NATURE

SATURDAY, DECEMBER 13, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

No. 3189, VOL. 126]

Central Research Stations in Tropical Agriculture.

ONE of the features of the post-War administration of the tropical possessions of the British Empire is the increasing attention which is being paid to the application of science to agriculture. This is no longer the sole concern of the Colonial Office, as a number of new organisations, official and commercial, such as the Empire Marketing Board and the Empire Cotton Growing Corporation, are devoting every year large sums of money to research. The new movement gained considerably, both in impetus and in direction, when the Imperial Agricultural Research Conference met for the first time in London in 1927 (NATURE, Oct. 29, 1927). One of the main recommendations of this Conference, as regards research, was a proposal for the establishment, as funds and staff permit, of a chain of central tropical and sub-tropical research stations which should, in the main, "confine themselves to long-range and wide-range investigations, or, in other words, should concentrate on (1) problems requiring more prolonged research than can normally be expected from the technical staff of any single administrative department, and (2) problems arising in more than one territory of the Empire towards the solution of which the comparative method may be expected to make an effective contribution". On the relations between the proposed central stations and the local agricultural departments, the Conference laid down some general directions. The work of the central stations was expected to be developed as a reinforcement of the undertakings of the local agricultural departments and in no sense as a substitute for such activities. It was felt that such a policy would not only prevent friction but also would make overlapping impossible.

The recommendations of the Imperial Agricultural Research Conference were, with commendable promptitude, duly endorsed by the Committee on the Colonial Agricultural Service appointed by the Secretary of State for the Colonies, under the chairmanship of Lord Lovat. The first of the chain of Imperial Agricultural Research Stations, to be devoted solely to research, was started at Amani in East Africa in 1927. Steps were taken to develop and expand the estate and buildings taken over from the Germans at the armistice of 1918. The reports of the new station for the period Mar. 2, 1927, to Mar. 31, 1930—a little more than three years—have just been issued by the Colonial Office.*

* East African Agricultural Research Station, Amani. First Annual Report, 1928–29. Price 6*d*. net. Second Annual Report, 1929–30. Price 1*s*. net. London: His Majesty's Stationery Office, 1930. (Colonial, Nos. 50 and 51.)

These papers contain the fullest details of the history, purpose, and progress of the Amani Institute, and should be carefully studied, not only by all research workers concerned with tropical agriculture, but also by the administrative officers of the Colonial Services interested in the development of the regions entrusted to their care.

Although the original experiment station at Amani, founded by the Germans in 1902, passed through a period of neglect and vicissitude from November 1918 until March 1927 when the new scheme started, nevertheless the station generally was found to be in a surprisingly good condition when the present Director, Mr. W. Nowell, took over charge. The roads and plantations were in good order; the laboratories, library, and the botanical and entomological collections were well cared for. These circumstances have not only lightened the heavy work involved in the formation of a modern agricultural experiment station, but have also assisted the Director and the staff of the Institute in formulating a programme of work and in setting in motion a number of interesting investigations on such subjects as the rôle of shade trees in coffee cultivation, the nature and spread of the virus diseases of plants, the best methods for the study of soil erosion, and the maintenance of the fertility of tropical soils—a matter of the first importance in the future development of the African continent. One important extension of the research station has already been carried out. The neighbouring coffee estate of Kwamkoro has been taken over, connected with Amani by a motor road, and considerably developed. Plans for additional sub-stations at Tengeni and other places are being rapidly matured. The Amani Station is settling down to serious work and already the need for more workers is beginning to be felt.

As is inevitable in such undertakings, the new station has had to contend not only with local difficulties of a particularly trying nature, but also with a certain amount of adverse criticism. Much time and energy have had to be expended in improving the communications of the station itself and in making it accessible to visitors. The supply of local labour is scanty, as the climate of Amani is unpopular with the inhabitants of the lower levels. The experiment station has not yet been provided with a fully qualified medical officer and has to rely in all cases of emergency on the medical staff of the Universities' Mission at Tongwe. This is a great defect in organisation and one which should be dealt with by the authorities without delay. Adequate medical arrangements are not only imperative for the scientific workers and their families, but also would help in attracting a better supply of native labour. A good deal of local criticism, to the effect that Amani is not representative of East African conditions and that the results obtained cannot possibly apply to the six dependencies which contribute to its support, has had to be met. The Director points out that such criticisms would apply to any other site that could be selected, and that no alternative has yet been suggested with advantages which would offset the roads, buildings, equipment, and plantations which were already in existence at Amani in 1927 and which cost no less than £100,000 sterling.

A critical study of the Amani reports discloses one administrative weakness which is of considerable interest both to the scientific worker and also to the general public, namely, the incompatibility of long-range and wide-range research with the preparation of a detailed annual report. So little progress can be made in such work in twelve months that the submission of an annual report is almost ridiculous. Further, the practice leads to the waste of much valuable time, and also exposes the workers to the risk of uninformed comment and to undeserved criticism. It would seem that an important improvement in administration could be made, and that a reform long overdue could be carried out, if these annual reports could be abolished altogether so far as research is concerned. If the workers at Amani could be asked to furnish instead a well-thought-out quinquennial review in which the purpose, equipment, progress, and cost of the station could be set out in clear and definite form, the present annual reports could be replaced by a brief account of important administrative events, to which a statement of the annual receipts and expenditure, with the usual auditor's certificate, could be attached. This would provide for any necessary administrative control of the station.

From the point of view of the scientific investigator such an innovation has obvious advantages. The workers overseas would then receive adequate protection, and they would be able to work out their own salvation under conditions approximating to those obtaining in the research centres of Great Britain. The growing volume of annual reports, now such an alarming feature of agricultural research in the Empire, would be replaced by the five-yearly review, which would soon find a permanent place in the literature of the subject. Further, such reviews would provide an effective documentation both for the Press and for the general public interested in the work, and would

also prove invaluable as a basis for the deliberations of the Imperial Agricultural Research Conference, the next meeting of which will take place in Australia in 1932. A beginning in the direction indicated might be made next year. If quinquennial reviews of the various experiment stations in Australia and New Zealand for the period ending Mar. 31, 1931, could be prepared and circulated in time, visitors to the antipodes in 1932 would be provided with all the information they need for the study of the local experiment stations and of the results obtained. If other parts of the Empire adopted the same practice, the 1932 meeting of the Imperial Agricultural Research Conference would mark a distinct step in advance in providing that effective publicity which is now becoming so necessary in scientific work, not only for the workers themselves, but also for the public from whom the funds are ultimately derived.

Chemistry for the Layman.

(1) *Chemistry for Beginners.* By Dr. E. J. Holmyard. (Dent's Modern Science Series.) Pp. xi + 223 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s.* 6*d.*

(2) *In the Realm of Carbon: the Story of Organic Chemistry.* By Prof. Horace G. Deming. Pp. x + 365. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s.* net.

(3) *The Spirit of Chemistry: an Introduction to Chemistry for Students of the Liberal Arts.* By Prof. Alexander Findlay. Pp. xvi + 480. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10*s.* 6*d.*

AT the beginning of the present century there were few works on chemistry written in such a manner as to appeal to the intelligent layman; so that, in spite of such earlier works as Scoffern's "Chemistry No Mystery" (1839), chemistry remained a decided mystery to the average educated person. The text-books of the period were dressed in the trappings of an unimaginative formalism, and to layman and aspiring chemist alike the subject appeared to be far removed from the activities and interests of everyday life. Little attention was paid at that time to the historical evolution of the science or to the personalities of its creators. Such a system of instruction was capable of transforming a chemical enthusiast into a chemist, but it aroused no general interest in chemistry.

The texts of thirty years ago were designed originally for the training of chemists. In recent years, particularly since the War, there has been a growing recognition of the importance of chemistry as a subject of general education. As a result, it is no longer sufficient to provide treatises and courses for the training of the professional chemist: it has become necessary to consider the needs of the increasing number of pupils and students who require courses in what may be called cultural chemistry. Thus, the last few years have witnessed a striking popularisation of chemistry, and there is now available, particularly in the English language, a considerable variety of works on chemistry which may be read with pleasure and profit by the general student and by the educated layman. The publication of works of this kind has influenced in turn the character of the more formal text-books of chemistry. Altogether, the last decade has been characterised by a strong movement towards a brighter and more arresting presentation of chemical facts and theories, and at the same time there has been an equally marked growth of interest in the historical and humanistic aspects of chemistry.

(1) The three books under notice illustrate some of the main tendencies to be observed in the modern methods of presenting chemistry in the school, to the general reader, and to the lay student. In discussing methods of increasing the interest of pupils in school chemistry, an American writer (Collier, *Journal of Chemical Education*, 1930, 2141) states that "the foundation of a course is laboratory work. It is here the student at the start is given an opportunity to satisfy his curiosity and indulge in the interesting manipulation of chemical materials." Dr. Holmyard voices the same opinion in the preface to his little book: "Every opportunity has been taken to press into service those attractive phenomena in which chemistry is so rich; but if a boy or girl assimilates the fare provided, he or she will have acquired a knowledge of scientific method more difficult to appreciate than the beauty of the phenomena." Thus, already on p. 9, following an account of common laboratory apparatus, we find descriptions of an "astonishing experiment" with iodine and aluminium and an "exciting" chemical reaction with ammonium dichromate. We begin to realise, in fact, that "chemistry is a joyous adventure . . . rich in spoils". At appropriate intervals the narrative is projected against the background of history: when we visit Priestley, for example, we wear powdered wigs, travel in sedan chairs, and retail the current society gossip of Bath. Again, "our experiments with oxygen, simple as they are, represent the work of many different men,

of many different countries and ages". From the chemical laboratory, Dr. Holmyard passes in succession to chemical changes, combustion, oxygen, hydrogen, formulæ and equations, water, acids, bases and salts, carbon dioxide, and air. The result is a very efficient and attractive little book with an excellent selection of illustrations.

We have often wondered, by the way, why Jan Ridd's vivid description of a "winkey" has never been commended to their pupils, in these days of *laissez-faire*, by writers of popular school texts, in dealing with the phenomenon of combustion. "This is the manner of a 'winkey', which I here set down, lest child of mine, or grandchild, dare to make one on my premises; if he does, I shall know the mark at once, and score it well upon him. . . . Anon, as he reads by that light his lesson, lifting his eyes now and then it may be, the fire of candle lays hold of the peter with a spluttering noise and a leaping. Then should the pupil seize his pen, and, regardless of the nib, stir bravely, and he will see a glow as of burning mountains, and a rich smoke, and sparks going merrily; nor will it cease, if he stir wisely, and there be good store of peter, until the wood [of his desk] is devoured through, like the sinking of a well-shaft" ("Lorna Doone", Chap. i.).

(2) Returning from Blackmore to our American writer, we read that little do the modern secondary students "care whether oxygen weighs 1·429 grams per liter, or that lead has a specific heat of 0·0305. Far more important to them is the fact that hydrogen used to be used in balloons and is now used to make oleomargarine and ammonia gas. Material must be presented in a modern way if it is going to stick and mean anything to the student in later life. The applications must be stressed rather than the actual physical and chemical properties of the various elements. . . . The uses of materials that affect the life of the student should be stressed rather than simply the building bricks of chemistry, namely, the study of the elements and their properties." We cannot accept these statements at their face value. The principle outlined, however acceptable to the chemical propagandist, should be applied with caution by the teacher of chemistry. This principle is the *leitmotif* of such works as Slosson's "Creative Chemistry", and it is discernible in Prof. Deming's new book, which "is intended for the general reader who would like to know something of the manner in which organic chemistry grew and developed, and something of its contributions to the comforts and conveniences of modern life".

Prof. Deming, however, has skirted the pitfall which has swallowed divers of his countrymen who have sought to popularise chemistry; for, although he emphasises the material achievements of organic chemistry, he is not led thereby to shut his eyes to the importance of the theoretical foundations and the historical development of the science. He has, indeed, produced a proportioned and readable story of organic chemistry, written around the sub-titles: How the foundations were laid; The organic chemical industries; and, The chemical activities of living cells. The numerous illustrations include several original drawings which are intriguing if not always quite convincing in detail. We wonder, for example, whether Pasteur actually sorted his dextro- and lævo-rotatory crystals with the aid of two slips of paper labelled 'L' and 'R'.

(3) Prof. Findlay's book is a comprehensive text for British and American "students of the liberal arts" who are studying chemistry "as an element of general culture rather than as a part of their professional or technical training . . . the purpose of the book is not so much to impart a detailed knowledge of a wide range of facts as to create a scientific spirit; a spirit of toleration and of co-operation, of intellectual adventure and of intellectual honesty, which seeks ever to enlarge our knowledge of the external world and to found that knowledge, not on tradition or authority, but on a basis of ascertained fact." A mere glance at this admirably produced work, with its 480 pages, 88 figures, and numerous portraits and illustrations, gives an indication of the thorough manner in which the author has handled a task of considerable difficulty. The first three chapters deal with the aim and method of science and with the historical development of chemistry; fundamental laws, atomic weights, atomic constitution, and the states of matter are next discussed. The historical setting which is a feature of the whole treatment assumes a prominent place in Chap. x., which treats of the atmosphere and of combustion. The ensuing discussion leads naturally to a consideration of matter and energy and of fuels and illuminants. Without enumerating further headings, it may be said that the book constitutes a facile and consecutive narrative embracing and illustrating the fundamental principles, materials, and achievements of chemistry, inorganic, physical, and organic.

In reading this work, we were impressed particularly by its logical and balanced treatment of so wide a field, its apposite quotations, its historical background, and in general by its scholarly and literary presentation of a scientific theme. The book contains several illustrations of historical

interest which are not readily accessible elsewhere; we may here mention Cruikshank's interesting caricatures concerning the introduction of coal gas and the effects of laughing gas. As an example of the author's attention to detail, we commend his footnote on van Ostade's painting of "The Alchemist", incorporating an interesting observation which will be new to many admirers of this well-known picture: "On the sheet of paper lying on the floor the artist, with ironic humour, has painted the words, *oleum et operam perdis*, thou labourest in vain".

From these comments it will be realised that the book is not of the sugar-coated variety, which aims at sparing the reader all thought and effort and ends by giving him at the best a superficial smattering of the subject. It is, on the contrary, a sound and carefully planned treatment of chemistry for the non-professional student, framed withal in a very attractive and readable form. In evolving it, the author has carried out a noteworthy experiment in chemical exposition, and, in our opinion, has amply fulfilled the purpose indicated in his preface. We hope that in due course he may have an opportunity of expounding, in a complementary publication, his views concerning the practical work appropriate for the students for whom this book has been written.

JOHN READ.

Older Tectonic Geology of North-Western Europe.

Geologie von Europa. Von Prof. Dr. Serge von Bubnoff. (*Geologie der Erde*, herausgegeben von Prof. Dr. Erich Krenkel.) Band 2: *Das ausseralpine Westeuropa.* Teil 1: *Kaledoniden und Varisciden.* Pp. xii + 691 + 4 Tafeln. (Berlin: Gebrüder Borntraeger, 1930.) 49·50 gold marks.

THE fourth of the volumes of Prof. Krenkel's monumental work, "Geologie der Erde", is the first part of the second volume of Prof. von Bubnoff's "Geologie von Europa" and is a valuable monograph on the older geology of the extra-Alpine regions of north-western Europe. It is entitled the "Kaledoniden und Varisciden" and adopts the term Caledonids in the extended sense for all the pre-Permian mountains and not only for those of the Middle Palæozoic. That extension involves a double use of the word and makes it applicable to a greater range in time than when used for one of the main orogenic epochs—the "Kaledonische Discordanz" (p. 607).

The volume is occupied mainly by a description of the pre-Permian and, for some areas, also of the Lower Permian geology of north-western Europe. The first two chapters deal with the Caledonids of Norway and some parts of Sweden, and with the British Caledonids; it summarises the Palæozoic geology of the British Isles except of southern Ireland, Cornwall, and part of Devon, which are grouped tectonically with north-western France as part of Armorica. The further chapters deal with Brittany, the Central Plateau of France, the Ardennes and the Middle Rhine, and the mountain blocks beside the Upper Rhine, comprising the Vosges, the Black Forest, and some of the hilly uplands of south-western Germany, including the Spessart and the Odenwald; further chapters describe the Harz Mountains, the Bohemian mass and its bordering mountains—the Sudetes on the north-east and the Thuringer Wald on the west. The last chapters are on the older rocks of Poland, which are less well known as the Sventokrizer than under their old name of the Lyssa Gora. The final chapter discusses the influence of these old mountain remnants on the structure of western Europe.

Each chapter gives an account of the pre-Palæozoic and Palæozoic stratigraphy of the area, and of its structure and economic geology, with a bibliography which is especially useful as it gives reference mainly to the later literature. The book is not only a compendium but also a critical re-examination of the main evidence and states the conclusions regarding various questions of stratigraphical classification by an authority whose knowledge of European stratigraphy is unusually wide. The stratigraphical successions and their correlation are clearly stated in four large folding tables. On the controverted question of the Silurian-Devonian boundary the author divides the Downtonian into two and places the upper division, including the Ludlow Bone Bed and the beds above it, in the Devonian; but as he correlates them with the Foreland Sandstones and the Dartmouth Slates, and includes the Whitcliff Flags (which he calls the Whitecliff) in the Downtonian, he does not take quite the same ground as those British geologists who extend the Devonian down to the Ludlow Bone Bed.

The term Silurian is not much used, as according to the author it includes everything between the Cambrian and Devonian, and thus the rocks which British geologists regard as the Silurian he calls Gotlandian.

In dealing with the claims for extensive rock metamorphism by the Variscan movements, the author notes but does not accept the view of the upper Palæozoic age of the schists and gneisses

which form the dominant constituents in the Moldavian-Danubian belt; and in re-affirming the pre-Cambrian age of the granulites of Saxony he notes the conclusion of Pietzsch (1922) that the quartzites and arkose of middle Saxony, which have been generally classified as Lower Carboniferous (Culm.), are also pre-Cambrian.

Each chapter concludes with an interesting account of the economic geology; the author notes that of the coal of Europe the British shelf contains 11·2 per cent, as compared with 87 per cent in the fields associated with the Variscan blocks, mainly in Germany and Upper Silesia. As regards the disputed genesis of the Rammelsberg ore-body, he quotes the recent conclusion of Frebold that it is of sedimentary origin but has undergone fundamental dynamic metamorphism; this view takes up a position intermediate between the old syngenetic and the metasomatic theories. As the book includes only rocks up to the top of the Rotliegende, the Kupferschiefer which lies upon that horizon is not considered.

British geologists naturally turn first to the British section, which is the least complete. The author makes a heroic attempt to deal with the problems of the Scottish Highlands and gives summaries of the various classifications. Prof. von Bubnoff appears to favour the views of Frodin, according to whom the Scottish metamorphic rocks conform with the conclusions of those Scandinavian geologists who accept the Palæozoic age of large areas of their crystalline schists. The book reproduces a sketch map by Frodin that represents the schists of the Scottish Highlands as the metamorphosed representatives of the Ordovician and Silurian rocks of the Southern Uplands. The evidence from Ireland appears, however, to negative that view conclusively.

There are occasional verbal slips in the British section, such as 'in Lancaster' instead of Lancashire, and 'scherts' for cherts, while 'Jorkian' is unfamiliar for Yorkian, and 'Canal' for English Channel. The volume is large and expensive, but it is illustrated by 201 excellent figures, which are mostly sketch maps and sections, with theoretical diagrams to summarise the author's interpretation of the epeirogenic movements that controlled the depth and character of the deposits. Unfortunately, the map of the German Variscan Mountains, which like many others is after Kosmat, has been printed upside down in reference to the legend, so that use of this instructive figure requires constant inversion of the book to compare its elaborate shading with the explanation. J. W. G.

Bird Studies.

