data available on the adults of the species of *Brachylaima* the larvæ of which are found in terrestrial molluscs, add a similar table for the larvæ, and a third table showing the trematodes recorded in terrestrial molluscs (except the Succineidæ). They record their observations on two species of *Brachylaima* from five helicine snails collected in Belgium.

The Embryonic Cell. The modern fashion for sectional monographs leads occasionally to the delimitation of subjects for treatment which leave the writer revolving almost *in vacuo*, and this seemed to have happened to Dr. René Souèges in the monograph on "La Cellule Embryonnaire" published as No. 208 of Actualités Scientifiques et Industrielles (Paris: Hermann et Cie). He expressly disclaims any intention of dealing with the phenomena of fertilisation or of subsequent embryonic development, and there remains very little to say in these 60–70 pages upon the plant oospore. It is probably very useful to have our ignorance of this all-important cell thus clearly exposed, and such problems as its polarity of organisation, the persistence of such structures as plastids, vacuome and chondriome are discussed very interestingly. Dr. Souèges goes a little beyond his own prescribed limits when he makes the interesting point that cell divisions follow most rapidly in Angiosperm oospores when these are associated with an endosperm also built of cells; when the endosperm remains for a long time a tissue with many nuclei without separate walls, then the oospore is slower to continue its development.

'Brown Spot' Disease of Turf. A short article by Dr. F. T. Bennett, in the *Gardeners' Chronicle* of February 23, describes a disease of grass turf known as dollarspot in America. It has been assumed that *Rhizoctonia solani*, the fungus causing *Rhizoctonia* disease of potatoes, was a common cause of brown spot maladies of turf. Dr. Bennett shows, however, that this is rarely the case in England, where another species of *Rhizoctonia*, named provisionally *R. Monteithianum*, is responsible for most of the damage. No spores of the fungus have yet been discovered, but it propagates itself readily from pieces of mycelium and sclerotial flakes. These may be blown by wind, and can withstand storage for fifteen months or more. Cultural characters of the fungus on artificial media, and symptoms of the disease on lawn turf, are described.

Gaseous Transfer of Silica. In *Economic Geology* (pp. 454–470; 1934), E. Ingerson discussed in a most stimulating way the problem of the possibility of transfer of 'insoluble' oxides by solution in gases at supercritical temperatures. That the process is a real one, and of fundamental importance in the genesis of both ore deposits and igneous rocks, is indicated by some experimental results recorded by F. V. Syromyatnikov (*Econ. Geol.*, pp. 89–92; 1935). The object of the study was the synthesis of serpentine from magnesium hydroxide (in the upper part of an autoclave) and silica and water (in the lower part of the autoclave). Silica was transferred upwards by water (gas) at temperatures of the order 400° C., and in some of the experiments Fe_2O_3 was also found to have migrated upwards. A sample of gas with 'dissolved' SiO_2 and Fe_2O_3 was condensed and analysed. The amounts found were 0·74 gm. of SiO_2 and 0·90 gm. of Fe_2O_3 per 1,000 gm. of water. Another point of interest is the proof that more silica was carried up, and fixed as serpentine, than was present at any given time in the gaseous solution. Hence diffusion of silica through the gaseous medium must have occurred.

New Zealand Pastoral Industries. A monograph on the pastoral industries of New Zealand by Dr. R. O. Buchanan is the first publication of the newly established Institute of British Geographers, which appears along with the *Transactions* as Publications Nos. 1 and 2. The treatment of the subject is mainly economic, and goes at length into questions of labour, marketing and prices; but certain facts of geographical importance emerge. The whole of the occupied area of the country seems to be suited for both cattle and sheep, but almost everywhere there is a more or less pronounced bias, in which

local geographical conditions play a part, in favour of one or other branch of the live-stock industry. Conditions favouring cattle, which means dairy cattle since the world situation does not favour beef export, are low elevation, easy relief, rich soil and frequent, dependable rainfall. Absence of these factors, especially the topographical ones, leads to predominance of sheep. The monograph is well illustrated by maps and statistics, and is furnished with a detailed bibliography.

Ignition of Firedamp in Coal Mines. We have received papers Nos. 89 and 90 from the Safety in Mines Research Board, the former headed "The Ignition of Firedamp by Broken Electric Lamp Bulbs" by G. Allsop and R. V. Wheeler, and the second headed "The Ignition of Firedamp by Coal-Mining Explosives" by C. A. Naylor, W. Payman and R. V. Wheeler. The former is somewhat inconclusive. It is pointed out that under certain conditions the heated filament of an electric lamp after fracture of the glass bulb can ignite firedamp, and experiments have been carried out by the Research Board to see whether it is possible from the appearance of a tungsten filament to determine whether or not the filament has been burnt out in the presence of air (possibly air and firedamp mixed) and may therefore have originated an explosion. Whilst the condition of the filament, whether oxidised or not, can be determined, the results are by no means conclusive. The second paper gives a historical review of experiments on the Continent on the use of cooling salts for preventing explosives from igniting firedamp. It seems that an explosive sheathed in sodium bicarbonate is effective and practicable in this respect, and that the sheath does not interfere with the action of the explosive.