(1) *British Birds.* By F. B. Kirkman and F. C. R. Jourdain. Pp. xvi + 184 + 202 plates. (London: T. C. and E. C. Jack, Ltd., 1930.) 21*s.* net.

(2) *The Birds of Tropical West Africa: with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria.* By D. A. Bannerman. Published under the authority of the Secretary of State for the Colonies. Vol. I. Pp. lxxv + 376 + 10 plates. (London: The Crown Agents for the Colonies, 1930.) 22*s.* 6*d.* net.

(1) THE shelf of works of reference on British birds is now so crowded that a new book must have special merit to be welcome as an addition. This requirement is well fulfilled by the volume which comes from two well-known authorities, Mr. Kirkman and Mr. Jourdain, with two hundred coloured plates by a group of artists—Winifred Austen, G. E. Collins, H. Goodchild, H. Grönvold, G. E. Lodge, and A. W. Seaby. The plates, among the best of their kind both for utility and for pictorial merit, were published nearly twenty years ago in the monumental "British Bird Book" edited by Mr. Kirkman. Their reappearance here, excellently reproduced, in a single volume of moderate size, will be convenient even to possessors of the larger work, and will also bring them within the reach of a wider public.

The text is new and adequate to the purpose. It consists of a brief account of the appearance, range and habitat, nest and eggs, food, and usual notes of each species, conveniently placed to face the corresponding plate. The information given is accurate and up-to-date within its scope, but no general description of habits is attempted. There is text also for the rarer species which are not figured, and at the end there is a series of plates showing the eggs of British breeding birds. Altogether, most excellent value for a guinea; but the alphabetical table of contents has not been revised with sufficient care.

(2) In writing a book on the birds of West Africa, Mr. Bannerman is breaking practically new ground, but he has immediately set a high standard. The bulk of the volume consists of a systematic account of the species, giving for each the distinguishing characters, particulars of range, and a summary of the information available as to habits. The volume before us covers only eight natural orders, and, with the Passeres among those still to be treated, several further volumes are to be expected. It is to be hoped that, despite the immense labour that must be involved, the author will be able to

complete the work in the near future and so let it achieve its full measure of utility.

That the work will be most useful cannot be doubted. Mr. Bannerman has aimed not only at setting down existing information, in which there are necessarily many gaps, but also at facilitating further additions to knowledge of the subject. At present, many potential observers in our West African colonies are hampered by the lack of means for identification, and opportunities for gaining valuable information on habits and economic status are thus wasted. Mr. Bannerman has therefore supplemented the account and figures of the species by the addition of two useful 'keys', one pictorial and the other verbal, to assist the observer to classify and identify the birds. The practical importance of the subject, from an economic point of view, is encouragingly recognised by the financial support to publication given by the West African Governments, and by the preface contributed by the Secretary of State for the Colonies.

Matter of much general interest is to be found in the preliminary chapter in which Mr. Bannerman ably discusses the relation of vegetation belts to the distribution of bird life. The region includes belts of desert, either wholly barren or with the scant Saharan vegetation; of savanna, either of the thorn-scrub type or grass-woodland; and of rain-forest; while smaller areas show the mangrove, the freshwater swamp, or the 'montane' types of vegetation. Each kind of area has its characteristic bird association. The virgin forest, with its 'closed canopy' above and its twilit, almost impenetrable depths, has indeed two distinct associations, the hornbills and parrots of the tree-tops being almost in a different world from the guinea-fowl and ground-doves that walk below: a third type of avifauna is found in secondary forest.

Several general points stand out. The vegetation belts stretch mainly right across the continent, so that latitude makes more difference to bird-life than longitude. Then there is the similarity of the avifaunas of the various widely separated mountain ranges. Striking, too, is the statement that equatorial forest constitutes a greater barrier even than utter desert to the spread of native species or to the passage of northern migrants: the extent and continuity of the forest zone in the west as compared with the east, indeed, seems to be one of the chief factors influencing routes of bird-migration in Africa. Truly, as Mr. Bannerman says, "Naturalists who find themselves in West Africa need not allow time to weigh heavily on their hands!" His book will certainly help to direct their activities.

Our Bookshelf.

Handbuch der Pharmakognosie. Herausgegeben von A. Tschirch. Zweite, erweiterte Auflage. Lieferung 1. Pp. 112. (Leipzig: Bernhard Tauchnitz, 1930.) 8 gold marks.

PROF. TSCHIRCH'S handbook of pharmacognosy, the publication of which was commenced in 1909, has proved to be such a mine of information to all interested in crude drugs that the appearance of a new edition will undoubtedly meet with general approval. In the course of the twenty-one years that have elapsed since the issue of the first part, the study of drugs has been so vigorously prosecuted and with such important results that many additions and corrections were necessary; in fact the early parts were in many respects out-of-date. It is obvious that the task of revising a work comprising some 4000 pages and embracing pharmacognosy, botany, chemistry, and several other sciences, was an almost impossible task for a single individual, and the news that the author has obtained the collaboration of other experts for certain sections of the book will be universally welcomed. It is expected that the revision will be completed in about three years and that the size of the work will be increased by about 1000 pages.

On comparing the first part now published with the corresponding part of the first edition, it is evident that this revision is being very carefully carried out and that much new matter is being incorporated. Entirely new, for example, is the truly remarkable list of medicinal plants used in the allopathic and homœopathic treatment of disease. The section on the collection and cultivation of medicinal plants has been entrusted to Dr. W. Himmelbaur, who, with Prof. de Graaff and others, has contributed so much to the revival of interest in this department of pharmacognosy. In this section numerous additional maps and illustrations have been incorporated. Quite apart from the information given in the text, the very complete bibliography will be invaluable to research workers; for example, in the list of plants grown in East Prussia the number of references has been more then trebled. The utility of microchemical reactions, of microsublimation and of examination by means of the quartz lamp, all methods of comparatively recent introduction, receive adequate attention, which serves to show the thoroughness with which the revision is being carried out. The author and his collaborators are to be congratulated upon the results of their work.

A Narrative History of Aviation. By John Goldstrom. Pp. xii + 319 + 32 plates. (New York: The Macmillan Co., 1930.) 17*s.* net.

"A NARRATIVE History of Aviation" is a title both bold and comprehensive enough to suit the most captious person. Unfortunately, this book falls far short of justifying either of these adjectives. One of the most essential requirements of the historian is a sense of proportion, unless he is producing an encyclopædic production continuing to many volumes. 'Scissors and paste'

may have legitimate functions, but they are not for the writer of history, as their use means sacrificing whole batches of facts contained in the lopped-off portions. 'Precis' is rather his refuge.

The author's extensive use of inverted commas admits that his book is principally culled from other sources, as indeed any history must be; but his editing of the subject matter at his disposal is out of proportion. He states that "Countless centuries of heroic failure . . . must be summarized in a chapter", and then proceeds to devote whole chapters to such subjects as "Women in Aviation" and "The American Air Mail". Such things have occurred only in the last few years, and are then merely episodes.

Lack of perspective is marked in the author's choice of subjects and illustrations. American aeronautics receives a far larger proportion of pages than its share in the world's aeronautical history merits. This is understandable in a book written and published in the U.S.A. National pride is wholly admirable, but it is out of place under the title that this book carries. The book goes even further than this in publishing a photograph of the author with a delivery of U.S.A. air mail. Surely the decision as to the historical importance of that could better have been left to posterity.

Its limitations are redeemed, to a certain extent, by an extensive bibliography, which mentions other sources of historical knowledge, but this is by no means up-to-date, especially with regard to European publications.

As a collection of short historical studies the book provides instructive and amusing reading. It should never have been submitted to the world of serious technical history under so ambitious a title. *Coram non judice.*

The Electric Wiring of Buildings. By F. Charles Raphael. Pp. x + 258. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 10*s.* 6*d.* net.

THERE are many practical hints in this little book which appeal to common sense, although from the point of view of the ordinary electric wireman they are quite unorthodox. The author points out, for example, that the wiring of many houses is spoilt by placing the wall sockets indiscriminately without regard to the position or character of the apparatus to be connected to them. It is as absurd to place the wall socket for a floor standard lamp or vacuum cleaner three feet from the floor as to put one for a table standard at floor level, if the table is to be against the wall. It is quite right to put the wall socket for an electric fire on the skirting, but the almost universal practice of placing the switch there as well is foolish. It is true that this saves the cost of a wood block and a few feet of wire, but this saving of a shilling or two on capital cost is only effected by compelling people for ever afterwards to stoop down to the floor when they want to switch on or off the electric fire. The book finishes up with a useful chapter on bells, telephones, fire alarms, and radio. As a rule, it is advisable to have all these kinds of wiring done before the building is actually furnished. In the case of telephones, however, it is sometimes difficult to tell which is the most suitable place for them before the house is furnished, and hence surface wiring is very frequently used for telephone work. The proper wiring of all electric radio receiving sets deserves special care. Unless the Institution of Electrical Engineers Wiring Regulations, published in June 1928, be followed, there may be danger from shock or fire.

Calculus. By Prof. Egbert J. Miles and James S. Mikesh. Pp. xiii + 638. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 18*s.* 9*d.* net.

To the student reading natural science as his main object, this book will have a definite appeal. A considerable number of well-chosen examples of the use of the derivative in hydrostatics and in pumping machines is an unusual feature. The authors state that, in the earlier part of the book at least, they purposely reject the delta notation, with the object of making the transition from conventional algebra easier for the average reader. This seems a somewhat needless scruple, for it only means greater difficulty at a later stage when the methods of the operator calculus have to be mastered: in these days this branch of the subject is finding new applications.

Nevertheless, one gets the impression that the authors intended to produce their work, in the first place, for the pure mathematician rather than for the physicist or engineer. If this is so, they will be less successful, for the treatment throughout tends to be more careful of the reader's supposed attainments at each stage than is quite compatible with perfect rigour.

That the volume will prove helpful in a variety of ways is certain: a special word of commendation is due to the publishers for the excellence of the graphs, which really do enhance the value of the book.

Optical Rotatory Power: a General Discussion held by the Faraday Society, April 1930. Pp. iv + 265-461. (London: The Faraday Society, 1930.) 10*s.* 6*d.*

THE reports of discussions held by the Faraday Society are always welcome. Naturally, a series of individual contributions lacks unity of aim to some extent, but a certain freshness of outlook results, which is all to the good. The meeting itself has been described at some length in our columns (NATURE, May 17, 1930, p. 762); little therefore remains but to direct attention to the appearance of the papers in book form.

The memoirs by Dr. Temple, Dr. Kuhn, and Prof. Ewald contain the vital points at issue; probably, however, in no case has the last word been said on a subject unusually intractable. Right- and left-handed forms of active molecules certainly possess stability, and yet the new mechanics has no solution of these facts to offer. Workers will be grateful, none the less, for the results of a decidedly interesting conference.

Letters to the Editor.

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

Constitution of Tungsten.

AFTER many earlier unsuccessful attempts, I have now obtained the mass-spectrum of tungsten. As in the cases of the lighter members of the same group, chromium and molybdenum, success was made possible by the preparation of the volatile carbonyl, $W(CO)_6$, by Dr. A. v. Grosse, of Berlin. It was to be expected from the greater atomic weight that the photographic effect would be feeble, and only by means of very sensitive plates were lines of satisfactory intensity obtained.

Tungsten proves to have four isotopes, of which the strongest two give lines of practically identical intensity. The mass numbers and provisional relative abundances are as follows :

Mass number . .	182	183	184	186
Percentage abundance	22·6	17·2	30·1	30·0

The packing fraction has not been measured with accuracy, but the position of the lines relative to those of mercury proves their correspondence to whole numbers within one part in two thousand, and the packing fraction curve also suggests a zero value. Adopting this, we get for the atomic weight on the chemical scale 183·96, in good agreement with the value 184·0 now in use. F. W. ASTON.

Cavendish Laboratory,
Cambridge, Nov. 28.

The X-Ray Interpretation of the Structure and Elastic Properties of Hair Keratin.

RECENT experiments,[1] carried out for the most part on human hair and various types of sheep's wool, have shown that animal hairs can give rise to two X-ray 'fibre photographs' according as the hairs are unstretched or stretched, and that the change from one photograph to the other corresponds to a reversible transformation between two forms of the keratin complex. Hair rapidly recovers its original length on wetting after removal of the stretching force, and either of the two possible photographs may be produced at will an indefinite number of times. Both are typical 'fibre photographs' in the sense that they arise from crystallites or pseudo-crystallites of which the average length along the fibre axis is much larger than the average thickness, and which are almost certainly built up in a rather imperfect manner of molecular chains—what Meyer and Mark [2] have called *Hauptvalenzketten*—running roughly parallel to the fibre axis.

Hair photographs are much poorer in reflections than are those of vegetable fibres, but it is clear that the α-keratin, that is, the unstretched form, is characterised by a very marked periodicity of 5·15 A. along the fibre axis and two chief side-spacings of 9·8 A. and 27 A. (? mean value), respectively; while the β-keratin, the stretched form, shows a strong periodicity of 3·4 A. along the fibre axis in combination with side-spacings of 9·8 A. and 4·65 A., of which the latter is at least a second-order reflection. The β-form becomes apparent in the photographs at extensions of about 25 per cent and continues to increase, while the α-form fades, up to the breaking extension in cold water, which is rarely above 70 per cent. Under the action of steam, hair may be stretched perhaps still another 30 per cent, but no other fundamentally new X-ray photograph is produced. The question is thus immediately raised as to what is the significance of a crystallographically measurable transformation interpolated between two regions of similar extent where no change of a comparable order, so far as X-ray photographs show, can be detected.

The elastic properties of hair present a complex problem in molecular mechanics which up to the present has resisted all efforts at a satisfactory explanation, either qualitative or quantitative. Space forbids a detailed discussion here of the almost bewildering series of changes that have been observed, and we shall merely state what now, after a close examination of the X-ray and general physical and chemical data, appear to be the most fundamental.

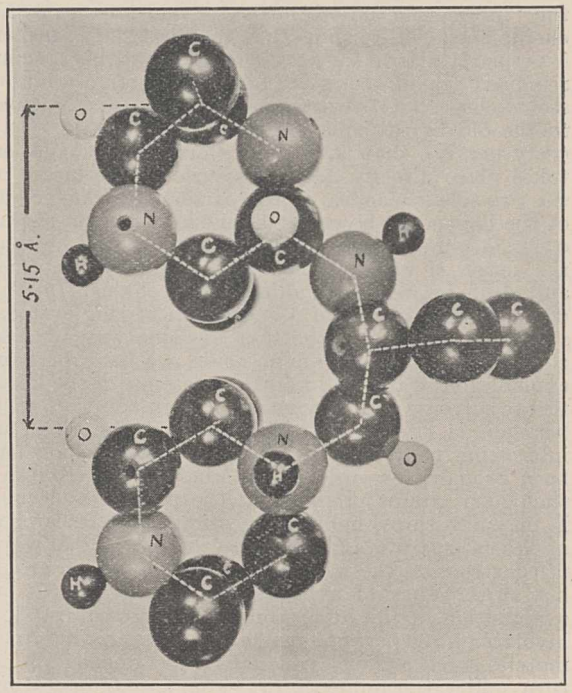

FIG. 1.

(1) Hair in cold water may be stretched about twice as far, and hair in steam about three times as far, as hair which is perfectly dry. (2) On the average, hair may be stretched (in steam) to about twice its original length without rupture. (3) By suitable treatment with steam the discontinuities in the load/extension curve may be permanently smoothed out, the original zero is lost, so that the hair may be even contracted by as much as one-third of its original length, and elasticity of form may be demonstrated *in cold water* over a range of extensions from −30 per cent to +100 per cent. (4) The elastic behaviour in steam is complicated by 'temporary setting' of the elastic chain and ultimately by a 'permanent setting' of that part which gives rise to the fibre photograph. (5) That part of the elastic chain which is revealed by X-rays acts *in series* with the preceding and subsequent changes.

On the basis of these properties and the X-ray data, it is now possible to put forward a 'skeleton' of the keratin complex which gives a quantitative interpretation of the fundamentals, and may later lead to a correct solution of the details. The skeleton model is shown in Fig. 1. It is simply a peptide chain folded into a series of hexagons, with the precise

nature of the side links as yet undetermined. Its most important features may be summarised as follows :— (1) It explains why the main periodicity (5·15 A.) in unstretched hair corresponds so closely with that which has already been observed in cellulose, chitin, etc., in which the hexagonal glucose residues are linked together by oxygens. (2) When once the side links are freed, it permits an extension from 5·15 A. to a simple zigzag chain of length $3 \times 3{\cdot}4$ A., that is, 98 per cent, and also allows for possible contraction below the original length, without altering the interatomic distances and the angles between the bonds. (3) It explains why natural silk does not show the long-range elasticity of hair, since it is for the most part already in the extended state,[3] with a chief periodicity of 3·5 A. We may now hope to understand why it is that the photographs of β-hair and silk are so much alike. (4) It gives a first picture of the 'lubricating action' of water and steam on the chain, since X-rays show that the direction of attack is perpendicular to the hexagons and that this spacing remains unchanged on stretching. Furthermore, it now seems clear that the new spacing, 4·65 A., is related to the old by the equation $27/(3 \times 4{\cdot}65) = 3 \times 3{\cdot}4/5{\cdot}15$ (very nearly), that is, the transformation elongation takes place directly at the expense of the larger of the two side-spacings. In the particular arrangement of the hexagons shown in the model, the side chains occur in pairs on each face, and it may well be that the action of water is the opening-up of an internal anhydride between such adjacent side chains. (5) The chain being built up of a succession of ring systems stabilised and linked together in some way by side chains of the various amino-acids, we have here an explanation of the well-known resistance of the keratins to solvents and enzyme action. In addition, each hexagon is effectively a diketo-piperazine ring, an interesting point in view of the evidence which has been brought forward by Abderhalden and Komm[4] that such groups pre-exist in the protein molecule. It may also throw light on the stimulating researches of Troensegaard.[5] (6) There are three principal ways of constructing the model, according to which group lies at the apex of a hexagon. It thus affords an explanation of the apportioning of a transformation involving a 100 per cent elongation into three approximately equal regions which may be opened up in turn under the influence of water and temperature and other reagents. The modification shown in the model must be ascribed to the crystalline phase, since it would, alone of the three, be expected to give rise to a strong reflection at 5·15 A., as in the α-photograph.

A detailed account of the above work will be published shortly.

W. T. ASTBURY.
H. J. WOODS.

Textile Physics Laboratory,
The University, Leeds,
Nov. 15.

[1] W. T. Astbury, *J. Soc. Chem. Ind.*, **49**, 441; 1930.
[2] Meyer and Mark, "Der Aufbau der hochpolymeren organischen Naturstoffe".
[3] Meyer and Mark, *Berichte*, **61**, 1932; 1928.
[4] Abderhalden and Komm, *Z. physiol. Chem.*, **139**, 181; 1924.
[5] Troensegaard, *Z. physiol. Chem.*, **127**, 137; 1923.

Electrode Potentials in Air-free Electrolyte.

THE following somewhat wide problem is of very considerable practical importance.

What potential will a metal surface assume when it is immersed in a salt solution which contains none of its own ions, under different conditions of aeration, *p*H and salt concentration, and what conditions control this potential? Such practical matters as corrosion, and in general the behaviour of metal surfaces in ordinary circumstances, depend on the answer.

Work was undertaken in this laboratory some time ago with the view of discovering the controlling factors in connexion with the above problem, for though a great deal of special experimental data is available, very little systematic knowledge seems to exist regarding the potential of a metal in such a solution. It was recognised that the problem must be attacked in two sections, first, with the solution completely air-free, as an oxide film in most cases greatly modifies the electrode potential, and secondly, in the presence of air.