Insulators of High-Voltage Transmission Lines. It is now well known that when the insulators of high-tension lines are subjected to an atmosphere loaded with industrial or saline matter, the deposits they receive frequently cause 'faults' on the line owing to 'flashovers' at the normal pressure. In a paper read to the Institution of Electrical Engineers on March 20 by W. J. John and F. M. Sayers, it is stated that these flashovers are usually due either to the insulators getting coated with dirt or grit if near an industrial neighbourhood or, if near the sea, to a coating of salt. To prevent faults forming, it is necessary to keep the insulators clean, as the deposit may increase rapidly. In some cases an ounce of matter has been collected from an insulator after only a few weeks service. When it is an industrial deposit, experience has shown that all faults occur during fog and mist, and that all insulators which fail are covered with a deposit of carbon. It has also been noticed that no faults occur during or after rainfall. Normal rainfall keeps the insulators reasonably clean. This shows that the insulation can be improved by designing the insulator so that a large length of the leakage path is exposed to direct rainfall. Although rain can wash deposits away, it unfortunately provides a wet surface which forms by itself a leakage path. Similarly wind blows the deposits away, but it also brings grit and dust to them. Hence the good and bad effects of wind and rain have both to be taken into account when designing insulators. Salt spray is deposited when near the sea in moist sticky patches on their surfaces. When dew falls a conducting film of salt moisture is formed which may lead to sparking giving excessive leakage current and so cause the protective gear to operate and interrupt the supply. An important conclusion the authors arrive at is that insulators of different designs may be advisable along different sections of the transmission line.

Cataphoretic Velocity of Colloid Particles. Measurements of the cataphoretic velocity of colloid particles made by Messrs. G. N. Mukherjee and S. G. Chandhury, University College of Science and Technology, Calcutta, since 1923 and published in the *Journal of the Indian Chemical Society* from time to time, have indicated that the concept of the 'critical coagulation potential' is of doubtful value, since the value of the cataphoretic velocity at which coagulation occurs may vary very considerably according to the electrolytes employed. Furthermore, coagulation may occur when the velocity is greater than that of the original sol. The forms of the curves relating the cataphoretic velocity to the electrolyte concentration show no correlation for various electrolytes of differing valencies, whilst the velocity may often increase at high concentrations of univalent coagulating ions, especially near the stage of rapid coagulation. Some experiments with arsenious sulphide sols, made by Mr. K. D. Bhaback, have shown that on adding electrolytes, the cataphoretic velocity increases with time as aggregation proceeds, and falls sharply on coagulation. This increase of cataphoretic velocity with aggregation confirms the experimental conclusions of Robinson (*Proc. Roy. Soc.*, A, **143**, 130; 1934) who observed a similar effect in the case of particles of benzopurpurin B.

Alchemy at the Time of Dante. In a recent issue (pp. 411–417; 1934) of the *Annales Guébhard-Séverine* (Institut Guébhard-Séverine, 4 rue du Seyon, Neuchâtel. Issued free), Prof. J. Ruska gives a brief survey of Latin alchemy of the first third of the fourteenth century. It is to this period that he would ascribe the composition of the celebrated "Summa Perfectionis Magisterii", a work which he says has nothing in common with the genuine books of the Arabic Geber. A treatise of the same period, but one which in argument and exposition is in marked contrast to the "Summa", is the "Margarita Pretiosa Novella" or "New Pearl of Great Price" of Petrus Bonus of Ferrara. This is an introduction to alchemy, and was completed at Pola in 1330. Although the author apparently had some knowledge of practical chemistry and metallurgy, the book as a whole is an uncritical justification of alchemy on philosophical and metaphysical grounds. Its value to the historian of chemistry lies in the numerous and interminable quotations from previous authorities, which render it a rich mine of discovery in the detailed study of the influence of the older alchemists. The principal authorities are the pseudo-Rhazes, the "Turba Philosophorum" and the "Summa"; the paradox of the equal esteem accorded to the last two is explained by the fact that Petrus Bonus appreciated the value of the "Summa" but wished also to appeal to the venerable authority of the "Turba". As usual, the book concludes with a solemn assurance that it contains nothing but the pure truth. Prof. Ruska points out in his closing paragraph that the fourteenth and fifteenth centuries now form the most obscure period in the history of chemistry, and hopes that the problems they present may attract the young generation of chemists.

X-Ray Single Crystal Photographs of Insulin

By DOROTHY CROWFOOT, Department of Mineralogy, Oxford

SINCE insulin was first prepared crystalline[1] in 1926, several efforts have been made to obtain X-ray photographs of the crystals. The first attempts of W. H. George[2] by the powder method failed to show any pattern indicative of a crystal structure, and though later long spacings were reported by G. L. Clark and K. E. Korrigan[3], it was impossible to base any unambiguous interpretation on their results. The fact that pepsin could be made to give a single crystal X-ray diffraction pattern[4] suggested that the problem of insulin, which is in many respects a more stable crystalline species, could be attacked in the same way if large enough crystals could be grown. This was made possible by D. A. Scott's study of the crystallisation of insulin in the presence of salts of zinc and of other metals[5].

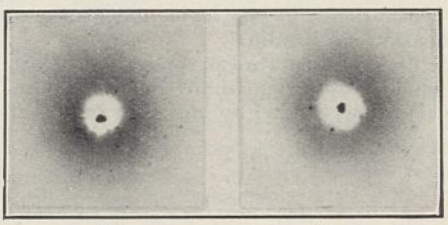
The crystallisation was therefore carried out by a modification of Scott's method from a phosphate buffer solution containing a little acetone and some zinc chloride at a *p*H of 6·2–6·5. The solution was cooled very slowly from 50° to room temperature over a period of three days, at the end of which time sufficiently large crystals had grown.

The crystals have the form of very flat rhombohedra which often grow in pairs united at the ends of their trigonal axes. The larger ones present the appearance of six lobed stars and are as much as 0·2 mm. across and 0·05 mm. thick. These show a positive uniaxial figure when viewed along the trigonal axis. The crystals prove to be perfectly stable in air (unlike pepsin) with unchanged birefringence and reflecting power, and it was accordingly possible to examine them dry by X-ray methods.

Three series of X-ray photographs have been taken on three separate crystals, one rotating about the trigonal axis and the others about the normals to $(10\bar{1}0)$ and $(11\bar{2}0)$. Examples are shown in Fig. 1. Copper $K\alpha$-radiation was used and exposure times of about 15 hours for a single 5° oscillation photograph with a plate distance of 6 cm. The crystals have so far proved unaltered by exposure for more than 100 hours to X-radiation. The photographs taken indicate a simple rhombohedral cell of a 44·3 A. and $\alpha = 115°$ correct to about 2 per cent. This referred to hexagonal axes corresponds to a cell three times as large with $a = 74·7$ A., $c = 30·6$ A., which shows no halvings but those required by the rhombohedral lattice. The structure may also be described in terms of a pseudocubic body-centred cell twice the size of the primitive cell with $a = 47·7$ A., $\alpha = 103° 6'$. No planes of symmetry are present and the space group is therefore $R3$. The cell molecular weight calculated for the primitive rhombohedral cell and the density 1·315 measured by Dr. Eyer[6] is 39,300 ± 800. (Density measurements on the actual crystals used gave 1·306 ± 0·003.) As Abel has measured the water lost by heating the crystals at 104° in a vacuum at 5·35 per cent of the air-dried weight[7], the weight of insulin in the cell (cell molecular weight—water of crystallisation) may be deduced as 37,200, which is very close to the weight of one molecule of insulin reported by The Svedberg[8].

It therefore appears that the crystal unit cell contains only one molecule of insulin, although a cell containing $3n$ sub-molecules is not excluded by the X-ray data. The laws of crystal symmetry rigorously applied would require this molecule to have trigonal symmetry, but it is possible also that the crystal attains apparent trigonal symmetry by a statistical regularity of arrangement of molecules about the lattice points, or that the X-ray effects so far observed are first approximation mass effects to which further work may add a fine structure, due to the arrangement of the atoms within the molecules, which our methods are as yet insufficiently delicate to detect. The measurements obtained do, however, fix quite definitely the arrangement of the molecules with respect to one another and their approximate size and shape, since this follows directly from the crystal lattice, while the variation of the intensities of the spectra strongly suggests that the arrangement of atoms within the molecules is also of a perfectly definite kind.

The crystal structure of insulin is of an eight co-ordination type, as the possible reference to the pseudo-cubic body-centred cell of twice the size most clearly indicates. Each insulin molecule is



(*a*) (*b*)

FIG. 1. X-ray photographs of crystalline insulin. (*a*) Rotation axis normal to $(11\bar{2}0)$, beam direction 0°–5° from ‖ $(10\bar{1}0)$. (*b*) Rotation axis [0001], beam direction 0°–5° from ‖ $(10\bar{1}0)$.

surrounded by eight others, two at the short distance of 30 A. above and below along the trigonal axis, and six at the longer distance of 44 A. along the edges of the primitive rhombohedron. The shape of the molecule therefore appears approximately as an oblate spheroid of diameters 44 A. and 30 A. D. A. Scott gives the atomic percentage of zinc in insulin crystals as 0·00795, or 3 atoms of zinc per molecule of insulin[9]. It therefore seems reasonable to suggest that these atoms are required to bind the molecules into nets parallel to the *c* plane, one between each pair of insulin molecules along the six points of contact, the closer linkage along the *c* axes being due to other causes. This would provide some explanation of the rôle played by zinc and other bivalent metals in promoting the crystallisation of insulin.

It is of particular interest to compare this crystal structure of insulin with that which may be deduced for pepsin from the X-ray measurements previously reported. It has been found that the true cell of pepsin has a *c* dimension three times as long as that at first suggested, namely, 461 A., and that the structure should probably be referred to rhombohedral axes[10] $a = 162$ A., $\alpha = 23° 50'$. The first order of the reflections from the *c* plane to occur is, however, the 45th, while the strongest order is the 48th, which indicates that the most marked periodicity along *c* is one of only 9·6–10·2 A., very much the

same as the distance—10 A.—between layers of atoms along the c axis of insulin. It seems significant, further, that the length of a in pepsin—67 A.—referred to the original hexagonal axes, is so similar to that of insulin—74·7 A.—when given hexagonal axes. These two dimensions define a crumpled layer structure in which the molecules are arranged in networks of six-sided rings of the non-planar cyclohexane type which occurs, for example, in diamond and wurtzite. From the side of such a ring projected on to (0001), $a/\sqrt{3}$, or 38·7 A. in pepsin, and the thickness of the order of 10 A., a length for one radius of the pepsin molecule may be calculated = 20 A. In insulin, the layers are so arranged that atoms in one fall as nearly as possible into the spaces of the one below, which makes a very compact structure. In pepsin we may imagine that the layers of rings are slid relatively to one another, to bring atoms of the lower ring directly beneath those of the upper ring in such a way that each is approximately tetrahedrally co-ordinated. The effective depth of a single layer is then equal to the thickness of the ring system plus the diameter of a single molecule, and may be calculated to be 51·2 A., with a spheroidal pepsin molecule of diameter 41·2 A. in this direction. A combination of the crystallographically possible ways of sliding the ring systems is able to give the required length of c, nine times that of the depth of one layer and fifteen times the c dimension of insulin.