It is felt to be worth while at this stage to review the conclusions so far arrived at in air-free conditions. They are drawn from a certain amount of unpublished work, together with some that has been published.[1] The conclusions are arrived at principally as the result of a study of the three metals iron, zinc, and cadmium, although rough experiments have been made with other metals. They are as follows :

(i.) *A steady reproducible potential can be obtained in air-free solution.* When an electronegative metal, previously exposed for some time to air, is immersed for some hours in an air-free electrolyte which is not strongly alkaline, it attains a steady reproducible potential, even in the absence of its own ions in the body of the electrolyte, and even when its salt with the anion of the electrolyte is soluble. Exceptions arise in the case of metals made strongly passive by exposure to air, such as aluminium and stainless steel.

(ii.) *Dependence of reproducible potential on pH.* When the electrode has a low hydrogen overvoltage, this reproducible potential is determined by the *p*H of the solution and varies with it. As might be expected, it is independent of the *p*H, except in concentrated acid, when the electrode has an overvoltage high compared with its deposition potential, like cadmium or zinc. It must be remembered that this discussion applies to rigidly air-free conditions, and in such a case with the electronegative metals investigated, the overvoltage of which is high, there was no indication of behaviour as metal–metal oxide electrodes. Iron, on the other hand, when the electrolyte was alkaline and the electrode was probably not behaving directly as a hydrogen electrode, did give evidence of acting as a metal–metal oxide electrode, and variation of potential with *p*H still took place.

(iii.) *Effect of anion concentration.* The concentration of the anion in the solution does not affect the electrode potential where this is controlled by *p*H, but it does do so to some extent where such is not the case; for example, the potential of a pure cadmium electrode is about 70 millivolts more positive in $N/2000$ normal potassium chloride than it is in normal potassium chloride. In $N/2000$ potassium chloride, the electrode is at a potential corresponding to a concentration of about $N/2000$ cadmium ions. It appears probable that there is a thin layer of ions of the metal of the electrode in close contact with its surface, the concentration of the layer being determined by the anion concentration in the body of the solution.

(iv.) *Potential not determined by electrode metal ions in body of solution.* In the case of a metal having a low hydrogen overvoltage, the potential as expected is much more positive than can be accounted for by metal ions which have come into the electrolyte by solution from the electrode itself or from an oxide film.

But this was found to be the case with metals of high overvoltage as well; for example, when the potential of a cadmium electrode was such that the

concentration of its ions according to the Nernst theory should have been $N/10{,}000$, it was actually found by direct chemical analysis to be less than $N/100{,}000$.

Attempted generalisation of whole position. When there is no sensible concentration of the ions of a metal electrode in a solution, and the electrode is not covered by an oxide film, its potential is determined by pH if its hydrogen overvoltage is positive to the deposition potential which it would have in a solution of the order $N/1000$ in its own ions. When this is not the case, the potential is controlled by anion concentration, probably acting through a film of electrolyte in contact with the metal with a concentration of electrode metal ions of the order of $N/10{,}000$.

It is hoped later to investigate further the reason for the reproducible potential attained by high overvoltage metals, but for the present it is intended to study aerated conditions, and for this reason it has been thought well to summarise previous work in which air was strictly excluded.

Our best thanks are due to the Commonwealth Council for Scientific and Industrial Research (Australia), which, by a generous grant, has made this work possible.

A. L. McAULAY.
G. L. WHITE.
E. C. R. SPOONER.

Physics Laboratory,
University of Tasmania,
Sept. 13.

[1] McAulay and Bastow, *J.C.S.*, p. 85, 1929. McAulay and White, *J.C.S.*, p. 94, 1930.

Raman Spectra of Pinene.

IN a series of researches to be published in full shortly on the Raman spectra of *d*- and *l*-pinene in the liquid condition, we have observed near the line $\nu = 23257$ (corresponding to the Raman $\nu = 1454$ excited by the line $\lambda = 404{\cdot}6$ of mercury) a series of

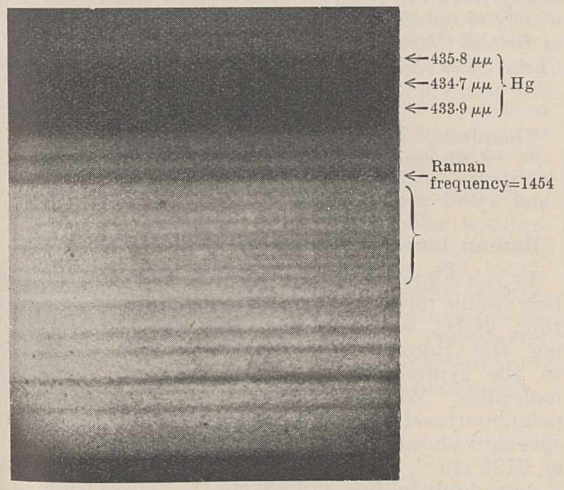

FIG. 1.—Raman spectrum of pinene.

eight lines, very weak, sensibly at the same distance, and the distances of which from the Raman line above mentioned can be represented to a good approximation by the relation $\Delta\nu = B(4m+4)$,[1] which, as is well known, corresponds to the series of Raman frequencies of rotation relative to the rotator with fixed axis. By putting $B = 6{\cdot}15$, the mean differences between calculated and observed values amount to $\pm 0{\cdot}017$ per cent. The value of m should correspond to the even series, namely, 2, 4, 6, 8, etc. Supposing the rotator composed by two atoms of H of one CH_2 rotating round the carbon atom (considering that the Raman frequency $\nu = 1454$ is attributed [2] to the transverse oscillations of the two H atoms in the group CH_2), we calculate, from the value of B, that the distance between the atoms of hydrogen and carbon in the CH_2 group is $1{\cdot}16 \times 10^{-8}$ cm., in good accordance with the values published by Mecke,[3] namely, $1{\cdot}13 \times 10^{-8}$ cm. In view, however, of the difficulty of obtaining good vibration and rotation spectra in liquids with complex molecules, we merely direct attention to the coincidence observed (working with a spectrograph with small dispersion); we intend to repeat the work with higher dispersion, before giving a definite interpretation to the results.

G. B. BONINO.
P. CELLA.

Laboratory of Physical Chemistry
of the Royal University,
Bologna, September.

[1] V. P. Pringsheim, "Ramanspektra". "Handb. der Physik", Bd. 21, p. 629; and Schrödinger, *Ann. der Phys.* (4), **79**, p. 520; 1926.
[2] Dadieu u. Kohlrausch., *Ber. Deut. Chem. Ges.*, **63**, p. 262; 1930.
[3] Mecke u. Hedfeld, *Zeits. f. Phys.*, **64**, p. 161, note.

The Wave-length of X-Rays.

IT is well known that determinations of the wave-length, λ, of X-ray spectral lines, which have recently been made by means of line gratings, do not agree with those found by crystals, the crystal values being 0·1 to 0·3 per cent less than the line grating values. In this use of line gratings the angles of incidence and diffraction have been small and have proved difficult to measure, but the accuracy attained in some of the observations of λ (for example, that of Backlin for aluminium $K\alpha$) is probably not less than 1 in 1000. In the crystal method, relations of the form $n\lambda = 2d \sin\theta$ and $d^3 = eM/\rho F$ (e, electronic charge; F, faraday; M, molecular mass; and ρ the density of the crystal) are used to find λ, and the angle of reflection θ has been measured with high accuracy. Since M, ρ, and F are subject to smaller errors than e, the disagreement in the values of λ found by the two methods is usually attributed to an error of 0·3 to 0·9 per cent in the accepted value of e. If the precision of the grating method could be increased, these relations would be available to find the electronic charge more accurately than it is known at present.

The precision with which the wave-lengths of the lines of the spectrum in the optical region are known has enabled many problems in physics to be solved, and it is probable that improvement in the absolute accuracy of X-ray wave-lengths will prove of similar value.

In X-ray spectrometry up to the present the grating appears always to have been used to measure wave-lengths not relatively but absolutely, and this involves the precise determination of small angles. In the light of experiments we have performed, it would appear to be possible to use Rowland's method of the coincidence of lines in different orders of the grating spectrum over the whole spectral region from the optical to X-rays. It should be noted that the absolute errors in Rowland's wave-length tables do not imply any failure of this method, and from Kayser's comparison of Rowland's values of λ with interferometer values it appears that the method has a precision of one in a million in relative determinations in the optical region.

One of the difficulties to be anticipated in extending the methods to the X-ray region is that, owing to the small angle at which X-rays are reflected at the surface of a solid, the method would fail in that region. Using

a plane glass grating of 10,800 lines to the inch, a vacuum spectrograph, and X-ray tube with a graphite target in the same vacuum, we find that the K line of carbon can be photographed from the 18th negative order to the 13th positive order, or over a range of $n\lambda$ from 0 A. to 810 A. In this way, using a small dispersion, the carbon K line has been compared with the copper $L\alpha$ and Ll lines in their second and fourth orders, the wave-lengths 44·7 A. and 44·8 A. being obtained for the carbon line relative to 13·32 A. for the copper $L\alpha$ line. The approximate coincidence of different orders has also been used to compare the wave-length of the first order K lines of aluminium lines reflected from a sugar crystal with the wave-length of the $K\alpha_1\alpha_2$ copper lines in the 5th and 6th orders. We find Al $K\alpha_1\alpha_2 = 8{\cdot}315$ A. relative to Cu $K\alpha_1\alpha_2 = 1{\cdot}5392$ A.

T. H. LABY.
R. BINGHAM.

University of Melbourne,
Oct. 17.

Structure of Hydrogen Sulphide, Hydrogen Selenide, and Nitrogen Dioxide at Liquid Air Temperature.

IN connexion with previous determinations of the structure of solid α-nitrogen[1] and of solid carbon monoxide, we have during last year carried out a structure analysis of solid hydrogen sulphide, hydrogen selenide, and nitrogen dioxide by means of powder diagrams obtained with an apparatus described in a previous paper. A more complete description of the results will appear elsewhere, but I want here briefly to state some of the principal results.

Solid hydrogen sulphide and selenide are both isomorphic with a cubic elementary cell containing four molecules. The sulphur and selenium atoms are arranged in a face-centred lattice. If the hydrogen atoms are to be given definite positions in the lattice, a discussion of all possible arrangements leads to the result that the atoms of a molecule must be situated on a straight line.

The most probable space group would be T^4, if the molecule is asymmetric, and $T^6{}_2$, if it is symmetric. For the side of the cell (a) and the density (ρ) we found for hydrogen sulphide, $a = 5{\cdot}76$ A.; $\rho = 1{\cdot}17$; for hydrogen selenide, $a = 6{\cdot}10$ A.; $\rho = 2{\cdot}34$.

These determinations were finished in July this year.

Solid nitrogen dioxide has also a cubical structure, but much more complicated than that of hydrogen sulphide and selenide.

The side of the elementary cell (a) is 7·77 A. The density (ρ) of solid nitrogen dioxide was determined separately to be 1·93, which gives six molecules in the cell. All lines observed fulfil the condition: Σh = an even number, which means that the lattice may be regarded as composed of cube centred lattices.

After having discussed all space groups fulfilling these conditions, we find T^5 to be the only one possible. This space group gives one parameter for the nitrogen atom, and three parameters for the oxygen atoms. By making certain assumptions regarding the limits for the nearest approach of the atoms, we have succeeded in determining the parameters so as to give a remarkably good agreement between observed and calculated intensities.

A more detailed description of this rather complicated structure will be reserved for a subsequent paper.

L. VEGARD.

Physical Institute, Oslo,
Nov. 6.

[1] L. Vegard, *Zeit. f. Phys.*, **58**, 497; 1929.

Isomorphism and Chemical Homology.

IN April 1929 I published a paper on "Monofluorphosphoric Acid and the Similarity of its Salts to the Sulphates" in the *Berichte der Deutschen Chemischen Gesellschaft*, p. 793. I stated that I had succeeded in preparing the monofluorphosphates, which I described in detail and also that the ion PO_3F'' shows all the properties of SO_4''. I pointed out that the salts of monofluorphosphoric acid resemble completely the salts of sulphuric acid and that the crystallographic investigation of the new salts was being carried out. I considered that the reasons for the similarity of chemical properties of the two ions lay in the similarity of the radii of the two central atoms, in the equality of their co-ordination number and of the electric charges of the anions and also in the equality of the volumes of O'' and F'. At the end of the paper I stressed the fact that this investigation was still in progress. The direction in which the investigation was being continued is revealed in a petition which I addressed on April 29, 1929, to the *Notgemeinschaft der deutschen Wissenschaft* which contains this statement: "monofluorphosphoric acid H_2PO_3F resembles sulphuric acid H_2SO_4 so closely that it even gives alums, which are isomorphous with ordinary sulphate alums". Since the discovery of alums was to be foreseen by anyone after the publication of these facts, I delayed immediate publication of the new results, since they did not involve any new point of view.

I was, therefore, surprised to see in NATURE of Aug. 30, p. 310, a paper by Sir P. C. Rây on monofluorphosphates in spite of my notice that my work was being continued. Amongst other matters he prepared the alums which were to be foreseen. He also described as quite new facts his results, which he obtained with the aid of the conclusions which I had already indicated, without any mention of my name or acknowledgment of my work. Moreover, he did not give the method by which he prepared the PO_3F'' ions. I can only suppose then that Sir P. C. Rây is unaware of my work, although it appeared in one of the most widely circulated journals, and was indeed abstracted in *British Chemical Abstracts*, vol. A, p. 663, and in the *Chem. Zentralblatt* I. p. 2626, and in *American Chemical Abstracts*, vol. 23, p. 4903.

WILLY LANGE.

Chemisches Institut,
Universität Berlin,
Oct. 30.

Raman Lines of Simple Polyatomic Molecules.

IN the course of a study of the structure of simple polyatomic molecules, the Raman spectrum of hydrazine, N_2H_4, was obtained with the view of finding the Raman line or lines which correspond to the symmetrical vibration N-N in polyatomic molecules. We should expect to find a line in the neighbourhood of 1600 cm.$^{-1}$, but the hydrazine spectrum showed three lines of roughly equal intensity at 3196 cm.$^{-1}$, 3270 cm.$^{-1}$, and 3344 cm.$^{-1}$, along with a very doubtful line at 1720 cm.$^{-1}$. These three lines are obviously due to N-H vibrations, and it seems curious that the symmetrical vibration should be so weak (if present at all) in the spectrum of this molecule.

Hydrazine hydrate, $N_2H_4H_2O$, gave the same three lines but with very much weaker intensity for comparable times of exposure. Both gave much continuous background, especially the latter. It appears from the results of other workers on polyatomic molecules that the vibration frequencies which turn up with greatest intensity in the Raman effect are those which correspond to symmetrical (inactive)

vibrations of the molecule. It had been hoped that a comparison between the hydrazine and the hydrazine hydrate spectra would show a difference in the intensity of the line corresponding to the N-N vibration in each molecule, but the results are so far indecisive on this point.

It is of interest to compare the three lines of hydrazine with the three lines which Daure (*Trans. Faraday Soc.*, Dec. 1929) gets in liquid ammonia, namely, 3210 cm.$^{-1}$, 3300 cm.$^{-1}$, and 3380 cm.$^{-1}$. Ammonia gas shows only one line at 3330 cm.$^{-1}$, according to Wood (*Phil. Mag.*, 7, 1929) and other workers; and it has been suggested that the triplet in the liquid is the result of association into molecules of the type $H_3N\text{-}NH_3$. On the surface, the hydrazine result would seem to strengthen this view, but one cannot be certain until the structure of hydrazine has been more fully worked out from its infra-red, as well as from its Raman spectrum. The work for this molecule is now being carried out here along with similar work for other simple molecules and upon the results it is hoped that a description of the exact selection rules will be obtained.

G. B. B. M. SUTHERLAND.

Laboratory of Physical Chemistry,
Cambridge, Nov. 11.

The Activity of Surfaces.

IN recent years a good deal of attention has been given to the relation between the catalytic effect of a surface and its structure, and in this connexion it is perhaps of interest to point out that the general idea underlying many theories was published by me in 1911 (*J. Chem. Soc.*, 475 ff., 1911) in a qualitative form. The hypothesis in relation to the specific problem studied, the dehydration of a salt crystal, was based on the view that the lattice structure of such a system was disturbed, and that the rearrangement of the surface (described as 'amorphous', in harmony with the prevailing views before the application of the X-rays to crystal analysis had been discovered) underwent a recrystallisation, a process which required time. It was further pointed out that "a treatment of somewhat simpler systems than the present, such as occur, for example, in the 'ageing' of deposited catalytic surfaces, would probably present points of interest"; and such has, in fact, proved to be so. This view of a catalytic surface is incompatible with a smooth 'chess-board' surface. The latter has now been recognised as inadequate. The application of the idea to heterogeneous reactions has been considered by Slonim (*Z. Elektrochem.*, p. 439, 1930). The examination of all such surfaces by X-ray analysis would, clearly, throw much light on the general problem, as Slonim shows in a particular case. The method contemplated had, however, the use of reaction velocity in mind.

J. R. PARTINGTON.

East London College,
University of London,
Nov. 14.

Evolution and Ethics.

THE correspondence in NATURE of Nov. 29 under the heading "Heredity and Predestination" raises a topic of surpassing interest.

An ethical system of some kind is an essential adjunct of every social organisation. Apart from the social organisation to which it is related, any ethical system is a mere abstraction. On the other hand, a species without social organisation can have no ethical system. For such a species ethical values do not exist.

Ethical systems are in general just as much a product of evolution as are the bodies of individual organisms. If it were possible to view our own ancestry sufficiently far back, we should be able to trace an unbroken series commencing with a creature without social organisation or the possibility of ethical standards of conduct and proceeding by gradual steps to the present stage of organisation with its related standards, which, in conformity with the well-known dictum of Heraclitus, is no more permanent than its precursors.

Viewing the world of the present day, it is obvious that a variety of differing ethical systems are in actual operation in the human as well as in other social species. It is also obvious that the number of ethical systems which are theoretically possible is unlimited. The only condition that must be satisfied is that the ethical system must be in harmony with the society to which it applies. Failing such harmony, instability would ensue, with results which need not now be pursued.

Within the sphere of any ethical system the term 'good' applied to conduct means simply that the conduct is in accordance with the dictates of the system. The same conduct under another ethical system would possess a certain value, but would not necessarily be 'good'. Considered apart from all ethical systems no conduct can be assigned any ethical value.

So far as the comparison of ethical systems is concerned, it is impossible to condemn one or to favour another on ethical grounds. This is a field in which an ethical court can have no jurisdiction, as there are no ethical principles on which it can proceed. If one were to assume the superiority of one ethical system, it would be easy to condemn all others, but such a procedure would be transparently naïve.

On the other hand, there exists a court which does exercise jurisdiction in this field. As there is no appeal against its decisions, it is perhaps deserving of rather more consideration than it receives. The authority of this court depends on the fact that ethical systems have a most potent selective influence over the individuals composing the society in which the systems function. The existence of the social organisation shields the individuals comprised within it from many of the hazards that arise from the external environment. The selective effects of the external environment are thus minimised and their place is taken by the internal selective activity of the society itself, exercised in accordance with its ethical system. The more highly developed the social organisation the more far-reaching will this activity become. Ultimately the evolutionary trend—whether upwards or downwards—of the individuals composing the society will be controlled principally through this type of social selection. One ethical system will lead to degeneration and ultimately extinction, while another will lead in the opposite direction. We have here the *natural* criterion for discriminating between ethical systems. We are thereby enabled to apply the term 'good' or 'bad' to any ethical system, but it should not be overlooked that in such application neither term possesses an ethical connotation.

I will conclude by quoting in translation one of the less familiar fragments of Heraclitus:

"The Ephesians would do well to hang themselves, every grown man of them, and leave the city to beardless youths; for they have cast out Hermodorus, the best man among them, saying: 'We will have none who is best among us; if there be any such, let him be so elsewhere and among others'."

HUGH BIRRELL.

Huntington,
Ascot, Berks.

Determinism.

THE wide circulation and attractive style of Sir James Jeans's book, "The Mysterious Universe", will probably mark a step in the crystallisation of ideas towards the rejection of any mechanical system. But many will ask, Why go so far, and go no farther? Why have we dethroned a mechanical system and set pure mathematics to reign in its stead? The essence of a mechanical system, or to give it its more general name, Determinism, requires a single time sequence, proceeding in one direction, and postulates that each state is an inference from any past state, the necessary major premiss being Causation. One immense consequence of Einstein's ideas has scarcely yet been touched,—as the quantum theory undermined Causation, so relativity undermines Determinism and every other ethical theory by abolishing the time sequence.

Pure mathematics differs from this in possessing no time sequence; all its statements are interconnected so that each implies the others, and no statement is made at all other than the original axioms out of which it was evolved. Therefore it assumes the possession of complete knowledge of the theme before it makes any statement at all. If this leads to mysteries in the description of the universe, as well it may, it is hard to see why it too should not be rejected as unsuitable for the purpose, in the same way as we have rejected the animism and anthropomorphism of our ancestors. Pure mathematics is the last thing we would reject—if it goes, number goes, for the logic of pure mathematics depends upon number; and if number and the separation of objects of thought is discarded, all experience merges into one changing whole, incapable of exact description and communication to others. Apparently physical science owes its success to having elected to describe Nature on the lower plane of abstraction, where exact communication is possible. This is the alternative we may have to embrace. We can say with Faust, *Im Anfang war die Tat*, and nothing more. R. A. S.

Edinburgh.

Embryology and Evolution.

I HAVE read with much interest Prof. MacBride's review entitled "The Problem of Epigenesis", and I should like to make a few remarks upon what he says at the end. First of all, I wonder if the following analogy will help him, as it has helped me, to reconcile the conceptions of the geneticist with those of the embryologist. In a modern motor works the cars, so I understand, move along a track past a series of workmen, each of whom has one particular job to do, which is related to what has already been done and also to what is going to be done afterwards. Now if we imagine that all the parts and materials which are going to make up the finished car represent the substances in the developing embryo and that the workmen are the genes, we have an analogy which can be carried surprisingly far. Not only will it give us a picture of normal development, but we can see, by altering one of the parts, how a variation may occur; by altering a workman, how 'sports' may arise; and, by adding a new workman with a new job, how progressive evolution may take place.

There is no need for me to occupy space in working the analogy out, for anyone can do it for himself: what is more important is to point out where the analogy fails. A motor-car is adapted for life on the road, and, until it is completed, it has, for all practical purposes, no environment at all comparable with that which bears upon an embryo throughout its development. So whereas a feature of a car is simply due to the action of the workman on the materials, a feature of an animal is the result of the combined action of the genes and of the environment upon the materials of the embryo. Genes without the appropriate materials can produce nothing; genes with the appropriate materials can only produce a partially developed structure; but genes with the appropriate materials and environment can produce the fully developed functional character. Hence it is that in the development of the frog, for example, the gill-clefts, etc., are full developed, whereas in the Amniota, with the radical change in the environment of the early stages, such structures are only partially developed and the stages, to quote Prof. MacBride, are smudged.

Looked at from this point of view, two other conclusions of great importance are unavoidable. The first is that the recapitulation of an ancestral stage of the evolution of an animal, as distinct from the repetition of an ancestral character, will only occur when the early stage of development is passed in the same environment as that of the ancestor, which environment is different from that of the present-day adult. Only under such conditions will the genes responsible for the adult ancestral characters give rise to them all together without any great admixture of other features; though it must always be borne in mind that such stages in the life history, being larvæ, may evolve on their own account and, therefore, may have features which the ancestor never had. In parenthesis, I should just like to add here that, so far as I know, a larva has never been properly defined: such a definition would be "A free-living stage in an animal's life history which fends for itself and possesses certain characters which it has to lose before it can become a young adult": the possession of *positive* characters distinguishes a larva, not its lack of adult ones.

The other conclusion is reached thus. The appearance of a functional feature is dependent, as we have seen, upon the interaction of three things: the materials of the embryo, the genes, and the environment. Now the facts of Mendelian inheritance give clear evidence that there need be no change in the materials of an embryo for a new gene to modify the form, so, in discussing the origin of a new feature, there is no need to consider a change in the materials as one of the essential factors. The fortuitous appearance of a gene without the appropriate environment would produce a partially developed character, but, in actual experience, we do not find features in a partially developed condition which *have never been functional* at any period in the history of the race. So the genes must, in actual fact, only arise after the suitable environment is present; and the only conclusion to be drawn from that is that there is a causal relation between the two; that is, that the environment is in some way responsible for the appearance of the gene, which is surely nothing more or less than the basis of a new proof of the inheritance of acquired characters. G. L. PURSER.

The University, Aberdeen,
Oct. 29.

I HAVE read with interest Mr. Purser's thoughtful letter on the subject of my review. If he will substitute the term 'race-memory' for 'gene', we shall not be far apart. But the gene of the Mendelian stands out as something that is never functional. "No one", said the late Sir Archdall Reid, "ever heard of a useful gene." When one takes into consideration the fact that the Mendelian genes in *Drosophila* have been shown to increase in their damaging effect on the viability of the organism in proportion to the structural change which they involve, and when further it is discovered that genes can be artificially produced by irradiating insect eggs with X-rays—a

process which kills most of the eggs—one is driven to the conclusion that a gene is germ damage of which the outward manifestation is a mutation. The only effect that natural selection would have on such aberrations would be to wipe them out. In my opinion, mutations and adaptations have nothing to do with one another and only adaptations are recapitulated in ontogeny. E. W. MACBRIDE.

Administration and Anthropology in India.

THE leading article in NATURE of Nov. 22 appears at a critical moment and must be deeply appreciated by everyone who knows anything of the present state of affairs in India, political or academic. It rightly stresses the literary bias of research in India, in answer to which it may be pointed out that, whereas the older universities teach Indian languages, the University of London is the only English university to accept Indian cultural studies for the B.A. degree (Hons. Archæology, Sect. H). It is true that field-work is non-existent in India, and that, therefore, the bulk of the anthropological research carried out must be more or less arid, because it is at second-hand and divorced from the facts. As an outcome of this, we are now faced by the peculiar prospect of listening to a lengthy debate, and of accepting willy-nilly a decision of sorts, upon a subject that is nothing else than a problem in applied anthropology, that is, the organisation of a federal India; and we are forced to do so with the knowledge that the facts are not accessible. Whatever is done must, therefore, be done in the dark. The action taken will be political and not scientific. One would have liked to have heard Huxley's views on such a state of affairs!

The problem has, however, been foreseen by many people, most of them harassed government officials, who, following the magnificent Anglo-Indian tradition of Tod, Sleeman, Cunningham, and Meadows-Taylor, have found time to make themselves acquainted with scientific thought, but were never free to undertake research. In spite of Risley and Thurston, and the solitary excellence of Sarat Chandra Roy, it is not possible, in the present state of our knowledge of India, even to begin to discuss the basic problems of Indian ethnology. The district gazetteers are a mine of information, but they are uncorrelated compilations. The very terminology is lacking, because no body of scientific opinion has ever been brought to bear on Indian studies. If the delegates of the Round Table Conference were to be suddenly and blessedly converted to science, it is doubtful whether six people could be brought before them who could speak with authority upon India as a whole. It is not enough to explain the dearth of Indian scholars by saying that India is a continent in itself and a whole compound of races, beyond the ability of one man's compass. So are China and Africa, both of which are academically well represented. The only answer is that India has been academically neglected. The remedy is in the hands of the teaching bodies.

Incidentally, should not a candidate for the Indian Civil Service know a very great deal about the history and culture of the peoples to whose welfare he is devoting his life? It may be asked, Where *does* the Indian administrator get his knowledge from? The answer is that he picks it up. He certainly does not get what he needs from the older universities.

K. DE B. CODRINGTON
(Hon. Sec., India Research Committee
Royal Anthropological Institute).

Claire Cottage, North Road,
London, N.6,
Nov. 29.

Foaming of Beer.

I DO not know sufficient of chemistry to appreciate the full inwardness of Sir Robert Robertson's commentary on my letter in NATURE of Sept. 20, but I am convinced that the phenomena in question are not purely chemical, and that a physical, and even a directly mechanical explanation, is at least partly appropriate. I have in mind the air lift pump.

As a matter of interest I tried pouring a gassy beer into a champagne glass and it was quite flat. But more convincing was a letter from a well-known professor at Harvard, who states that the mid-west 'hobo' sought to combat short measure by greasing the inside of his tin can or pail with ordinary soap. These 'hobos' argued that they got enough fresh air without drinking it. The Harvard professor, whose initials coincide with my first two, experimented on foaming phenomena and found that something like 20 per cent could be gained by soaping. He was told that the quality of the beer was such that the taste was not unpleasantly affected.

It is permissible to observe that the 'hobo' did not use a glass vessel, and to judge by his name, he would not allow sufficient time for soap to be absorbed or dissolved by the beer. Moreover, my Harvard correspondent does not explain why a slippery container kills froth. H. S. ROWELL.

39 Spencer Road, Chiswick, W.4,
Nov. 9.

Ball Lightning.

IN view of the interesting letter from Dr. A. Russell on the above subject in NATURE of Nov. 22, and his remarks as to the undesirability of touching these mysterious globes, the following case (quoted from Flammarion by Prof. Ignazio Galli in *Mem. Pont. Acc. Rom. N. Lincei*, **30**, 281-2; 1912), when the experiment was actually tried, might be of interest.

During a storm at Beugnon (Département Deux-Sèvres, France) about the year 1904, a globe approached the door of a cattle-shed where were sheltering two children. "One of the children had the courage to touch it with his foot; immediately a frightful detonation shook the walls of the farm, the two children were thrown to the ground, without any wound, but eleven head of cattle were killed in the stable."

Prof. Galli also quotes (*ibid.*, 272) many cases of globes accompanied by a sound variously described as blowing, whistling, roaring, buzzing, and crackling.

CICELY M. BOTLEY.

"Guildables," 17 Holmesdale Gardens,
Hastings, Nov. 24.

A Toy Balloon's Long Flight.

SOME fourth form boys here have recently been carrying out several simple researches. One such research, on air currents, included the liberation of coal-gas-filled balloons. One flight is sufficiently remarkable to be worth recording.

A Woolworth threepenny balloon was liberated near Johnstone, 12 miles south of Glasgow, 100 feet above sea-level, on Oct. 26, at 12.30 P.M. It reached Stony Stratford, in Buckinghamshire, after a journey of at least 310 miles, and was picked up next day at 10.30 A.M.

Alan Hird, the experimenter, remarks: "The day was fine and sunny, in fact it was the only officially 'dry' October day in this part of Renfrewshire, and a strong, steady N.W. wind was blowing."

EDWARD P. KAYE.

Glasgow Academy.

The De-Nationalisation of Helium.

By HENRY B. MILNER.

THE disaster to the British airship *R101*, still fresh in the public mind, torn between sad memory and impatience to learn the findings of experts now holding a court of inquiry, has had, as it was bound to do, world-wide repercussion. Everywhere dirigible construction, either in project or in progress, has received an abrupt check. Whatever may be the ultimate technical findings of this court, it is safe to assume consensus of opinion on at least one point: the danger of hydrogen, the urgency of helium. In Germany the Zeppelin Company was engaged in laying down a new airship to be known as *LZ128*, but the lesson was quickly learnt. Complete revision of plans of construction was undertaken, in which the salient factors were provision for the exclusive use of helium and heavy, virtually non-inflammable, oil-fuel, in place of hydrogen and the 'Blau' gas fuel hitherto employed in Zeppelins. Clearly, even at the expense of a year's delay, Dr. Eckener is in no mind to chance a re-enactment of the deplorable tragedy which we have just witnessed.

At the same time, such plans might well be frustrated and progress reduced to complete standstill if resources of helium were not forthcoming. Since the United States holds a virtual monopoly of this valuable gas, then clearly the question of future supplies is the crux of the situation for everyone concerned. Dr. Eckener announced to the American Chamber of Commerce in Berlin last month (*Times*, Nov. 6) that the embargo on helium export from the United States had just been removed, which made practicable the execution of the revised plans for *LZ128*. It is interesting to review the situation and the chain of events which have made possible this release.

The original law relating to the export of helium from the United States is contained in Section 4 of the Act approved March 3, 1927—Public, No. 758, 69th Congress—which states: "That hereafter no helium gas shall be exported from the United States . . . until after application for such exportation has been made to the Secretary of Commerce and permission for said exportation has been obtained from the President of the United States, on the joint recommendation of the Secretary of War, the Secretary of the Navy, and the Secretary of Commerce. . . ." The Act also authorises "the conservation, production, and exploitation of helium gas, a mineral resource pertaining to the national defence . . .", and places the jurisdiction of Government plant under the Bureau of Mines, from which Bureau the Army, Navy, and other branches of the Federal service will requisition it as required.

Specific mention of the Government plant recalls the existence of the U.S. Helium Production Plant near Fort Worth, Texas, the helium being actually extracted from natural gas of the Petrolia-field, Clay County, Texas. Until 1928, practically all the helium produced came from this source, but it was then found that this source of supply was inadequate to international demands. The effect of the Act was to stimulate investigations by the Bureau of Mines into supplementary resources, and in April of that year a contract was made between the Government with the Amarillo Oil Company of Amarillo, Texas, to exploit the gas from leases on what is known as the Cliffside Structure in that region. While it was a vital matter to develop such helium-bearing gas resources as could be found, questions of the prospective life of such supply, also facilities for disposing of the 'treated' gas, had to be faced. The estimates proved satisfactory so far as the first point is concerned, and the Company having agreed to take care of the treated gas, developments went ahead, so that in August of that year the new plant-site was selected at Soncy, some six miles from Amarillo, and almost coincidently the Company brought in a new gas well having an open flow volume of more than seven million cubic feet per day, with a helium content of about $1\frac{3}{4}$ per cent by volume, the average for gas produced from this particular structure.

By May of last year the first tank-car filled with about 200,000 cubic feet of helium was dispatched from Soncy to a place in Virginia. This helium was transported under a pressure of 2000 pounds per square inch and ultimately discharged into stationary containers for use in connexion with the U.S. Army dirigibles. Thereafter the new plant continued more than ever to justify initial confidence, both in itself and in the quality of the gas handled. In September 1929 there was produced from Amarillo 874,840 cubic feet of helium with the remarkable factor of 97·7 per cent purity, at an operating cost of 17·63 dollars per thousand cubic feet of contained helium, a much reduced cost compared with that previously involved. In January 1930 the output of helium was more than a million cubic feet of gas with a purity factor of 97·85 per cent, at a still further reduced cost of 9·64 dollars per thousand cubic feet.

The significance of this purity factor will be more readily understood when it is realised that a Navy dirigible (U.S.) of $6\frac{1}{2}$ million cubic feet capacity has about 5 tons more lift when filled with helium of 98 per cent purity than when the purity factor is only just over 95 per cent, the average of the Fort Worth product.

A Department of Commerce 'Press release', dated Aug. 20, 1930, shows that the helium output for the fiscal year ending June 30, 1930, attained the high figure of 9,801,060 cubic feet, the largest ever achieved, and it is pointed out that the plant was only operated at a fraction of its real capacity, the latter determined almost entirely by the U.S. Army and Navy demand. This communication also contains the statement, "Under present conditions it costs less to operate Government airships with non-inflammable helium than it would cost to operate them with flammable hydrogen". At this point we leave this amazing record of progress

until *R101* showed the vital need of de-nationalisation of helium.

With such resources at her command, with her service and commercial needs amply provided for, an international call for exported helium could not remain for long unheeded, in the interests both of humanity and the future of the airship. On Oct. 11, 1930, the Department of Commerce, apparently satiated with inquiries relative to the helium export situation, cleared the air by publishing a memorandum setting forth the provisions to be observed when sanction for export was requested. These provisions are entirely reasonable, including among others, the quantity to be exported, the purpose for which the helium was destined, and the country to which it was being sent. It is therefore obvious that Section 4 of the Act is to all intents and purposes inoperative, and that this invaluable commodity is henceforward available to all *bona fide* demands.

The Testing of Wood Preservatives.

THE problem of carrying out tests in the laboratory to give a rapid indication of the probable effectiveness of any material as a wood preservative is one which has arisen on many occasions in different countries and a number of different methods have been evolved. Unfortunately the results obtained have frequently been in no way comparable and efforts are being made to standardise the different methods. Following a conference of American workers, early this year at St. Louis, on the standardisation of laboratory methods for the measurement of the toxicity of wood-preserving materials, the wish was expressed that the European investigators should gather together at a similar congress to discuss the conclusions which had been reached at the American meeting, and to describe the methods up till now used in Europe, which differ considerably from those used in America.

The conference, which was convened on the initiative of Dr. Hermann von Schrenk of St. Louis, met in June at the Biologische Reichsanstalt, at Berlin-Dahlem, and included representatives from Austria, Denmark, Germany, Great Britain, Holland, Japan, Norway, Switzerland, and the United States of America. The Department of Scientific and Industrial Research was represented by Mr. W. P. K. Findlay, of the Forest Products Research Laboratory, Princes Risborough. The matter for discussion was put forward under the following three heads :

1. Which method of investigating wood preserving materials appears, in the light of experience so far obtained, to be the most certain and the most reliable ?

2. Which wood-destroying fungi should be used for carrying out these experiments ?

3. What conclusions as to the value of a wood preservative in actual practice may be drawn from a determination of its toxicity ?

1. METHODS.

It was stated, according to the conclusions of the American conference referred to above, that in the United States the fungicidal power of wood preservatives under test is determined only by the method of using petri dish cultures of certain fungi upon agar medium containing the preservative. The reason for accepting this method is the exactitude with which the amounts of preservative and the point of inhibition may be determined. Experiments have, indeed, been made in the United States using the wood block method customary in Europe, but the results obtained there by this method have not proved satisfactory, because the use of different species of wood, or of woods of the same species of different resin contents or containing different proportions of spring and summer wood, or, finally, of woods with a varying capacity for impregnation, has introduced so many variables into the method that strictly comparable results could scarcely be expected. The use of sawdust, or of discs made of wood meal, has certainly lessened these difficulties, but, nevertheless, the agar method is considered as far exceeding all others in accuracy and as particularly convenient, because results can be obtained from it in a shorter time than from any other method.

In opposition to the American point of view, all the European research institutes were of the opinion that the wood block method should have first place in importance, the following arguments being advanced in support of this view :

All laboratory experiments on the preservation of materials should in general be carried out on the material in question, using as the attacking agent the appropriate micro-organism concerned. Experience has shown that a preservative may easily inhibit the growth of a micro-organism in agar or gelatine for example, while this same organism will develop quite unchecked by the preservative used in another substratum. The difference in behaviour may be due to such causes as chemical reactions, absorption phenomena, changes in the coefficient of dispersion, and so on, which cannot always be foreseen. Such phenomena have been observed in the case of wood-preserving materials and a number of instances were quoted during the discussions. It was shown by means of tables and figures how some wood preservatives may have the same effect in wood as in agar, while others produce a many times greater effect in agar than in wood. Values obtained in agar cannot, therefore, be taken as applying for wood without further investigation ; it was considered that an opinion as to the preservative properties of an antiseptic can only be established by experiments carried out with all necessary precautions upon wood blocks.

Against the objection of the American workers, put forward by Dr. von Schrenk, that the use of wood blocks introduces too great a variability into the experiments, which is absent in the agar method, it was shown that while the undeniable variability of wood may introduce differences amounting to

approximately 10 to 20 per cent, these differences are without significance in comparison with differences of 1000 per cent or more which might easily appear when conclusions are drawn as to the toxicity of a material in wood from figures derived from agar tests. The agar method may in this way lead to false conclusions.