This kind of structure proposed for pepsin is of a very much looser type than that of insulin. Each molecule is surrounded by only four others and there are large channels through which free movement of water and dissolved substances may occur within the crystal structure. On drying, such a structure would collapse, in agreement with the fact that, in contradistinction to insulin, the crystals of pepsin lose their birefringence on exposure to air and only show crystalline X-ray diffraction effects when immersed in the mother liquor. Various observations[11] suggest that loose 4 co-ordination structure of this kind may be general among certain classes of protein crystals which belong either to a hexagonal type with an axial ratio about 2·3 similar to that of pepsin, or to a cubic type which shows diamond cleavages. Wherever the attraction between the adjacent protein molecules is of the same order of magnitude as that between the protein molecules and the medium, a low co-ordination structure type may be expected. In insulin, on the other hand, where the molecules can be strongly attracted together with the assistance of metal atoms, the structure is very much more condensed and shows a high co-ordination number.

I have to thank Prof. Pyman and Messrs. Boots Pure Drug Co., Ltd., for a gift of the insulin used in this research.

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History of the Menthols

At a joint meeting of the Chemical Society, and the Glasgow Sections of the Society of Chemical Industry and the Institute of Chemistry, held in the Royal Technical College, Glasgow, on March 15, Prof. John Read, of the University of St. Andrews, gave a lecture entitled "From Governor Phillip to *d*-neoisoMenthol: the Story of a Research, 1788–1934".

Prof. Read said that it was his intention to select a research paper and show what a rich background it possessed when given its proper setting in the world of things, men and affairs. The paper in question closed a chapter, or perhaps more correctly a book, in the history of the important chemical family of menthols. The usual source of ordinary menthol is the essential oil of the peppermint plant, *Mentha piperita*, which has been cultivated in Japan for more than two thousand years. The first mention of crystalline menthol was made in 1771 by Gambius, a Dutch botanist. It is now known that this so-called 'mint camphor' is a member of the first of four series of menthols. Prof. Read and Dr. Grubb completed the tale of these four series in the University Chemical Laboratories at St. Andrews on Christmas Day, 1933.

In tracing the trend of events which led up to this chemical climax, Prof. Read reminded his audience that Capt. Cook landed in eastern Australia, hitherto unknown, on April 29, 1770. In his "Journal" he wrote of the landing-place: "The great quantity of New Plants, etc., Mr. Banks and Dr. Solander collected occasioned my giving it the name of Botany Bay". From the earliest days, indeed, the unique vegetation of this isolated land attracted the interested attention of visitors and settlers. Two-thirds of the native Australian flora belongs to the family Myrtaceæ, which is represented in Europe by a single species. *Eucalyptus*, the outstanding Australian genus of this family, is a specialised form adapted to the barren and extra-tropical Australian areas; it developed after the separation of Australia from the tropical lands. Typically Australian, it is virile, aggressive, and an excellent colonist, with all the characteristics of youth.

Some graphic extracts from Dr. John White's "Journal of a Voyage to New South Wales" followed. Dr. White was surgeon-general to the First Settlement, under Governor Phillip, who reached Botany Bay with his fleet of marines, officials and convicts on January 20, 1788, after a voyage lasting eight months. The "Journal" shows that the voyage had its romantic aspects as well as its hardships and notes of grimness: "May 28. Departed this life, Ismael Coleman, a convict, who, worn out by lowness of spirits and debility, brought on by long and close confinement, resigned his breath without a pang. August 31. James Baker, a private marine, received 200 lashes for endeavouring to get passed on shore by means of one of the seamen, a spurious dollar, knowing it to be so. . . . Many of these young ladies [in a convent in Rio de Janiero] were very agreeable both in person and disposition; and by frequently conversing with them at the grate, we formed as tender an intercourse as the bolts and bars between us would permit of."

The fleet lingered for a month at Rio, before weighing for the Cape of Good Hope. It is said, although Dr. White does not endorse the statement,

that Governor Phillip took with him from Brazil some prickly pear plants, for the sake of the cochineal insects which infested them. These insects produced the scarlet dye used for the military uniforms of those days. Unfortunately, the insects appear to have perished during the voyage; thus the prickly pear, freed from its insect control, developed eventually into Australia's foremost plant pest.

At that time, oil of peppermint was a much prized specific; for in the first issue of the *Glasgow Advertiser*, dated January 27, 1783, it is stated in an advertisement that "this elegant preparation", sold by J. Gillies, bookseller, above the Cross, Glasgow, gives immediate relief "in Gouty and Cholicky Pains in the Stomach and Bowels, Low Headachs, and all Disorders arising from wind". Dr. White, being short of this oil, found a very efficient substitute in the essential oil distilled from a certain eucalypt growing around Port Jackson—now known as the Sydney peppermint, or *Eucalyptus piperita*. This is the first recorded instance of the distillation of a eucalyptus oil.

Many years later, in 1900, the Australian chemist, H. G. Smith, isolated the peppermint ketone imparting the characteristic odour to this oil, and called it piperitone. There are about three hundred species of eucalyptus, each kind—as shown by H. G. Smith and R. T. Baker—producing its own characteristic leaf oil: of these more than twenty secrete piperitone. It was then found that, by hydrogenation and dehydrogenation, piperitone could be changed into menthols and thymol, respectively, so that it has become a commercially valuable substance.