In addition to the agar and wood block methods which had been discussed, mention was also made of methods involving the use of cooked rice or of sawdust as nutritive substrata. At Zurich a modification of the latter method is customary, in which the wood-destroying fungi are cultivated on sawdust prepared from impregnated wood, and as a measure of the amount of the fungus attack, the xylan and the cellulose contents are determined before and after the growth of the fungus.

2. Choice of Fungi.

As the first standard fungus, *Fomes annosus* was chosen in America because this fungus is considered to be specially resistant and easy to grow. In addition, other species of fungi (species of *Lenzites*, *Polyporus*, *Polystictus*, *Coniophora*, etc.) have occasionally been used for comparative experiments.

Against the use of *Fomes annosus* general objection was raised because this fungus does not, in practice, come into consideration as a destroyer of dead, constructional timber and it cannot, therefore, be regarded as a typical wood destroyer. Neither can *Fomes annosus* be regarded in general as particularly resistant, since, while it may be very resistant against certain antiseptics, in respect of others it is surpassed by other fungi. On account of the varying behaviour of different fungi to the same antiseptic, it is not sufficient to carry out the experiments with only one fungus; it is much better that several species should always be used. Not only do the values determined for the inhibition point of any particular material in agar fail to agree with the values obtained in wood blocks, but the relation between the agar value and the wood block value may be different for one and the same material for different fungi. It is, therefore, not possible to determine the inhibition points for numerous fungi by the agar method and for a single fungus by the wood block method in order to calculate, from the relation determined for this one fungus, the inhibition points in wood for the other fungi. Several fungi should, therefore, be used in each wood block test against any one preservative. The fungi should be chosen after consideration of the use to which the timber treated with the particular preservative will eventually be put (whether in sleepers, poles, or as building timber). Obviously the choice will also depend upon the species of wood used (frondose or coniferous).

Further, it was shown that not only do species of fungi differ in their resistance and virulence, but that the strains of one species may also show differences amongst themselves, in consequence of which it will be necessary for the different research institutes to make use of the same strains of fungi of known origin, if the values are to be internationally comparable. The Biologische Reichsanstalt at Berlin-Dahlem expressed its willingness to supply strains of fungi having the same origin, if the research institutes could come to an agreement as to the species and strains or races to be used.

Until now the effectiveness of preservatives has been tested only against infection by mycelium; tests against spore infection are equally important and deserve further consideration.

3. Inferences from Toxicity Determinations.

It was agreed that the inhibition figures determined by the wood block method are only of value for practical application if the laboratory experiments are supplemented by field experiments and by investigations to determine the liability to leaching and to evaporation, and the physical and chemical stability in wood, and so on. But from a consideration of all these points valuable conclusions may be drawn as to the probable preservative power of a material in practice, especially when it is possible to compare the new material under test with other known materials of the same type.

Conclusions.

The conclusions reached were as follows:

1. The wood block method (using the Kolle flasks), which was thoroughly discussed by the conference, should be considered as a suitable means for estimating the effectiveness of a wood preservative against fungi. The agar method should only be considered as of value for the preliminary investigation of the toxicity to fungi of any new material.

The inhibition point in the wood block method shall be expressed as kilograms of preservative per cubic metre of wood. In the agar method the inhibition point shall be expressed as the interval between that concentration of the material under test, in the artificial medium, at which growth just takes place and the next concentration above it in the series, which prevents all growth.

2. It should not be considered sufficient to carry out the tests under consideration with one fungus only. Much rather should it be the aim to carry out all tests on impregnated wood with two fungi; the exact species still to be decided upon, but one of them should be *Coniophora cerebella*.

3. The conference was unanimous that the determination of the toxicity to fungi of any material is not alone sufficient to determine its value as a wood preservative, and that investigations as to its susceptibility to leaching, and on its physical and chemical stability in the wood, must also be taken into consideration.

In view of the wide field for discussion, the conference resolved not to regard the two days' discussion as in any way final, but rather to look upon itself as a sort of permanent working committee of people interested in the subject. In order to make the work easier, the following committee was set up: Prof. Liese, of the Forestry School, Eberswalde; Prof. Nowak, of the Wood Industry Technical and Chemical Research Institute, Vienna; Dr. F. Peters, of the Rütgers Company, Berlin; and Dr. A. Rabanus, of the I.G. Farbenindustrie A.G., Uerdingen.

Crust-movements connected with Tango (Japan) Earthquake of 1927.

IN no other earthquake have the movements of the crust been studied so exhaustively as in the Tango earthquake of Mar. 7, 1927. In several districts, such as those of the Californian earthquake of 1906 or the Kwanto earthquake of 1923, the series of levellings have been repeated once, but after the Tango earthquake they have been repeated again and again, with a lavish expenditure of trouble for which seismologists are deeply indebted to the Land Survey Department of the Imperial Japanese Army. Series of precise levellings were carried out during April-June, June-July 1927, Mar.-April 1928, and Aug.-Oct. 1929, while the re-triangulation of the central district was made during May-June, Aug.-Sept., and Oct.-Nov. 1927, and April-Sept. 1928. The results of the repeated measurements have been studied by Prof. C. Tsuboi, of the Earthquake Research Institute, in an admirable series of papers published in the *Bulletin* of the Institute (vol. 6, pp. 71-83; 1929; and vol. 8, pp. 153-220, 338-345; 1930).

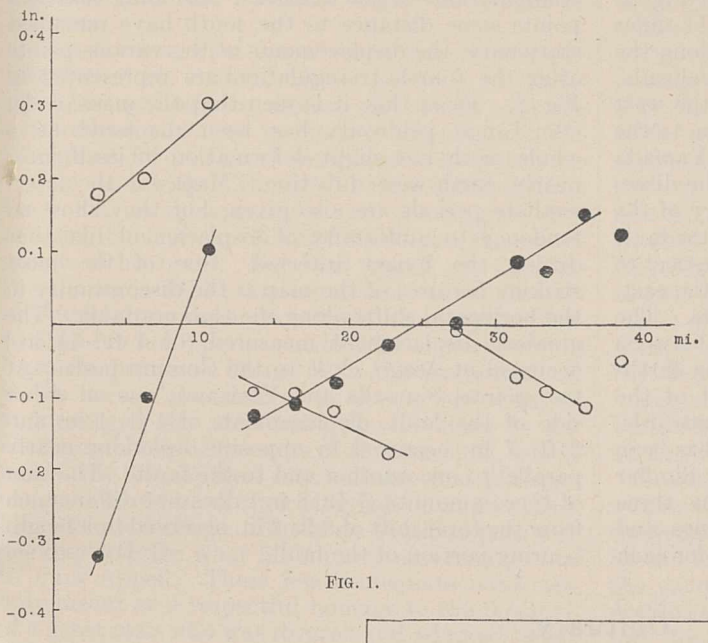

FIG. 1.

The first of these memoirs is confined to the vertical displacements that occurred during the intervals between the first and second and the second and third series of levellings. Diagrams are drawn representing these displacements along nearly straight portions of the levelling route. One of them is reproduced in Fig. 1, in which the small black dots indicate the displacements during the first interval and the small circles those during the second. It is clear from this and similar diagrams (i) that the points lie nearly on segments of straight lines, and (ii) that the ends of these segments lie on the same ordinates for both series of graphs. These features are well explained on the supposition that the crust is made up of a number of blocks, each of which behaves as a nearly rigid body and, at any rate after the earthquake, was able to move with comparative ease apart from its neighbours. The boundaries of the various blocks have been drawn, and it is remarkable how closely they agree with the known fault-lines of the district. Two other points of some interest are also evident from Fig. 1 and other diagrams, namely, (iii) the tilting of the blocks in some cases takes place in opposite directions in the two intervals considered, while

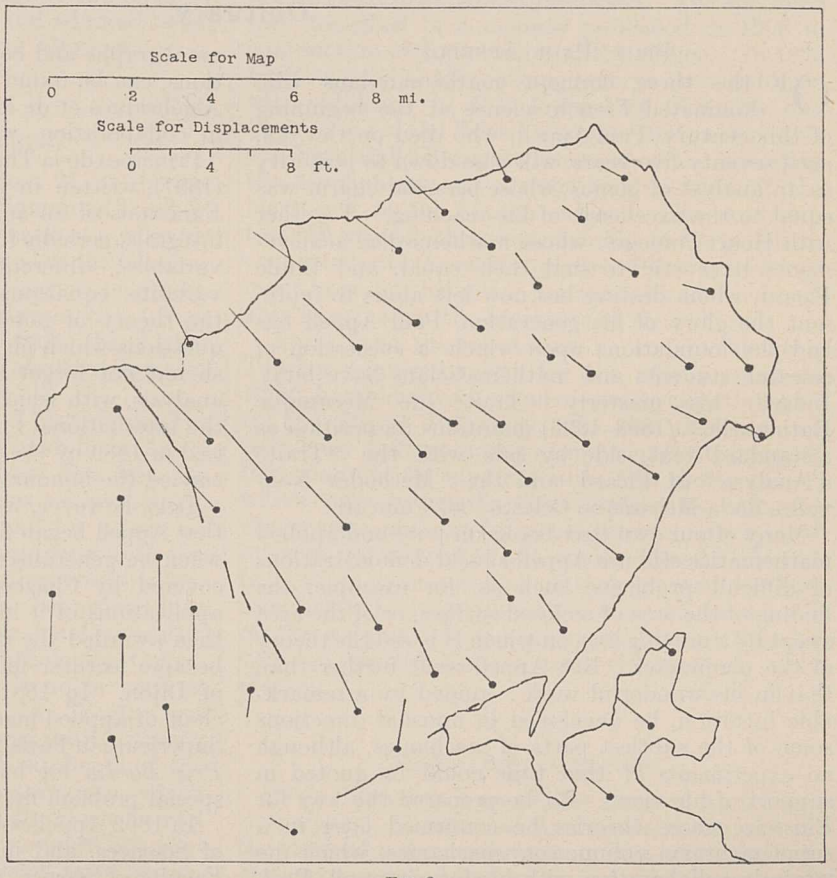

FIG. 2.

(iv) Fig. 1 shows that two blocks were subjected to a common tilting during the earlier stage but moved separately during the later.

At the time of the earthquake, two remarkable faults were renewed along old lines of dislocation. They are represented by the thick lines in Fig. 2. The Gomura fault, or series of faults, is 11 miles long, and runs in the direction S. 30° E. along the western boundary of the Oku-Tango peninsula. Relatively to the other side, the crust to the west of the fault was shifted as much as 8 ft. 2 in. to the south and uplifted about 1 ft. 8 in. The Yamada fault is about 4½ miles long, and runs in the direction N. 55° E. along the southern boundary of the peninsula. The crust on the north side of the fault was raised by as much as 2 ft. 3½ in. with respect to that on the other, and shifted 2 ft. 7½ in. to the east.

The main line of levels crosses both faults. The vertical displacements of the bench-marks between 1888 and the first series of levels after the earthquake show that the ground to the west of the Gomura fault has been generally tilted westwards, while the block bounded by the two faults has been tilted to the north by as much as 20″. Similar curves have been drawn for each of the three intervals between successive series of levellings, and it is worthy of notice that, while the curve for each interval differs materially from that up to the first series, the curve representing the total displacements between the first and fourth series resembles it very closely.

No less interesting are the results of the repeated triangulations of the district. Assuming that two points some distance to the south have remained stationary, the displacements of the various points after the fourth triangulation are represented in Fig. 2. From this, it is seen that the mass of the Oku-Tango peninsula has been displaced as a whole, with but slight deformation in itself, in a nearly north-west direction. Maps for the intermediate periods are also given, but they show no tendency to uniformity of displacement like that during the longer interval. One of the most striking features of the map is the discontinuity in the horizontal shifts along the Gomura fault. The greatest displacement measured (of 5 ft. 4½ in.) occurred at Asago, close to the Gomura fault. At two points, Simooka and Yosizawa, one on either side of the fault, displacements of 4 ft. 1 in. and 3 ft. 7 in. occurred in opposite directions nearly parallel to one another and to the fault. The sum of these amounts (7 ft. 8 in.) does not differ much from the total shift of 8 ft. 2 in. observed in a neighbouring portion of the fault. C. DAVISON.

Obituary.

PROF. PAUL APPELL.

OF the three eminent mathematicians who dominated French science at the beginning of this century, Paul Appell, who died on Oct. 23, aged seventy-five years, will pass down to posterity as an analyst of genius, whose personal charm was equal to the excellence of his teaching. Together with Henri Poincaré, whose mathematical achievements have still to find their equal, and Emile Picard, whom destiny has now left alone to represent the glory of his generation, Paul Appell has laid the foundations upon which a succession of research students and mathematicians have built. Indeed, his masterly "Traité de Mécanique Rationnelle" (1893–1896) maintains its position as a standard text, side by side with the "Traité d'Analyse" of Picard, and the "Méthodes Nouvelles de la Mécanique Céleste" of Poincaré.

Many of our own text-books on pure and applied mathematics still use Appell's lucid demonstrations of difficult problems, such as, for example, the finding of the area of a closed surface, or of the area swept by a moving line, on which is based the theory of the planimeter. But Appell went further than that in his wonderful work: guided by a remarkable intuition, he developed in unusual directions some of the subtlest parts of mechanics, although no experiments of that time could be quoted in support of his views. So he prepared the way for Einstein, whose theories he confirmed later in a supplementary volume on mechanics which he wrote in collaboration with his former pupil, Prof. Thiry.

The fundamental ideas of Paul Appell on higher analysis, which are scattered in a large number of monographs and contributions to learned publications, can be found in his "Théorie des Fonctions Algébriques et de leurs Intégrales" (1895), written in collaboration with Prof. Goursat, and in his "Principes de la Théorie des Fonctions Elliptiques" (1897), written in collaboration with Dr. Lacour. Functions of an analytic point, series and definite integrals, periodic functions and functions of several variables, differential equations and their invariants, equations with partial derivatives, and the theory of potentials, are among the abstruse questions which he attacked successfully; and one should not forget his brilliant memoir on higher analysis, with which he secured the second prize in the international mathematical competition organised in 1889 by the King of Sweden, when Poincaré carried the honours of the day.

It is, however, with his thesis on pure geometry that Appell began his mathematical career in 1876, when he generalised the notion of involution discovered by Chasles, and made some remarkable applications of it in the theory of cubics. He was then awarded the degree of Doctor of Science and became lecturer in mathematics at the University of Dijon. In 1881 Appell was appointed to the chair of applied mathematics at the École Normale Supérieure in Paris, and in 1885 he was awarded the *Prix Bordin* for his memoir on the solution of a special problem first suggested by Monge.

In 1892 Appell was elected to the Paris Academy of Sciences, and in 1903 he became Dean of the Faculty of Science, and, soon after, a member of the Higher Education Council, in which capacity he exercised a far-reaching influence over the whole field of university education in France. In 1920 he

was appointed Rector of the University of Paris, whence he retired some years after on account of ill-health. On several occasions Paul Appell received the highest distinctions from French and foreign universities; and in 1924 Oxford conferred on him the honorary degree of Doctor of Science.

As a teacher, Paul Appell knew how to win the affection of his students by his patience, his kindness, his readiness to discuss difficulties, and his extraordinary ability in finding illuminating explanations for the most complicated questions he had to deal with. Those who were privileged to know him more intimately were not long in discovering his high moral virtues and also the secret sorrow of his heart. For Paul Appell was born in Strasbourg in 1855; and as a result of the Treaty of Frankfurt, sixteen years later, he was prompted to abandon his "petite patrie" for the sake of his "grande patrie, la France", to the restoration of which he was determined to devote his strength and energy. He tells his poignant story in his charming book, "Souvenirs d'un Alsacien", which makes his biographers' task an easy and pleasant one, and shows in all their simplicity and greatness his patriotic feelings. But more qualified pens will one day describe what his country and science owe to Paul Appell. These few inadequate notes are only meant as a respectful homage to the memory of a great man who was revered and admired by all who knew him. THOMAS GREENWOOD.

PROF. J. H. TEACHER.

BY the premature death on Nov. 21, at the age of sixty-one years, of Prof. John Hammond Teacher, the School of Medicine of Glasgow has lost a valuable member of its personnel. Educated at the Glasgow Academy and the University of Glasgow, he graduated in arts in 1888 and in medicine with 'High Commendation' in 1893. He took the higher degree ten years later and was awarded honours and a gold medal for his thesis.

It is probably true to say that of his teachers Dr. Joseph Coats was the most influential in determining Dr. Teacher's bent. From the first his interests centred in the problems of pathology. After serving as house surgeon and for a time as medical officer of the Rio Tinto Company in Spain, where he had the opportunity of observing the life-history of the malaria organism, he returned to undertake an important duty for his University. The celebrated Anatomical and Pathological Collection of William Hunter had long stood in need of reconditioning and rearranging. Dr. Teacher was appointed to do this, and after some years of work, produced a valuable two-volume catalogue of the collection, with descriptions and annotations which testify to the care and insight with which he had carried through the work. The volumes are prefaced by an interesting and scholarly introduction on William Hunter and his school in relation to the collection.

Dr. Teacher next spent some years as assistant to the professor of physiology, being chiefly engaged in the histological work. Here he was able to perfect his microscopic technique, which was of a high order. About this time he entered upon a study of the remarkable disease known as chorionepithelioma, and to further this he travelled abroad to make acquaintance with all the early human embryos then known. Presented as a thesis, this memoir received recognition from his University, and was acknowledged an important contribution to the subject. In 1904 he joined the staff of Prof. Muir, and in view of his special proficiency and interest in microscopic work he was nominated by him for the lectureship in pathological histology. In 1909 he was appointed pathologist to Glasgow Royal Infirmary, and this appointment was followed in 1911 by his election to the St. Mungo (Notman) chair of pathology instituted in 1910. As St. Mungo professor he was *ex-officio* pathologist to the Royal Infirmary, and his professorship was inaugurated by the opening of the excellent new Pathological Institute, for the planning and organisation of which he was largely responsible.

Teacher's work on chorionepithelioma gave him a special interest in the history of the chorion in early development, and this was greatly enhanced by his discovery in 1907 of a very young embryo, the youngest hitherto known, in a minute piece of decidua sent to him for examination. The specimen was described in a memoir published in 1908 in conjunction with the writer of this notice. In 1923 he discovered another young embryo at an autopsy, and published in the *Journal of Obstetrics and Gynæcology* of the British Empire (1924) a very able and beautifully illustrated memoir on the history of the trophoblast and on the implantation of the blastocyst in the human subject. The contributions he made in these two memoirs to the problems connected with the earliest phases of human development have left his name permanently and honourably inscribed in the literature of the subject.

Apart from the reputation he won in this field, Teacher acquired merit for the able manner in which he conducted his routine duties as pathologist to the Royal Infirmary. To the literature of pathology he from time to time contributed papers (too many to be enumerated in this short notice), which were invariably characterised by accurate observation and careful presentation. His special interest, determined by the studies already referred to, was in gynæcological pathology, and he had accumulated a large amount of material for a book on the subject. It is a great misfortune that he was not granted time to carry this work to completion. T. H. B.

CAPT. OTTO SVERDRUP.

OTTO SVERDRUP'S name, like those of his fellow-countrymen, Nansen and Amundsen, ranks high in the story of polar exploration. In a long course of arctic voyages, he had become the most experienced ice-master of his time, and his knowledge was sought by many expeditions.

Sverdrup, who died in Norway on Nov. 26, was

born on Oct. 31, 1855, on a farm in Helgeland, Norway. He went to sea at the age of seventeen and sailed for many years in American and Norwegian ships, besides having experience in fishing boats. For some years he had left the sea, when in 1888 he was chosen by Nansen for his memorable expedition across the ice-sheet of Greenland. The party reached the west coast after their crossing, and then Sverdrup and Nansen made a daring journey in a crazy and scarcely seaworthy boat to Godthaab to bring help to the other men.

In 1893 Sverdrup was chosen by Nansen to command the *Fram* in her drift across the Arctic Ocean. When Nansen left the ship in lat. 84° N. with Johansen as a companion in an attempt to reach the north pole, Sverdrup took over command of the expedition, and eventually extricated the ship from the pack-ice and brought her safely to Norway after a three years' drift. The highest latitude reached by the *Fram* was lat. 85° 57′ N., which is still the northern record of any vessel.

In 1898 Sverdrup returned to the arctic with the *Fram* in an attempt to explore the north of Greenland. Ice in Robeson Channel barred the way, and Sverdrup transferred his attention to Ellesmere Island and the unknown regions lying to the west. During the first year, from a base at Cape Sabine he explored much of Ellesmere Island, and in the two years following he charted much new land to the west and threw light on the nature of that part of the arctic. The islands he discovered are known collectively as the Sverdrup Islands. The *Fram* returned safely to Europe in 1902.

Sverdrup's next important arctic voyage was in 1914, when he was charged by the government of Russia with the task of searching for the lost Russian explorers, Brussilov, who had sailed in *Ste. Anna* in 1912, and Russanov, who sailed the same year for the Kara Sea. Sverdrup in the *Eclipse* passed through the Kara Sea, reached the Yenisei mouth, and eventually wintered in lat. 76° N., long. 92° E. In August 1915 the ship was liberated from the ice and resumed the search, which, however, proved fruitless. This expedition made several discoveries, but most of the detailed records were sent to Russia and have never been published. In 1920 Sverdrup again took an expedition to the Kara Sea, to bring help to a Russian ice-breaker imprisoned in the pack. He gave valuable advice in the rescue of the survivors of the *Italia* airship in 1928.

Sverdrup was a silent man and his great store of knowledge was not easy to reach. His chief book was "New Land" (London, 1904), and he wrote nothing on many of his expeditions. He was an honorary LL.D. of the University of St. Andrews.

R. N. R. B.

Mr. James Edge-Partington.

We regret to record the death of Mr. James Edge-Partington, which took place at Beaconsfield on Nov. 4, at the age of seventy-six years. Mr. Edge-Partington was an authority on the material culture of the Pacific, and at one time was the owner of a very extensive collection of objects from the South Seas, which included many rarities. This was dispersed during his lifetime, part going by purchase and gift to the British Museum and part to the Auckland Museum. A second collection of books and prints relating to Australasia went to an Australian museum. Mr. Edge-Partington's contributions to scientific literature, which were numerous, were mostly descriptive, but they were characterised by extreme accuracy, critical acumen, and a common sense which was allied with a sound appreciation of the bearing of the analytical study of material culture on the problems of ethnology. His most important contribution to anthropological literature, however, was an ethnographic album of the Pacific in which tools, implements, personal ornaments, and other objects in European collections, especially his own and that of the British Museum, were reproduced by lithography from his own drawings. It was issued in three series, which appeared in 1890, 1895, and 1898 respectively. It is now extremely rare, very few copies remaining in private hands. Mr. Edge-Partington's interests were not confined to the Pacific; he was also a keen student and collector of objects illustrating the culture of the European peasantry, and had devoted much attention to the peasant industries of the Chiltern area in which he lived. For many years he was a valued voluntary worker in the ethnographical department of the British Museum, and a very active member of the council of the Royal Anthropological Institute.

Prof. Walter Herz.

Dr. Walter Herz, professor of physical chemistry in the University of Breslau, died on Sept. 7, aged fifty-five years. From the *Chemiker-Zeitung* we learn the following particulars of his life. Herz was a native of Breslau and at the University of that city he studied under Ladenburg, who quickly recognised his ability both as an original worker and as a teacher. Under Ladenburg's direction, it was only natural that Herz should direct his attention first to organic chemistry, but after graduation his interests in other branches of the subject were awakened by F. W. Küster and R. Abegg. Under their influence he began to devote himself to investigations in physical chemistry, particularly to problems of solubility, chemical equilibria, partition coefficients, viscosity, and critical states. In 1903 Ladenburg appointed him first assistant in the Chemical Institute at the University of Breslau. In 1909 he was transferred to the Pharmaceutical Institute, but in 1919 he returned to the University as director of the department of physical chemistry in the Chemical Institute. Herz was the author of numerous volumes, the best known of which is his "Leitfaden der theoretischen Chemie". In conjunction with Abegg he compiled a "Chemisches Praktikum" and with Gadamer a work on chemical toxicology. He succeeded Ahrens in editing the *Sammlung chemischer und chemisch-technischer Vorträge*.

News and Views.

AT the anniversary meeting of the Royal Society, Sir Ernest Rutherford, the retiring president, announced that by an alteration of the existing statute regulating the election of fifteen fellows annually, and enacted in 1847, the number to be recommended for election in future would be seventeen. This new version of a particular statute takes us in retrospect to a very early period, namely, 1682, when it was decided that "Every person that would propose a candidate shall first give in his name to some of the Councell, that so in the next Councell it may be discoursed *vivâ voce* whether the person is known to be so qualified as in probability to be usefull to the Society. And if the Councell return no other Answer but that they desire further time to be acquainted with the gentleman proposed, the Proposer is to take that for an Answer". Repeal of this reading occurred in 1728, the substance of alteration being that persons for election should first be proposed at a meeting of the Society, approved by the council, and recommended by three members, at least one of them a member of council. Soon after (1730) there was another change, mention of council being omitted, the requirement being that every person to be elected should be proposed and recommended at a meeting of the Society by three or more members, and qualifications were necessary to be set forth. The several elections of individuals were by ballot, not immediate, but at intervals.

IN 1830, no fewer than forty-two fellows, on a home list, were elected to the Royal Society between January and December (within these months, by the the way, Charles Darwin and J. J. Sylvester were included). Only four foreign members were elected. In 1841 the astonishing total of forty-four individuals was registered for the fellowship, whilst not a single foreign member appears in the list. In 1847 the number elected dropped to twenty-three, a result indicative, one may surmise, of impending changes in the mode of entry. In 1848 a drastic alteration in the system of the annual election came into operation, due to the regulations adopted the previous year. Fifteen candidates were duly selected; actually there were fourteen persons only who took up fellowship in that year. The meeting was notable as being the occasion of the valedictory address of the Marquess of Northampton, who had served ten years as president. It was already known that the latter held strong objections to the innovation, and he did not fail to express them in the course of his address. We have referred above to the fact of the election of only fourteen individuals. The president stated that—"It is rather a singular circumstance, that, since our selection was made, one of the gentlemen whom we had chosen, Mr. Syme, should have withdrawn his name. . . . The possibility of occurrence of such a case had not arisen in the minds of the former council when the new rules were framed, but it may perhaps be considered next year whether it ought to be provided against, or whether it is likely to occur so seldom as not to require any special provision." It is of interest to add that this "Mr. Syme" was James Syme, the eminent Scottish surgeon, to whom Joseph Lister had early acted as house-surgeon at Edinburgh, and whose daughter Lister afterwards married.

THE considerations which to-day bear upon the present slight increase in numbers admitted annually to the Royal Society may be briefly given; they are, however, recognised generally. The advance of science during the past half-century has provided new aspects and new fields of knowledge. In course of time it has led to an almost exclusive nomination from the lists of candidates of those (in various departments) who are comprised in the broad category of research workers attached to home and overseas universities; coupled, in lesser measure, with others who have entered industrial technical organisations where the exercise of expert training is required. The issues arising from the recurrent claims underlying specialisation have long occasioned serious thought. It has been stated that the council was able at one time to bring in annually a proportion at least of distinguished men outside the academic or professional sphere, whereby, it was claimed, a useful discriminating leaven and freedom from standardisation was maintained. Although the new enactment changes the existing situation in the annual election of candidates for the fellowship, it does not appear to involve abandonment or modification of the statutory provision of 1902, which, while it repealed an old rule for the election (at any time) of privy councillors, gave the council power to recommend to the Society for election, in alternate years, two persons who either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society.

BY 255 votes against 225, the House of Commons has confirmed the Government's decision to allow the Dyestuffs (Import Regulation) Act to lapse in January next. Sir P. Cunliffe-Lister opened the debate on Dec. 4 by moving an amendment to provide for its extension for five years; the matter, he said, raises grave national issues, and is not merely a question of free trade. The industry is in origin British, and it has already once been lost to German foresight and wisdom; that loss was, at the outbreak of War, about the greatest handicap with which we had to contend. Sir H. Samuel, while admitting the possibility that foreign competitors might make the purchase of certain dyes dependent on the acceptance of dyes of cheaper quality, and that by selling at low prices they could stop valuable work in research and development now being pursued in Great Britain, nevertheless found no reason why the measure should be extended; his views were, he said, based mainly on the report of the Dyestuffs Industry Development Committee, to the effect that the building up of a substantial dye industry under the protection of the Act has temporarily laid a serious burden on the user of dyes. The President of the Board of Trade, Mr. Graham, said that the problem on which the

Government had to pronounce was the balance of advantage, and they were satisfied that the dyestuffs industry could continue in perfect strength and safety. The fact that the industry is able to offer virtual guarantees concerning price and quality is an indication that the central part of the case for protection has gone. He could not bring himself to believe that the industry will either collapse or operate under very great difficulties, because there has been a considerable measure of concentration of production. He was advised that there may be an agreement or understanding between British and German producers, and that that agreement may well be independent of whether the Act continues or lapses.

MR. GRAHAM, in the course of his speech on the Dyestuffs Act, referred to a memorandum on the subject submitted by professors of chemistry in the universities of Great Britain, in which the fear was expressed that if the industry is weakened by the lapse of the Act, they would lose a great deal of the advantages of training in research and of the effort to link science and industry together. He replied that it would be the duty of the Government to see that research is fully safeguarded; he suggested, for example, the formation of a research association under the auspices of the Department of Scientific and Industrial Research. Until more is known as to the proposed method of implementing Mr. Graham's promise, no useful comment can be made. Sir John Simon said that everyone would agree that the Act has produced a very efficient industry, that it has very materially promoted research, and that it has done something to develop British science; he advocated some continuance of the Act pending an effective inquiry. Mr. Henry Mond said that dye makers would be perfectly satisfied if this suggestion were adopted. There are altogether 10,000 known dyes, some 4000 being in current use, and about 2500 are made in Great Britain. Extension depends on the supply of trained scientific workers, and it would be impossible to provide the necessary school for the purpose until there is a well-established and a sound organic chemical industry. The future of industry is based upon the organic chemical industry. Mr. Wise expressed disappointment that the Government had not taken the opportunity to review the whole position in regard to dyestuffs, continuing to give to this vitally important trade a measure of protection in a non-fiscal sense which would enable it to develop what is a key-industry, and using the occasion to acquire for the benefit of the community a much greater control over the operations of a tremendously powerful corporation. Major Tryon regretted that, at a time when so many great problems in the dyeing industry alone are unsolved, the work should be broken up and part of the staff disbanded; it would set back a great experiment in the infinite field of undiscovered science. The debate was concluded by the Secretary for War, Mr. Shaw; no one, he said, was against any reasonable expenditure on research needed for guaranteeing the safety of the country, but those who want research should pay for it.

THE commemoration in London of the centenary of the death of Simon Bolivar, whose name is written so large across the geography of South America, and who died on Dec. 17, 1830, has been organised by a committee of the diplomatic representatives of Bolivia, Colombia, Peru, Ecuador, and Venezuela, together with the Spanish ambassador and others. The programme is to include a requiem Mass in Westminster Cathedral on Dec. 17, and the laying of wreaths at the Cenotaph in remembrance of the British soldiers who fought in Bolivar's army, and at the statue of Canning, who was the first to recognise the free States of South America. A commemorative tablet will also be unveiled in Apsley House, where, in 1810, Bolivar, representing the *Junta Suprema* of Caracas, met Marquess Wellesley, Secretary of State for Foreign Affairs. The following day a dinner is to be given by the Latin American Society of Great Britain to celebrate Bolivar's achievements and the old friendship between Great Britain and the republics he liberated. Bolivar, who was born at Caracas on July 24, 1783, came of a noble family of Venezuela, and after being educated at Madrid visited France and the United States. By 1811 he held the rank of colonel during the struggle for the independence of Venezuela, and thenceforth he was associated with the efforts which led to the formation of the republics of Colombia, Ecuador, Peru, and Bolivia, the last of which was named after him. After holding the dictatorship of Colombia, he resigned office on Jan. 20, 1830, and died the same year at Carthagena on his way into exile. His grave is in the cathedral of Caracas, the capital of Venezuela.

THE second triennial congress which is being called by the International Industrial Relations Association at Amsterdam in August 1931 should meet under favourable auspices. The Association was formed for the study and promotion of satisfactory human relations and conditions in industry, and thus has aims allied to those of the Industrial Welfare Society. The congress will consider the need for scientific adjustment of economic resources, production, and consumption, as essential to satisfactory human relations and conditions in industry. The present widespread unemployment position and lack of purchasing power, at a time when the world's production capacity and economic resources are greater than ever, give pertinence to an attempt to determine whether scientific methods can be used to achieve some balance between resources, production, and consumption. Recent discussions at the British Association meetings on the rationalisation of industry have stressed the human aspects of rationalisation. In the scientific study of the management aspects of rationalisation which is being carried out by the International Management Institute, the human factor and industrial psychology receive due attention, and the subjects chosen for research have included the selection and training of workers, accident prevention, methods of remuneration, welfare devices, etc. The Industrial Health Research Board has also strongly advocated the need for closer co-operation between psychologists and industry; whilst the Committee on

Industry and Trade in its final report made recommendations for the scientific and practical investigation of the whole range of problems falling under the head of industrial fatigue, in the widest sense.

THE co-operation of scientific workers in this forthcoming congress is definitely invited, and the congress affords such workers an opportunity not merely of collaborating in the development of a technique of satisfactory human relations, including right working conditions, in industry, but also of assisting the formulation of economic policy, along the lines of knowledge in place of caprice or prejudice. The participation of scientific workers in such a congress with representatives of employers and of labour should at any rate assist in relating science to practice and practice to science. The important problem of securing national administration in economic and industrial matters along rational and scientific lines appears, however, to be rather outside the scope of the congress, Even the World Economic Conference of 1927 has thus far proved abortive so far as any real influence on Government policy is concerned. Once the management of industrial relations has been established on scientific lines, the international organisation and relationship of industry may exert a more decisive influence on national policy and administration, and scientific workers cannot be indifferent to a congress which holds any prospect of promoting the leadership of science.

A NOTEWORTHY recent lecture by Prof. R. Willstätter gives a searching analysis of the relations between fundamental scientific research and industry as seen in Germany at the present time. After stressing the debt of modern chemical industry to the scientific work of the universities, Prof. Willstätter analyses the activities of the industrial research laboratories, and pays tribute to the scientific merit of much of the development work carried out by such laboratories in fields which originally were opened up by purely scientific discoveries. The systematic investigation of a defined field—such, for example, as that of hypnotics, following on the discovery of veronal—to determine the substances possessing the most valuable combination of properties, even when carried out along lines of analogy, involves a high standard of scientific knowledge and frequently even more originality and inventive ability than the original and possibly fortuitous discovery. Such developments are as much among the greatest achievements of chemical industry as the elaboration of methods of large scale production for the new substances, and the success of such work depends more than anything else on the director of research.

EVEN in the development of large scale production and the improvement of technique, industry has frequently been indebted to academic research, and Prof. Willstätter views with alarm the gradual estrangement between the large industrial firms and the universities which has developed with the growth of industrial organisations and the expansion of their research departments. There is not now the same personal contact between the universities and the leaders of industry, and in some quarters there is a definite tendency to disparage or resent suggestions coming from the universities. This tendency has already had an adverse effect on the financial position of research at the universities, and Prof. Willstätter urges that a more generous policy on the part of the industrial combines and a close contact between industrial leaders and the universities is required to stimulate the fundamental scientific research from which industry itself benefits so largely.

IN an inaugural lecture delivered at the London School of Economics on Dec. 2, Prof. Morris Ginsberg, who has succeeded the late Prof. L. T. Hobhouse in the Martin White chair of sociology, reviewed the present position of instinct in the social sciences. He defended the conception of the instincts as inborn impulses serving the root interests or basic needs of the organism, of which they must be regarded as limitations or specifications. The attempt to reduce instincts to compound reflexes fails, first, since the component parts of instinctive behaviour admit of varied combinations in a series which as a whole has unity and continuity, and secondly, since no adequate account can be given of mental development on the basis of the reflexes alone and their conditioning. The function of intelligence in relation to instinct is (1) to clarify and render explicit the ends of the inborn impulses; (2) to detect relevant relations between the actual situation and the ends; (3) to systematise the ends of the impulses into comprehensive purposes. The objection to instincts as occult forces is based on a false view of causality, which properly interpreted does not imply any notion of mysterious efficacy. That no satisfactory classification of human instincts has yet been produced is true, but irrelevant as an argument against them. None of the critics has in the end succeeded in dispensing with the instincts. Proceeding to a survey of the use made of instinct in social psychology, Prof. Ginsberg showed that: (1) There has been too much readiness to refer highly complex phenomena to single instincts. (2) The instincts have been incorrectly conceived as separate 'forces', thus ignoring the conational continuity of the self. (3) Stress on impulse has led to a disparagement of reason; in truth, impulse and reason are inseparably intertwined. (4) The accounts which have been given of the psychology of morality, of the basis of social life, and of sublimation appear to require restatement in terms of a more adequate definition of the relation between the root interests and the specific impulses which serve them.

RECENT discussion of the antiquity of man in East Africa has served to direct attention once more to the importance of the 'Oldoway skeleton' found by Dr. Hans Reck in the northern part of Tanganyika Territory in 1914. The evidence, geological, palæontological, and anthropological, afforded by this discovery must now be viewed in the light of Mr. Leakey's work in Kenya. The data for such further consideration are furnished by a valuable study of the skeleton and the attendant conditions of its discovery communicated to the Royal Anthropological Institute by

Dr. Reck and presented at a meeting held on Nov. 25. The Oldoway geological series consists of seven horizons, of which the fifth is a fossiliferous bed in which were remains of a variety of *E. Antiquus*, previously known only from Europe and the Nerbudda deposits, and human remains. Above this was a red-earthy deposit, root-infested and therefore undisturbed. The skeleton itself was found only a little above the horizon of *E. Antiquus*. The bones were not highly mineralised. Dr. Reck is now inclined to correlate Oldoway man with Elmenteita man found by Mr. Leakey in Kenya; but he differs from Mr. Leakey on the point of chronology, on the ground that only one pluvial period is represented at Oldoway. He also holds that it is not yet possible to correlate the fauna with that of Kenya. Mr. Leakey himself, on the other hand, detects a non-conformity between the Oldoway sixth and fifth beds suggestive of a temporary land surface. He is inclined to equate the Oldoway bone-bed with the upper part of his 'Gamblian'. It is evident that more field-work is necessary before any definite conclusion can be reached; but if Dr. Reck should be able to pay his projected return visit to Oldoway in Mr. Leakey's company important results may be expected to follow.

ON Dec. 5 the extension of the new spirit building of the British Museum (Natural History), which has been erected out of funds provided by the Empire Marketing Board for the use of the Department of Entomology, was formally opened before a large gathering of entomologists and others interested in the work of the Museum. Nearly four years ago the Board realised that the task of combating insect pests, the depredations of which so grievously hamper commerce either by directly attacking the raw material or the commodities resulting from it, or by injuring the health of the workers, was seriously impeded by the congested condition of the Department of Entomology, which rendered it impossible for the insect collection to be properly arranged and to be readily available for study. Accordingly the Board, in response to the request made by the Trustees of the British Museum, decided to devote an appreciable sum for erecting a suitable building, and in the end about £26,000 was expended. On consultation with the architects of the Office of Works it was decided to be preferable to add a permanent building rather than one which might have to be pulled down as the Museum expanded. For that reason about one-half of the west wing of the new building, which had been provided eight years ago for the collections kept in spirit, was added. It has been adapted to the use of the Department of Entomology: large windows have been pierced in what will eventually be the blank walls of the storerooms, and the mezzanine floors of those storerooms and one wall of the future corridor have been omitted.