Eucalyptus piperitone is invariably a 'left-handed' substance. Soon after Prof. Read became associated with Mr. Smith at Sydney, in 1920, Prof. J. L. Simonsen, working independently at Dehra Dun, in India, discovered 'right-handed' piperitone in the oil of the Indian grass, *Andropogon Jwarancusa*. These two piperitones, of the northern and southern hemispheres, are identical, except that their molecules are related as object and mirror images.

One interesting result of later researches, carried out at St. Andrews, has led to a way of proceeding, by laboratory processes, from the 'left-handed' Australian piperitone to the 'right-handed' Indian piperitone. It has also been found possible by means of a complicated network of delicate reactions to utilise piperitone as a source of any one of the four series of menthols. Each of the four kinds of menthol exists in a 'right'- and 'left'-handed form, and methods have been devised for producing the 'right-handed' form of ordinary 'mint camphor', which always is 'left-handed' in Nature.

Crossing-Over of Sex Factors in *Lebistes*

WHILE the validity of the sex-chromosome mechanism in relation to sex determination is generally recognised, yet it has become clear from the work of Goldschmidt on *Lymantria*, Winge on *Lebistes*, and various other investigations in which intersexes and the crossing-over of sex factors occur, that genes influencing the sex towards maleness or femaleness are also found in the autosomes. Bridges' conception of genic balance applies to many characters, including sex, and it is necessary to suppose that there are many factors in all the chromosomes, some of which tend towards maleness and others towards the female condition. Various divergent views regarding the distribution of such genes in the X and Y and the autosomes are at present held.

In the little fish, *Lebistes*, in which there is a series of colour patterns inherited through the Y-chromosome from father to son, Winge has shown also that the X-chromosomes may be altered into autosomes, so that sex-linked genes are inherited as ordinary Mendelian differences. By selecting masculine autosomal genes, XX males were obtained, and by backcrossing a race was produced in which both the males and females were XX in composition and the Y-chromosome type of inheritance had been eliminated.

In a recent paper (*C. R. Lab. Carlsberg*, Série Physiol., 21, No. 1) Winge has carried the subject of sexual balance further. Probably in these fishes, as in pigeons, the difference between the sexes is small, so that the balance of the sex genes is easily upset. This is further shown by the fact that certain matings gave practically only females in winter but equal numbers of the sexes in spring. Nevertheless, conspicuous intersexes seldom appeared. Normally, females show no trace of the colour genes which are transmitted by the males in the Y-chromosome, but occasional females appear which show a trace of the male pattern and probably have several masculine genes. In a cross involving the *maculatus* and *lineatus* races, 7 XY females appeared having the *maculatus* spot. Crossed with XY males they gave, as predicated, 3 males : 1 female. Among these were fertile YY males which, when crossed with normal females, gave only male offspring.

There are no unequal pairs of chromosomes in *Lebistes*, so the X and Y must be of equal size. Among other conclusions reached are that all the genes in X are able to cross over to Y, and that the Y contains at one end a specific male-determining gene which is at the same time a gene for colour pattern. The X lacks this gene, but whether it possesses an allelomorphic feminine gene is undecided.

R. R. G.

University and Educational Intelligence

ABERDEEN.—The honorary degree of LL.D. has been conferred on the following, among others: Prof. E. V. Appleton, Wheatstone professor of physics, King's College, London; Mr. W. H. Buckler, engaged in archæological work in Asia Minor; Lieut.-Col. A. T. Gage, formerly director of the Botanical Survey of India and superintendent of the Royal Botanic Gardens, Calcutta; Dr. J. C. G. Ledingham, professor of bacteriology, University of London, and director of the Lister Institute, London.

EDINBURGH.—A gift of £10,000 has been received from Mr. J. Albert Thomson for the purpose of establishing a commercial laboratory in the University. This will provide for the immediate requirements in staff and equipment for a laboratory providing the approved methods of training for students for the commerce degree, so that those who aspire to the higher positions in industry shall have an intimate working knowledge of all up-to-date office machinery and appliances..

LONDON.—The County Borough Council of West Ham has decided to make a grant of £2,500, payable over five years, towards the cost of the erection of the new buildings in Bloomsbury. The Worshipful Company of Plumbers has made a donation towards the cost of the Ceremonial Hall to be built on the Bloomsbury site.

ST. ANDREWS.—The University Court has recorded a Minute on the occasion of the jubilee of the appointment of Prof. D'Arcy W. Thompson to the University (NATURE, 135, 59, Jan. 12, 1935). Tribute is paid to his outstanding worth and ability, not only in his own department of natural history but also in other departments of literary and scientific knowledge. His election to the presidency of the Classical Association testified to his knowledge of and interest in the ancient languages and literatures of Greece and Rome; his election as an honorary member and as president of the Edinburgh Mathematical Society in recognition of his pioneer work in the application of mathematical methods to biological studies was a guarantee of mathematical ability of no mean order; and his work as adviser to the Fishery Board for Scotland, and as a delegate to the Bering Sea Fisheries Conference and to the North Sea Conference indicated his international reputation as a scientific administrator.

MOSCOW STATE UNIVERSITY will hold a summer school from July 16 until August 25. Instruction will be in the English language by an all-Soviet staff in twelve courses of thirty hours each, with occasional addresses by prominent Soviet officials. The subjects of the courses include: Russian language (advanced), Russian literature, Russian arts, Russian education, Russian technology, Russian economics, Russian geography and Russian history (of the Soviet Union), administration of justice, public health and medicine, and the philosophy of dialectical materialism. The students will also be able to choose one of six specially organised tours. Last year's summer school enrolled 212 students.

UNIVERSITY COLLEGE, London, continues to attract students from abroad in large numbers. The recently issued annual report shows that of a total of 3,231 students enrolled in 1933–34, no fewer than 744, or 23 per cent, were from countries outside the British Isles, namely, 304 from other parts of the Empire and 440 from some forty foreign countries. Among European countries Germany contributed 102, France 35, Switzerland 26 and Holland 19 students, while India was represented by 157, the United States of America by 45, South Africa by 31, Palestine and Australia each by 26. In the course of the year, the quinquennial visitation by members of the University Grants Committee took place, and from the summary of developments of the years 1930–35 prepared for presentation to the Commissioners, a number of interesting paragraphs have been reproduced in the report. One of these relates to the great change that has taken place in the proportion between full-time and part-time students, the former having increased almost continuously since 1925–26 while the latter have diminished from nearly 1,600 to less than 1,100. The number of full-time post-graduate and research students has risen during the past ten years from 168 to 255. Several departments of the College were enabled, through the generosity of various benefactors, to offer hospitality during the past year to a number of scholars exiled from their homes in Germany, among them the distinguished chemist Prof. H. Freundlich. Annexed to the report is an address by Sir Josiah Stamp, delivered by him as Special Visitor on the occasion of the annual assembly of the Faculties: the subject is "The Management of Mind".

Science News a Century Ago

Lyell and Mantell

On April 13, 1835, Lyell wrote to Mantell: "I have been getting Dinkel to figure for me some fossil eggs of a turtle, found in the island of Ascension, imbedded in a hard rock something like that of Guadaloupe which contains the human skeleton. It is clear that the eggs were nearly hatched at the time when they perished for the bones of the young turtle are seen in the interior with their shape fully developed. . . . On my showing the specimen containing seven eggs to Owen, of the College of Surgeons, he remarked to me that they were hollow, whereas the bones of reptiles want the medullary cavity. Struck with this remark, and with the extreme hollowness of the bones, only to be compared to that of some Tilgate specimens which you have often shown me, I got Owen this morning to dissect for me a young turtle, not a fœtus, but so young that the mark of the attachment of the yolk was still a large opening. He immediately showed me that the bones were not hollow, though we both remarked that the outside looked harder than the interior. Owen has promised to get me a set of very young turtle's bones from the Zoological Gardens, and I am persuaded it will clear up a number of your difficulties."

The Zoological Gardens

"The Commissioners of Woods and Forests," said *The Times* on April 14, 1835, "have recently granted to the members belonging to the Zoological Gardens, in the Regent's Park, an extensive increase of land consisting of 10 acres, on the south side of the Park, which is now railed in. Immediately an immense number of workmen of various denominations will be employed in levelling the ground, laying out, and planting elegant shrubberies; erecting superb habitations for various beasts and birds, which will be placed in them with all possible speed, from the society's collection at Kingston-on-Thames, where they have an immense farm. On the completion of the intended improvements, these gardens will present to the public the most superb promenades in England, the whole of which will be completed in a few weeks. Since the commencement of the warm weather, the whole of the beasts and birds which were of tender habits have been removed from the menagerie, where they have been kept during the winter months, and are now exhibited to the public. During the present spring, these gardens will be considerably more frequented, on account of the immediate opening of the Regent's Park to the public. The grand broad gravel walk which passes through the Park leads to the Zoological Gardens."

The Franklin Institute

The forty-fifth quarterly meeting of the Franklin Institute, Philadelphia, was held on April 16, 1835. Various donations of books were stated to have been received, some of these being from the Society for the Encouragement of Arts, Manufactures and Commerce of London, and others from Faraday. In the report of the Board of Managers, it was said that "The Lectures of the Institute were closed on the 25th March last; the large number of the class, and the regular attendance during the season, clearly evince the interest taken by the members and the

public in this method of popular instruction, which, the Board indulge the hope, will long continue. A large portion of the time of the Committee on Publications has been industriously devoted to the improvement of the Journal, and its high reputation, not only throughout our own country, but also in Europe, should in the opinion of the Board, induce the members of the Institute, and the public generally, more extensively to encourage and patronize it. . . ." Referring to the exhibition arranged for October 1835, the Board said: "To awaken and create a laudable spirit of emulation and improvement, has always been the principal object of the exhibition of articles of domestic manufacture, and the Board rely with great confidence upon the support and co-operation of the mechanics and manufacturers of Pennsylvania, and of the United States, to render the exhibition of this year as interesting, attractive, and useful as those of preceding years."

The German Universities

On April 18, 1835, *The Times* stated that "the number of these institutions is 19, 2 only of which, those of Berlin and Bonn, were founded in the present century; there were 3 established in the 14th century, Heidelberg, Prague and Vienna; 6 in the next century, 2 in that which succeeded, and 3 each in the 17th and 18th centuries. The earliest founded was of the Protestant religion, the last for both Protestants and Catholics. Of the whole number there are 11 Protestant, 5 Catholic and three mixed. The greatest number of professors is at Vienna, where there are 79; the least at Erlangen and Kiel, each having 29. The greatest attendance of students is at Vienna and Berlin—nearly 2,000 each; the least at Rostock, 110; the number of professors at which are 34, very nearly one master to 3 students; and at Kiel, where there are 29 professors, and only 130 students. The universities next best attended by students to those named as having the greatest number are Prague, Leipsic, Breslau and Heidelberg, each of which has more than 1,000 students."