THE proceedings were opened by the Director of the Museum, Dr. C. Tate Regan, who directed attention to the importance of insects in human affairs. He said that the collection of insects in the Museum numbers some six million specimens and has outgrown its accommodation; the Empire Marketing Board took no narrow view of its duties and realised the intimate relation of the work of the Department of Entomology to health, agriculture, and commerce. Mr. Ormsby-Gore, M.P., who was chairman of the committee when the Board made the grant, emphasised the necessity for adequate scientific research in the development of the British Empire. The Archbishop of Canterbury, as chairman of the Trustees of the British Museum, expressed their thanks to the Empire Marketing Board and the Office of Works for their help, the value of which could not be exaggerated. The association between the Museum and the Government in the development of the Empire and its resources was appreciated. He hoped that the flow of fit persons would be quickened in the schools and universities to serve the Empire by research in every branch of science.

IT is easy to think of many ways in which the light sensitive properties of selenium can be utilised in the industrial world. When, however, an attempt is made to realise them in the research laboratory and later in the development department of a manufacturing works, many difficulties have to be overcome. We learn from the *Electrical Times* of Oct. 16 that the Radiovisor Parent, Ltd., of 26 Coventry Street, W.1, has surmounted many of these difficulties and perfected apparatus which is being employed commercially for various purposes. The most important application is to sound films. By means of a suitable electric bridge and an amplifier, it is now possible to give faithful reproduction of sound over the working range of frequencies. Another application is to the control of street lighting. There are some fifty street lamps in the Mortlake area, Surrey, which are controlled in this way, and they are also in use in several towns. Another application is a controller which regulates the lighting of clocks, telephone kiosks, signs, etc. Queensbury Church, a well-known landmark in Yorkshire, standing 1300 feet above sea-level, now has its four clock faces illuminated by electric lamps which are controlled automatically by a selenium unit. As selenium operates on both infra-red and ultra-violet light, it can be used as a burglar alarm. A special infra-red lamp is concealed and directs its beam across the object to be protected. Any interruption of the beam by the hand or body of an intruder instantly sets in action a warning device, either a red lamp or an alarm bell. Devices are made for indicating the presence of smoke in ships' holds. They are also officially recognised for the timing of racing motor cars and for dog racing. We understand that many other uses of the radiovisor bridge are being developed.

A LECTURE with novel demonstrations was given by Mr. Grace to the New York Electrical Society last month. It proved so interesting that it was repeated on three nights and very many people were unable to obtain admission. The first experiment was the 'projection' of speech directly into the human brain. This was done by transforming speech into a high

frequency current. The lecturer took hold of one electrode, his assistant held the other, and they placed their free hands against the ears of one of the members of the audience. The latter immediately heard music or speech, although no sound could be heard by any other person present. The explanation given was that the ear drums and surrounding tissues acted like the plates of a condenser receiver, the resulting vibrations of the ear drum due to electrostatic forces producing the sensation of intelligible sounds. Another experiment was the 'inversion' of speech. Ordinary speech was inverted so that the high notes became the low notes and vice versa. This inverted speech is quite unintelligible, but was reinverted into intelligible speech by suitable apparatus. In inverted speech, telephone sounded like 'play-o-fine' and company like 'crink-a-nope'. This method is already in use in transatlantic radio telephony to prevent unauthorised listeners from understanding the messages. Colonel Marshall, an engineer who had the misfortune to lose his larynx and had been provided with an artificial one, gave a short address to the audience from his home in California over the transcontinental telephone, on his method of controlling the floods in the valley of the Mississippi. A very successful demonstration was given of an ordinary carbon arc as a loud speaker. The method was originally discovered by Graham Bell, but hitherto the sound has been too faint. By using amplifiers, Mr. Grace made the talking arc almost as loud as the best modern loud speakers.

ON Dec. 4 a public lecture on "The Evidence of Astronomy and Technical Chronology for the Date of the Crucifixion" was delivered at Oxford by Dr. J. K. Fotheringham, reader in ancient astronomy and chronology in the University. Definite historical data, he said, limited the possible years to the period A.D. 27–34. Of these, the Jewish astronomical reckoning excluded all but the years 29 and 33. The year A.D. 29 was advocated by the late Prof. C. H. Turner, but Dr. Fotheringham gave reasons for dissenting from this view and also from that of the late Sir William Ramsay. He himself inclined to the date of April 3, A.D. 33, as offering fewer difficulties than any other. A point in his argument was the fact that the Jews reckoned the new moon from its first visibility; not from its astronomical position.

A NEW society has been founded in Paris for the scientific study of Africa. The president of the Society, which is to be known as the Société des Africanistes, is to be General Gouraud, and M. P. Lester will act as general secretary. Monthly meetings of the Society are to be held for the reading of papers, and a journal will be issued which, in addition to original memoirs, will contain reports of the proceedings at the meetings, notes and news on things African, and a bibliography of current literature on African ethnology. The Society will consist of patrons subscribing 2000 francs, life members subscribing 1000 francs, and ordinary members who pay an annual subscription of 50 francs, or if residing abroad 60 francs, with an entrance fee of 15 francs. Requests for further information and subscriptions should be addressed to M. P. Lester, General Secretary, 61 rue de Buffon, Paris.

MR. P. H. GRIMSHAW has been appointed Keeper of the Natural History Department in the Royal Scottish Museum in succession to Dr. J. Ritchie, who has recently been appointed to be Regius professor of natural history in the University of Aberdeen.

PROF. WILHELM SCHMIDT took over the chair of geophysics in the University of Vienna and the directorship of the Zentralanstalt für Meteorologie und Geodynamik, Vienna, on Nov. 25. He succeeds Prof. F. M. Exner, who died on Feb. 7 last.

THE following appointments have been recently made by the Secretary of State for the Colonies to the Colonial Agricultural and Forest Services: Mr. A. J. Findlay, assistant director of agriculture, Nigeria, to be deputy director of agriculture, Nigeria; Mr. V. F. Olivier and Mr. A. F. W. Sheffield, to be superintendents of agriculture, Nigeria; Mr. P. A. Allison, Mr. A. F. Ross, and Mr. B. E. A. P. Urquhart, to be assistant conservators of forests, Nigeria.

THE Institution of Automobile Engineers has for some years past been giving advice to parents as to how their sons can enter the automobile industry. This practice has been elaborated, and information can now be obtained of the possibilities of apprenticeship in works in any particular neighbourhood. No charge is made by the Institution, the staff of which can be consulted by appointment, by writing to the Institution, Watergate House, Adelphi, London, W.C.2.

THE War Office announces that there are vacancies for commissions in the Supplementary Reserve of Officers as ordnance mechanical engineers in the Royal Army Ordnance Corps. In addition to qualifications as to character, medical fitness, nationality, etc., candidates must be less than thirty years of age for appointment as subalterns and less than thirty-five years of age for appointment as captains, and must also be fully qualified mechanical engineers. Preference will be given to bachelors of science (Engr.), Whitworth scholars, graduates, and associates of the Institutions of Civil, Mechanical, or Electrical Engineers. Candidates will not be required to undergo training in peace-time, but will be liable to be called out on service when the Army Reserve or any part of it is called out by Proclamation. In return for their obligation, officers will be granted an annual gratuity of £25, payable in arrear. Particulars can be obtained from the Under-Secretary of State for War (A.G.9), the War Office, London, S.W.1.

"EARLY Photomicrographers" is the title of an article by C. H. Oakden in Watson's *Microscope Record* for September (No. 21). The honour of being the first photomicrographer is ascribed to the Rev. Joseph Bancroft Reade (1801–1870), who in 1837 obtained prints of the image thrown by a 'solar' microscope upon paper treated with silver nitrate and infusion of galls, fixing the print with hypo made by himself.

IN the autumn issue of *Sunlight* (Vol. 2, No. 3), the journal of the Sunlight League, a table is given of the

average daily readings for August of the intensity of ultra-violet radiations at various localities in the British Isles. The figures illustrate the high intensity which these radiations sometimes attain in England, figures of about 8·7 being obtained at Cleethorpes and Lowestoft, and of 7·75 at St. Ives and Ventnor. They also illustrate how much the intensity of the radiations must depend on climatic conditions prevailing, for while the figure for Clacton is about 7·0, at Southend-on-Sea it was only 1·0—the lowest record of all stations. Among other articles, Dr. Kathleen Vaughan writes on the value of sunlight and the open-air life for healthy motherhood.

A SHORT list of nearly 300 books on British and foreign birds has been received from Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1. It includes a few scarce items.

MESSRS. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, have just circulated a list (New Series, No. 23) of many second-hand works, classified under the headings of periodicals and publications of learned societies, miscellanea, zoology, botany, medicine, sport, and addenda. It is obtainable upon application.

WE have received from Messrs. A. Gallenkamp and Co., Ltd., a catalogue of apparatus for testing petroleum and its allied products. The list, which covers 52 pages and is well illustrated, covers nearly all the standard apparatus required for testing such materials, but the Tate specific gravity bottle seems to have been overlooked. The prices are all given.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Two inspectors of aircraft under the Union of South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand (Dec. 16). An assistant chemist at the sewage disposal works of the County Borough of Reading—The Town Clerk, Town Hall, Reading (Dec. 18). A head of the chemistry department of the Plymouth and Devonport Technical College—The Secretary for Education, Education Offices, Plymouth (Dec. 20). An inspector of alkali, etc., works, under the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (Dec. 20). A junior lecturer in the department of pathology of the University of Liverpool—The Registrar, The University, Liverpool (Dec. 24). A whole-time abstractor and translator at Sheffield, under the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Dean Stanley Street, S.W.1 (Dec. 31). A professor of biochemistry at the Indian Institute of Science, Bangalore—Prof. F. G. Donnan, University College, Gower Street, W.C.1.

Our Astronomical Column.

Magnetic Disturbance, Dec. 3-4, 1930.—A considerable magnetic disturbance, falling into the category of a small storm, occurred on Dec. 3-4. The storm began with a characteristic 'sudden commencement' on Dec. 3 at $1\frac{1}{4}^h$, but apart from this the oscillations of the needles were not appreciable until about thirteen hours later, the most disturbed part of the traces being between 15^h and 22^h on Dec. 3. The range in Declination at Greenwich was 51′. At the time of the storm there was only a smallish sunspot, of area 130 millionths of the sun's hemisphere, a little way past the central meridian. Spectroscopic observations, which greatly increase the range of detection and scrutiny of solar eruptions, were impossible owing to fog or overcast skies. The recent magnetic storm appears to be the largest since that of Mar. 11–13, 1929, though during 1930 a number of disturbances of somewhat lesser intensity have occurred.

Stellar Parallaxes.—*Scientia* for October contains an interesting paper by Prof. S. A. Mitchell, describing the remarkable advance that has been made in recent years in determining the distances of the stars. It is less than a century since Bessel found the distance of 61 Cygni ; it was not until the present century that the work was placed on a reliable basis, and the probable error of a parallax reduced to about one-hundredth of a second. Prof. Mitchell states that about three thousand accurate parallaxes have now been found ; his own observatory (the Leander McCormick) is the leader with a thousand parallaxes ; each of these rests on some fifteen plates, taken at about five seasons six months apart.

Reference is made to Prof. Schlesinger's measures with the Yerkes refractor twenty years ago ; since it was not a photographic telescope, yellow screens and isochromatic plates were necessary. The use of colour screens has the advantage of reducing the error arising from the different colours of the stars, which cause difference in refraction ; this difference is also reduced by taking all parallax plates near the meridian, and using only the parallax in right ascension. The systematic errors of the results of the leading American observatories were shown by Stromberg and van Maanen to be of the order of 0·003″, which is the angle subtended by one inch a thousand miles away. Other methods have been devised for estimating the distances of objects too remote to show any parallax : spectroscopic parallaxes, the relation between period and absolute magnitude for Cepheid variables. Eddington's relation between mass and absolute magnitude, and the strength of the lines in the spectrum that are due to interstellar calcium ; but all of these methods need a number of reliable parallaxes in order to calibrate the curves. Thus the spiral nebulæ are distant millions of light-years, but this estimate is ultimately based on the parallaxes of stars that are only distant about a hundred light years.

Comets.—*Beob. Zirk.*, No. 42, contains observations of comets 1925 II. (Schwassmann-Wachmann) and 1927 IV. (Stearns) made during September and October with the large reflector at Bergedorf, by Dr. W. Baade. Their magnitudes were 17 and 17·5 respectively. These were taken at an interval of $5\frac{1}{3}$ years after perihelion for the first comet, and $3\frac{1}{2}$ years for the second. It will be remembered that the orbit of 1925 II. lies entirely between those of Jupiter and Saturn, its period being about fifteen years. There appears to be a fair prospect of its being observable round the whole of its orbit, which would be a new cometary record. 1927 IV. is affording a record of another kind. It is now outside the orbit of Saturn, and has probably been observed at a greater distance from the sun than any previous comet. Halley's comet was lost soon after crossing the orbit of Jupiter.

Research Items.

Roman Britain.—An account by Dr. R. E. Mortimer Wheeler of the first season's excavations at St. Albans, which appears in *Discovery* for December, admirably summarises the chief points of interest. It was thought that Verulamium, which at one time was the nearest approach to a metropolitan city and the only town in Britain dignified with the title of *municipium*, might well supply evidence of exceptional importance in its bearing upon Romano-British culture and organisation. This has been confirmed already in a striking manner. The 'London Gate', for its size and what must have been imposing appearance, is compared by Dr. Wheeler to the great continental gateways or triumphal arches such as have been found at Arles and Autun. The defences of the city are also impressive, consisting of fosse, wall, and reinforcing bank totalling a width of some 165 ft., and even in one part running to 265 feet. Light is thrown upon economic conditions in the city and its possible relations with Germany by the excavation of a dwelling-house and another building, probably a shop. The house was rebuilt at least thrice during the Roman occupation, and its successive phases show the rise to prosperity and the subsequent decline of the town. Exploration outside the city wall has revealed a cemetery and a prehistoric earthwork. The purpose of the latter is not yet clear, but one of the alternatives suggested is that it may be the site of the settlement of Cassivelaunus, the most important centre of southern Britain in the first century A.D. These latter discoveries have added thirty acres to the area to be investigated, the site within the Roman walls being 200 acres.

The Wishram.—Although the Wishram were one of the tribes earliest met by European explorers of the Columbia River, and their trading establishment was of great importance in the development of the north-west of America, their culture is very little known. Only a few of the Wishram now survive, some on their original site on the Columbia River opposite the Dalles, others on the Yakima reservation in Washington. Information obtained by Dr. E. Sapir in 1905 and Mr. Leslie Spier in 1924 and 1925 from the survivors is embodied in "Wishram Ethnography", Vol. 3, No. 3, of the University of Washington Publications in Anthropology. The Wishram were the easternmost Chinookan tribe on the Columbia River, and their language an Upper Chinook dialect. Dislocation of the tribe began at the end of the eighteenth century as the result of tribal movement so early as, or even earlier than, 1750, which brought the Sahaptin into Washington State. The Wishram depended primarily on fishing for their livelihood, and their culture was entirely a river culture. Fishing was supplemented by seed and root gathering. Hunting the deer and other game took an entirely subsidiary place. They lived in villages on the northern side of the Columbia River, roughly from White Salmon River to Ten-Mile Rapids above the Dalles. Their houses were semi-subterranean lodges built over a circular pit, or mat lodges. The earth-lodge accommodated from one to half a dozen families. As elsewhere on the north-west coast of America, class feeling was strongly marked. There were three classes, besides slaves. The classes were based on wealth; but chiefs were not always among the wealthiest class. There were also war chiefs. The chiefs had considerable power and were implicitly obeyed. They adjudicated in murder cases, assessing fines or other punishment. In cases of murder by witchcraft through a shaman, the shaman was not held culpable, but only the man who employed him.

Tunnies.—Because of their economic importance as food fishes, allied with their peculiar habits, the tunnies have formed the subject of a vast literature, spread over a period of fully two thousand years. Active researches into their life-histories and abundance still continue, and recent workers have felt the need of a reasonably complete bibliography—a need which is now fully met by "A Bibliography of the Tunas", by Genevieve Corwin (*Fish Bulletin* No. 22, Contribution No. 87, from the California State Fisheries Laboratory, Terminal Island, California; 1930). The compiler has endeavoured to find and to catalogue all works written previous to the close of 1929 dealing in any way with the five large tunnies—*Thunnus thynnus*, *Neothunnus macropterus*, *Germo alalunga*, *Euthynnus pelamis*, and *Sarda chiliensis*. All the papers listed, with only a few exceptions, have actually been consulted, and after the title of each a brief note is appended indicating its main theme and general scope. These notes add greatly to the value of the bibliography. A list is given of all the abbreviations used for periodicals cited, and a classified index of subjects facilitates reference to any point upon which information may be desired regarding these fishes.

***Chirocentrus* and its Eggs.**—In *Treubia*, Vol. 12, 1, 1930, Dr. H. C. Delsman describes two fish eggs which, although easily distinguishable, give rise to closely similar larvæ ("Fish Eggs and Larvæ from the Java Sea"). Both belong to the genus *Chirocentrus*, the 'Parang-Para' of the natives. One of the larvæ is slightly longer than the other and has more myotomes. This interesting find is in accordance with the fact that Bleeker in 1852 distinguished two species, *C. dorab* and *C. hypsalosoma*, whilst other authorities found only one. Dr. J. F. Hardenberg, in another paper in the same number of this journal ("Some remarks on the Genus Chirocentrus (Cuv.)"), fully confirms the separation of the two fishes. Both are long and slender pelagic species, attaining the length of 90 cm. or more. *C. dorab* is the more slender of the two, with more vertebræ than *C. hypsalosoma*, larger scales, and other differences in the proportions of the various parts, the distribution being slightly different, although both species, old and young, and also the eggs, may be found together.

Antarctic Free-living Nematodes.—Dr. N. A. Cobb describes a large number of these worms, which are extremely abundant in the Antarctic marine waters, in a paper entitled "Marine Free-living Nemas" (Australasian Antarctic Expedition, 1911-14, under the leadership of Sir Douglas Mawson: Scientific Reports. Series C—Zoology and Botany. Vol. 6, Part 7, June 1930). They belong to twelve genera, collected from muddy sediment, three fathoms, Commonwealth Bay (Adelie Land), the larger forms from amongst the roots of brown algæ. A formula of measurements and signs is introduced in the systematic work, which conveys a large amount of information compressed into a very small space, and there is a key to the fifteen species involved. These Antarctic nematodes have several features in common. There is one new genus, *Hyptiolaimus*, created for the new species *cephalatus*, which may be related to *Oncholaimus*, and eight new species besides this. It is interesting to learn that one of these, *Monohystera naviculivora*, as its name implies, is a diatom feeder, especially eating *Navicula*. Sometimes the intestine is crowded with the frustules, many of which are as long as the width of the worm and half as wide as its head end; 150 diatoms have been seen in one individual.

The Walnut Tree in England.—Two papers in the *Journal* of the Royal Horticultural Society for September deal with this subject. Mr. H. Spence discusses the qualities of the timber and the cultivation of the walnut in France and California. He also comments upon the quality of the nuts obtained from the various isolated trees grown in Great Britain, so far as recent inquiries enable this to be gauged. Mr. A. W. Witt discusses the vegetative propagation of the tree under English conditions as ascertained by preliminary trial at East Malling. At present, grafting upon seedling stocks of *Juglans nigra*, or the common English walnut, seems to be most practicable, grafting under glass proving most successful. Stocks are also being raised vegetatively, the parent plant being planted in open, sandy ground, layered, and the buds covered with an inch of soil whilst still dormant. The young shoots thus etiolated afterwards root readily.