Societies and Academies

PARIS

Academy of Sciences, February 25 (*C.R.*, **200**, 701–792). LOUIS LUMIÈRE: Coloured screens for stereoscopic projections. CHARLES CAMICHEL and MAX TEISSIÉ-SOLIER: The influence of a perturbation of an immersed body, under the Poiseuille condition. PAUL PASCAL and MARCEL PATRY: Introduction to the study of the telluric acids. Description of the effects on dehydration at increasing temperatures of orthotelluric acid. ALEXANDRE MINIATOFF: A property of transformations in space of two complex variables. GEORGES VALIRON: The number of transcendental singularities of the inverse functions of a class of algebroids. PIERRE DIVE: Coronas with constant logarithmic potential and integral relations characteristic of the ellipse. BORIS FUCHS: Limitations for the variation of an angle in the case of a pseudoconformal transformation in space of two complex variables. PETER THULLEN: The second problem of Cousin. LOUIS FEYLER: The course of the Tafassasset valley to the north of the Grand Erg of the Ténéré and the probability of its prolongation, to the south, up to Tchad. J. TILHO: Remarks on the preceding communication. PAUL CHAMBADAL: The refrigeration of water by fractional evaporation. RENÉ PLANIOL: Currents of positive ions produced in a high vacuum. NY TSI-ZE and TSIEN LING-CHAO: The laws of the evolution of electricity by torsion in quartz. Two formulæ have been suggested for the quantity of electricity evolved by torsion in quartz, one by the authors and another by E. P. Tawil. For certain dimensions of hollow cylinders either formula represents the experimental facts fairly well, but with a wider range of ratio of internal and external diameters, the authors' formula appears preferable. IGNACE ZLOTOWSKI: The passage of the current at potentials below the decomposition potential of electrolytes. EMILE THELLIER: An induction apparatus for the measurement of small magnetic moments. The apparatus described is designed to eliminate the errors due to the instability of the zero, to variations in the external magnetic field and to thermo-electric effects in the circuit. It is sufficiently sensitive to measure the magnetisation of rocks and baked clays. BERNARD LYOT: A green monochromatic filter. Combinations of neodymium glass, or a solution of neodymium nitrate, with Schott *VG* 3 glass. One combination transmits a band at 82 A. PIERRE AUGER: The absorption of the cosmic radiation. A discussion of the published work on this subject. The hypothesis of a single type of primary cosmic rays does not give an explanation of the whole of the experimental facts. JEAN GRÉVY: The viscosity of very dilute solutions of nitrocellulose in ether alcohol mixture. According to Staudinger, the specific viscosity of a colloidal solution is independent of the solvent. The specific viscosities of very dilute solutions of nitrocellulose in mixtures of ether and alcohol are given, the proportion of alcohol varying from 18 to 90 per cent. Between 20 and 90 per cent of alcohol, the specific viscosity is practically constant: with lower proportions of alcohol, the specific viscosity is lower. JAMES BASSET and MAURICE DODÉ: The direct synthesis of nitrates at ultra-pressures. The amounts of nitrate obtained by heating baryta, baryta plus potash and lime with mixtures of nitrogen and oxygen at pressures of 3600 kgm. are given for temperatures ranging from 500° C. to 900° C. RENÉ PERROTTE: The synthesis of ricinic acid (12-ketostearic acid). MARCEL GODCHOT, MAX MOUSSERON and ROBERT GRANGER: The dehalogenation of the cyclanic chlorhydrins with shortening of the ring. MAURICE BADOCHE: Researches on the dissociable organic oxides. The photo-oxidation of sodium 1, 1′, 3′.triphenylrubene carboxylate. GEORGES RICHARD: Contribution to the study of the α-chlorketones. ANTOINE WILLEMART: Contribution to the study of the preparation of coloured hydrocarbons of the rubene type. ANDRÉ WAHL and MARC RINGEISSEN: 2, 2′.Dihydroxy-1, 1′.dinaphthyl sulphide. GEORGES DUPONT and WITOLD ZACHAREWICZ: The synthesis of nopinene and 1, 5.pinadiene starting with pinene. The oxidation of pinene by selenium dioxide yields the myrtenol already described, nopinene and 1, 5.pinadiene. CAMILLE LEFÈVRE and CHARLES DESGREZ: Contribution to the study of the aromatic sulphides. The phenol mono- and di-sulphides previously described, as well as their complex mercury compounds, give well-defined stable salts. J. JUNG and M. ROQUES: The petrography of the crystallophyllian strata of the Bas-Limousin. E. CHAPUT: The Eocene of the plateau of Galatie (Central Anatolia). P. LEJAY: Study of the diurnal variation of atmospherics at Shanghai. Three years observations

are summarised in monthly curves. Pierre Dangeard: The structure of some quiescent nuclei. Albert Pitot: The morphology of the seed of the Leguminoseæ in its relations with systematics. Emile Saillard and Roger Saunier: The determination of the ash of sugar beets by measuring the electrical conductivity. P. Portier and Mlle. A. Raffy: The action of water with low surface tension on the plumage of aquatic birds. Etienne Rabaud and Mlle. Marie Louise Verrier: The swim bladder and the pneumatic canal. Reply to criticisms of J. Meierhans. Emil Cionga: The presence of α-pyrryl-methyl ketone in stabilised officinal valerian. This ketone is regarded as one of the active principles of valerian. Emile Brumpt: Paludism in birds. *Plasmodium gallinaceum* of the domestic fowl. Mlle. Nine Choucroun and Maurice Peltier: The ultra-virus of murine leprosy. G. Mouriquand, J. Rollet and M. Courrières: The ultra-violet test for A avitaminosis. Etienne Sergent: The action of subcutaneous injections of water against fatal doses of snake poison. In experiments with mice, the specific serum saved 12 out of 30, a serum active against other snakes saved 10 out of 30, whilst physiological water saved 5 out of 30. Alexandre Besredka and Ludwik Gross: Cuti-vaccination of mice against sarcoma.

Amsterdam

Royal Academy of Sciences (*Proc.*, 38, No. 2). Ernst Cohen and H. L. Bredée: The velocity of oxidation of tin. A gas-dilatometric study showed that tin oxidises in dry air at 18° C. with a measurable velocity. E. D. Wiersma: Influence of the similarity and dissimilarity of mental qualities of the parents on their children. (3) The children of happily and unhappily married parents were examined with regard to differences in temperament, intellect and tendencies. J. Funke and C. F. E. Simons: The β-bands of boron monoxide. An analysis of the $B^2\Sigma \rightarrow X^2\Sigma$ bands of BO. P. J. Bouma: Outlines of a general theory of the colour metric. (2) Conclusion of a generalisation of Schrödinger's colour metric to allow for the part of the 'rods' of the retina in colour vision. F. Zernike and H. C. Brinkman: Hyperspherical functions and the polynomials orthogonal in spherical regions. M. Pinl: Quasi-metric on totally isotropic surfaces. (3). A. Jeannet: On two irregular echinoderms from the lower chalk of Ibiza (Balearic Is.). M. G. Rutten: *Orbitocyclina*, Vaughan, a synonym of *Lepidorbitoides Silvestri*. The genus *Lepidorbitoides* is identical with *Orbitocyclina* and the latter name should disappear. G. H. R. von Koenigswald: The fossil mammalian fauna of Java. Important conclusions regarding the original connexions of Java with the continent of Asia, the time and order of their severance are drawn. W. J. Prud'homme van Reine: Plasmolysis and deplasmolysis. The variation of plasmolysis and deplasmolysis of epidermal cells from *Allium cepa* in saccharose solutions has been investigated as a function of the temperature and concentration. H. J. Vonk: Solution of fat and fatty acid by the gastric juice of *Potamobius leptodactylus*. The gastric juice is able to bring into solution particles of milk fat and oleic acid suspended in water. This result is discussed in connexion with the digestion of fats and fatty acids by invertebrates. F. E. Kredel and W. J. Roberts: Supra-vital staining of cartilage. A satisfactory method is described for differentiating living and dead cartilage cells with neutral-red as a supra-vital stain.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, April 14

British Museum (Natural History), at 3 and 4.30.—Capt. Guy Dollman: (1) "Egg Laying and Pouched Mammals". (2) "African Antelopes".*

Monday, April 15

British Museum (Natural History), at 11.30.—F. C. Fraser: "Stranded Whales on the British Coast".*

Royal Geographical Society, at 8.30.—V. E. Fuchs: "The Lake Rudolf Rift Valley Expedition".

Wednesday, April 17

Royal Microscopical Society, at 5.30.—Dr. B. H. Knight: "Modern Uses of the Petrological Microscope in Road and Building Problems".

Official Publications Received

Great Britain and Ireland

Navy (Health). Statistical Report of the Health of the Navy for the Year 1933. Pp. 152. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

Wool Industries Research Association. Report of the Council, 1934. Pp. 39. (Leeds: Wool Industries Research Association.)

Researches published from the Wards and Laboratories of the London Hospital during 1934. Pp. iv+39 papers. (London: H. K. Lewis and Co., Ltd.) 7*s.* 6*d.* net.

Report of the Rugby School Natural History Society for the Year 1934. (Sixty-eighth Issue.) Pp. 56. (Rugby: George Over, Ltd.)

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending July 31st, 1934. Pp. 65+7 plates. (Newcastle-on-Tyne: Armstrong College.) 5*s.*

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Museum and Art Gallery Committee for the Year ending 31st December 1934. Pp. 28+4 plates. (Bristol.)

Other Countries

Technical Books of 1934. Compiled by William W. Shirley. (Twenty-seventh Issue.) Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1934. Pp. liv+219+7 plates. (Bern: Paul Haupt.)

U.S. Department of Agriculture. Technical Bulletin No. 431: A Revisional Study of the Genus *Scolytus* Geoffroy (*Eccoptogaster* Herbst) in North America. By W. M. Blackman. Pp. 31. 5 cents. Technical Bulletin No. 460: Studies of *Exeristes roborator* (Fab.), a Parasite of the European Corn Borer, in the Lake Erie Area. By W. A. Baker and L. G. Jones. Pp. 27. 5 cents. (Washington, D.C.: Government Printing Office.)

List and Prices of Publications issued by the Carnegie Museum. Pp. 34. Annals of the Carnegie Museum. Vol. 23, 1934. (Serial No. 162.) Pp. xii+432+50 plates. 3.50 dollars. (Pittsburg, Pa: Carnegie Museum.)

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