The Cultivation of *Pyrethrum*.—Of recent years knowledge has been gained as to the conditions necessary to observe if pyrethrum sprays are to be efficacious. Tutin has a paper upon its method of employment in the Annual Report of the Agricultural and Horticultural Research Station, Long Ashton, 1928, and there seems little doubt that this substance may prove a most valuable insecticide; at present it is one of many agents that are being tried out against the tsetse fly in Africa. An article upon its cultivation, in the *Bulletin of the Imperial Institute*, **28**, No, 3, 1930, is therefore very timely. Known for many centuries in Persia, the plant itself, and the powder ground from the flowers, were introduced into Europe early in the nineteenth century. In 1881, the Dalmatian species, *Chrysanthemum cinerariæfolium* Vis., was introduced into Japan, where its cultivation flourished apace, especially around Hokkaido, and 70 per cent of the world's yield is now claimed by Japan. This article, by the British Vice-Consul at Seoul, Japan, shows that the great development of this crop in Japan resulted from War conditions, when cultivation of the plant was almost suspended in Austria. A very good quality of flower is produced in Europe, and subsequent years may see a development of the European product again, especially if the insecticidal use of the product undergoes wide development.

Stratigraphical Position of the Coutchiching Series.—In the neighbourhood of Steep Rock Lake, Ontario, a series of schistose Pre-Cambrian sediments occurs, bordered on the north by Keewatin basic volcanics and on the south by intrusive granite. To the west these schists continue towards Rainy Lake, but to the east they gradually finger out and are lost in the granite. They have been alternatively correlated with the Coutchiching (below the Keewatin) and with the Seine (above the Keewatin). In the *Jour. Geol.*, p. 521, 1930, J. E. Hawley presents evidence to show that although the schists appear to dip beneath the Keewatin, the contact is one of nearly flat shear-faulting, in which case the stratigraphical evidence of relative age becomes ambiguous. From the larger structures it is thought probable that the disputed series is of post-Keewatin age. This does not, of course, imply that genuine Coutchiching schists may not exist in the Rainy Lake area.

Mineral Industry of Alaska.—The mineral industry of Alaska, if it has not been the mainstay of the country, has at least contributed largely to its economic development. Some thirty years of geological survey, fostered by the Federal Government of the United States, has produced results of inestimable value to the prospector, miner, and business executive, and abundant information relative to the origin, character, distribution, and extent of the various ore deposits is available. The total value of the mineral production in 1928 (*Bull.* 813-A, United States Geological Survey) was more than fourteen million dollars, furnished chiefly by gold and copper. There is also some silver, tin, lead, a little platinum, coal, and petroleum, while marble, gypsum, etc., are important. The gold is obtained from lode mines and placers in about equal quantities, the principal lodes occurring in the south-east. The Yukon Basin still figures as the prominent placer territory, though a considerable quantity of the metal comes from placers in the Seward Peninsula. Practically all the copper is derived from two mines in the Copper River region and from Latouche Island. The chief source of silver is the copper lodes, though it is also obtained from the gold lodes and placers. Lead is recovered as a by-product in the course of gold and silver mining. Platinum, together with palladium, osmium, and iridium, has been found sporadically in both lodes and placers. Tin has been mined from veins and mineralised rocks occurring in the Seward Peninsula, and the comparatively small tonnage finds its way to Singapore for reduction. The output of bituminous and anthracitic coals has increased, and in 1928 more than 126,000 tons were produced. Petroleum is mainly confined to the Katalla field. It is refined on the spot, and the products, gasoline and distillate, find a ready sale for the boats of the fishing fleets. This last industry has not apparently justified the optimism originally expressed or the vigorous search for fields in the past. Imports of oil from the United States supply most of the needs of the inhabitants.

Intensity of the Auroral Line.—It is possible, by the use of a special colour filter, to isolate effectively that part of the light from the night sky which extends for about 200 A. round the green oxygen auroral line $\lambda 5577$ and so to follow variations in its intensity. Lord Rayleigh, in the November number of the *Proceedings of the Royal Society*, has given an account of an attempt to make these relative measurements absolute, which has been accomplished by determining the absolute values of the numbers in his arbitrary scale of intensities, by reproducing them with the illumination from a standard incandescent lamp. Actually the light from the sky which was transmitted by the filter used consisted only in part of the auroral line, this being superposed upon a continuous background, the relative intensity of which is known to vary considerably. Taking the fraction of the light transmitted by the filter and due to $\lambda 5577$ to be 0·37, the brightness of this line in the sky was found to be approximately 3×10^{-5} candles per square metre. The energy required to maintain this is 6·4 ergs per second per square metre, and the number of atomic transitions required to supply this energy 2×10^{12} per second per square metre. These numbers are known to vary from time to time, and to be quite definitely rather approximate, but should be of much value in testing theories of the light emission from the upper atmosphere.

High Velocity Positive Ions.—Work is now in progress in several laboratories on the production and properties of particles of high speed, the aim of such experiments being to provide electrical sources to replace radio-active sources of α-particles and β-particles. A preliminary report on some work of this nature, which is being performed with positive ions in the Cavendish Laboratory, is given by J. D. Cockroft and E. T. S. Walton in the November number of the *Proceedings of the Royal Society*. The problem can be

divided into two parts, so far as the generation of the high-speed particles is concerned; first, the production of a stream of ions in a form suitable for acceleration, and secondly, the method of acceleration. The source of ions which has been used is a canal ray tube, the cathode of which is pierced with a narrow tube from which emerges a mixed beam of protons and molecular ions, and the acceleration of these has been brought about by a potential of 300 kilovolts produced by rectifying the output of a low-frequency step-up transformer. Many difficulties were, naturally, encountered in the course of the work on account of the high potentials involved. The electron tubes used to rectify the high potential had to be specially built, and were kept continually exhausted by a diffusion pump, the latter containing oil instead of mercury. The bulbs in which the ions were accelerated and the potential rectified were blown from a hard Jena 'molybdenum' glass, and, with their stems, were each approximately a metre in length, to minimise the chance of sparks passing externally through the air between the electrodes. It was found that the ion beam could be focused by suitable choice of the dimensions of the electrodes. Very little space is devoted in this paper to applications of the fast ions, but it is mentioned that a non-homogeneous radiation has been found to be produced when metals are bombarded by the stream of ions, the intensity of the radiation being approximately one ten-thousandth of that produced by a similar electron source at the same voltage.

Radiation Distribution of a Radio Antenna.—To the September number of the *Journal of the Institution of Electrical Engineers*, R. M. Wilmotte, of the National Physical Laboratory, contributes two papers on the radiation distribution which takes place from the antenna of a radio system. In the first paper, he obtains formulæ for this distribution from advanced theoretical considerations, and he shows how they can be applied in practice to the case of the beam antenna. He points out that even in complicated cases where we have an array of antennæ, it is possible to obtain solutions. In the second paper, he discusses experimental results on the radiation distribution in vertical planes from an antenna. The results were obtained by measuring in an aeroplane the strength of the received signals from an excited antenna on the ground. The position of the aeroplane was determined from the ground by means of a theodolite, and the signal strength was recorded on a cinematograph film. The results showed very definite maxima and minima, their positions being determined within a few degrees. But only rough values of the field strength could be obtained, as many experimental difficulties had to be overcome. In the case of low frequency, substantial agreement between theory and experiment was obtained. The radiation was also obtained for one of the beam stations of the Marconi Co. It was found that, owing to the sharpness of the beam, large discrepancies were sometimes observed. The average results obtained were, however, in good agreement with theory. It is concluded that the theory of radiation distribution is correct to a first approximation. The difficulties seem to be connected with the fact that in practice it is impossible to obtain a site which is theoretically perfect.

Hydrates of Hydrogen Fluoride.—In the October number of the *Journal of the American Chemical Society*, Cady and Hildebrand describe measurements of the freezing points of the system water + hydrogen fluoride, which indicate that, in addition to the solid hydrate $HF.H_2O$ previously known, the compounds $H_2O.2HF$ and $H_2O.4HF$ exist. The existence of two compounds with excess of hydrogen fluoride but none with excess of water indicates that hydrogen fluoride tends to assume a more complex polymerisation than water, and the formula $H_2O.4HF$ is in agreement with the existence of H_4F_4 as one polymer of HF. Berliner and Hann had suggested that this polymer exists, and had pointed out that hydrofluorides of amines have the general formula B.4HF. Other compounds such as $KF.3HF$ and $MgF_2.2HF$ may be regarded as derivatives of H_4F_4, and if water behaves in a manner similar to the amines, one compound formed should be $H_2O.4HF$.

Filter-cloth from Nitrocellulose.—In an article in the *Chemiker-Zeitung* for Nov. 8, Dr. Hans Gradl of Munich directs attention to the suitability of nitrocellulose as a material for the manufacture of filter-cloth. The resistance of various textile materials to the corrosive action of acids and alkalis appears to depend upon the amount of nitrogen which they contain, and numerous attempts have been made to increase this resistance by increasing the nitrogen content of the fibre. Thus, cotton cloth has been nitrated after it has been woven, but the best results so far have been obtained by using cloth woven from an artificial silk consisting of nitrocellulose, containing 12 per cent of nitrogen. This filtering material has given very satisfactory results during the last four years. It can be used to filter a 40 per cent solution of phosphoric acid at 90° C. without deterioration. It must be preserved damp, and the serious technical difficulties at first encountered in weaving it in this condition have been overcome. It can be cut into convenient shapes and sewn with nitrated thread.

New Inverted Metallurgical Microscope.—The Beck Inverted Microscope No. 30 is constructed on the same principles as the Beck-Hadfield microscope. By fitting a collimating lens in front of the vertical illuminator, it has been found possible to replace the long optical bench of the original microscope by a short fixed base, which makes the apparatus much more compact and robust. Apart from the camera, which has a variable extension of 10 in., all the major components are fixed. Just sufficient movement is allowed in the position of the source of light and in the illuminator to ensure that critical illumination may be easily obtained under all conditions. The simplicity of the new design, and the omission of the *macro*-photography equipment, have enabled the makers to reduce the price of the complete outfit from about £350 to £220. The whole apparatus has been designed to stand hard wear, and once it is set up it should need little attention. The microscope stage is remarkably rigid, and the coarse adjustment, which moves the stage, can be clamped in any position. The fine adjustment carries the objective only, and acts smoothly. The changing device for the objectives is positive in action, and very satisfactory. The thin glass illuminator can be replaced easily by a prism, though the makers recommend the use of the former type. The apparatus was tested with specimens of fine pearlite, the laminations of which were so close together that they could just be resolved with the $\frac{1}{12}$ inch oil-immersion lens. When the specimen was examined visually, using the thin glass illuminator, the resolution was found to be excellent. The illumination was even, and the image was satisfactorily free from glare. The definition at about 1500 diameters was good and the field reasonably flat. When the prism was substituted for the glass slip, however, the image was, of course, brighter but the illumination decidely less even. The illuminant was a 'pointolite' lamp which has only about one-fifth the intensity of a carbon arc.

Aspects of Carbohydrate Metabolism.

III. Some Relationships with Phosphorus Metabolism.

IT is now well known that esters of carbohydrate and phosphoric acid play an important part as intermediates in carbohydrate metabolism in both animals and plants. They were first obtained in the alcoholic fermentation of yeast; later they were found to play a part in the metabolism of muscle and other tissues. Phosphorus occurs in animal tissues in several other forms; for example, as ortho- and pyro-phosphate, as a constituent of nucleoproteins, and in combination with creatine in muscle. It is proposed in this review to discuss only certain aspects of the metabolism of phosphoric acid esters; the formation of hexose phosphate as a step in the production of lactic acid from starch by skeletal muscle has already been mentioned in a previous article (Nov. 8, p. 740). P. Eggleton has published a review on the rôle of phosphorus in muscular contraction, in which reference is made to the hexose phosphates (*Physiol. Reviews*, vol. 9, p. 432; 1929).

Resting muscles do not contain hexose diphosphoric acid; they can, however, glycolyse it and, in the presence of sodium fluoride and glycogen, synthesise it. The ester formed appears to be the same as that isolated by Harden and Young from yeast fermentations. W. T. J. Morgan has investigated its chemistry (*Biochem. Jour.*, vol. 21, p. 675; 1927; with R. Robison, *ibid.*, vol. 22, p. 1270; 1928). The first step was the formation of the methylhexoside-diphosphates, which were then separated into the α and β forms. The barium salts were hydrolysed with bone phosphatase (to which further reference will be made below), when the phosphoric acid was split off; further investigation, including estimations of the rotations before and after acid hydrolysis of the hexosides, and determinations of the methoxy group, indicated that the hexose present is fructose, probably γ-fructose. A tetramethyl hexose, having the same rotation as tetramethyl-γ-fructose, was also prepared; the constitution of the original acid is probably γ-fructose 1 : 6 diphosphoric acid.

J. Pryde and E. T. Waters have confirmed the presence of the diphosphate in muscle press juice after carrying out the fermentative re-synthesis; when this step was omitted, only a monophosphate was isolated, from the muscle of the rabbit, donkey, and goat, and this appears to be the ester of normal resting muscle (*Biochem. Jour.*, vol. 23, p. 573; 1929). The amount present in the muscles of the larger animals was less than in those of the rabbit, in which the yield was 0·13 per cent; it is possible that it is connected with the speed of contraction of the muscle. By oxidation of the hexose group with bromine and removal of the phosphoric acid by hydrolysis with weak sulphuric acid, a hexonic acid was obtained which was identified as gluconic acid. Ninety per cent of the hexose is an aldose, 10 per cent a ketose; from the formation of gluconic acid the former is presumably *d*-glucose.

The presence of phosphoric esters in different tissues suggests the presence of enzymes to synthesise and hydrolyse them; in fact, phosphatases are very generally distributed throughout the body, according to H. D. Kay (*Biochem. Jour.*, vol. 20, p. 791; 1926; vol. 22, pp. 855 and 1446; 1928). The enzymes can be extracted with chloroform water from the ground-up tissues, the extract being filtered through cotton-wool before use. They act upon hexose phosphates, glycerophosphates, and nucleotides; for quantitative estimation it is convenient to use sodium glycerophosphate in glycine-sodium hydroxide buffer at *p*H 8–9: the amount liberating 1 mgm. phosphorus in two hours at 38° may be called one unit. The enzyme is found in highest concentration in the mammal in the kidney and the mucous membrane of the small intestine: there is a close parallelism between its distribution and that of ereptase. Study of the reactions with the different substrates led to the conclusion that the same enzyme is responsible for the hydrolysis of each. In the case of the kidney, the enzyme is chiefly present in the cortex; there is more in the infant soon after birth than in the fœtus, and thereafter its concentration does not change much to adult life. It is capable of acting upon part of the phosphoric ester in the blood plasma. It has been suggested that its function is to hydrolyse this ester, which is then excreted as inorganic phosphate in the urine; but Kay, with R. T. Brain and P. G. Marshall (*ibid.*, vol. 22, p. 628; 1928), found that the excretion of phosphate was controlled by the level of the inorganic phosphate in the plasma, and not by that of the ester phosphorus. The low level of the latter in the plasma cannot be raised by administration of ester by mouth, though a temporary increase can be brought about by intravenous injection. On the other hand, the amount present in the kidney varies with its functional efficiency: thus it is markedly reduced in chronic nephritis in man and in acute uranium nephritis in rabbits (Brain and Kay: *ibid.*, vol. 21, p. 1104; 1927).

Both intestinal and kidney extracts show synthetic activity, provided high concentrations of the alcohol are used; sodium glycerophosphate was successfully isolated from the reaction mixture after allowing duodenal contents to act on sodium phosphate and glycerol for a week.

It may be mentioned that Kay has also found a pyrophosphatase in many mammalian tissues, with a distribution similar to that of the phosphatase described above; it hydrolyses pyrophosphate to orthophosphate. Its optimum *p*H is 7·2–7·8, in contrast to the range 8·8–9·3 of the orthophosphoric esterase.

The true phosphatase is of considerable interest; it can be conveniently extracted from young bones (rabbits) by soaking the split bone in chloroform water for some days, and filtering and evaporating the extract (M. Martland and R. Robison: *Biochem. Jour.*, vol. 23. p. 238; 1929). It can be purified by precipitation from water with alcohol and ether and extraction of the precipitate with 50 per cent alcohol; it cannot be dialysed or ultra-filtered, and is easily adsorbed. Its optimum *p*H is about 8·4; the initial rate of hydrolysis of glycerophosphate, however, increases up to *p*H 9·4, but at the same time inactivation of the enzyme is accelerated. It hydrolyses the phosphoric esters of the plasma. Small amounts of inorganic phosphate but not of glycerol retard the hydrolysis of glycerophosphate; in the presence of high concentrations of the alcohol it is capable of bringing about esterification of phosphate (Martland and Robison: *ibid.*, vol. 20, p. 847; 1926: vol. 21, p. 665; 1927).

H. B. Fell and Robison have investigated the phosphatase activity of embryonic avian femora, cultivated *in vitro* (*ibid.*, vol. 23, p. 767; 1929). They found that the tissue synthesised the enzyme during cultivation; the amount in the bone increased to a maximum and then declined, corresponding to the phases of histological differentiation followed by degeneration. The course of development was similar

to that occurring normally *in vivo*, but the degree of development attained was less. The enzyme is confined to bone and ossifying cartilage; it is absent from small-celled, non-hypertrophied cartilage. It presumably plays some part in calcification: it has been shown that it is capable of causing the deposition of calcium phosphate from calcium glycerophosphate in the complete absence of inorganic phosphate (for example, Robison, *ibid.*, vol. 20, p. 388; 1926).

T. H. Milroy examined the processes of fatigue and recovery in normal and diabetic muscle and found that fatigue was characterised by the entrance of water, the loss of some phosphate, depletion of the glycogen store, and increase in lactic acid, together with loss of the power of esterification of phosphate under the influence of sodium fluoride (*Quart. Jour. Exp. Physiol.*, vol. 17, p. 161; 1927). In recovery the reverse changes were observed; with muscle taken from a depancreatised cat, the recovery processes were much slower, especially the storage of glycogen and the ability to synthesise hexose phosphate.

D. Stiven has recently investigated in detail the part played by phosphoric esters in the formation of lactic acid from glycogen or starch, using a muscle extract: muscle from a cat perfused with Ringer's solution after killing instantaneously was extracted, after mincing, with cold sodium chloride and bicarbonate solution; the extract was obtained by pressing through muslin and concentrated by freezing out water; the *p*H was adjusted by adding phosphate and bicarbonate (*Biochem. Jour.*, vol. 22, pp. 867, 874, and 882; 1928: vol. 23, p. 583; 1929: vol. 24, pp. 169 and 172; 1930). Under anaerobic conditions, the extract produces lactic acid from glycogen, starch, or glucose, though at somewhat different rates. With glycogen as substrate, the changes in phosphoric esters were followed in detail and found to be of three types: in the first, there is no ester accumulation or change in phosphate until all the glycogen has been used up, when phosphate increases; in the second, no ester accumulates for the first 30–40 min. of incubation, but thereafter accumulation is rapid; in the third, ester accumulates at the commencement and is then broken down. The actual course depends in part on the concentration of glycogen and the extract used. In any event, there is no molar relationship between lactic acid production and phosphoric ester accumulation or breakdown.

Addition of hexose diphosphate under certain conditions inhibits lactic acid formation and increases the formation of phosphoric ester; at the same time the glycogen decreases more rapidly than when the addition is not made. Stiven has also found that a sterile cell-free muscle extract prepared from a cat or wild rabbit will convert glucose to lactic acid without the addition of any activator; the glycolysis occurred in the early stages of incubation and was certainly due to the muscle enzymes and not to any infection.

Although the rate and extent of lactic acid formation from glucose are usually greater than from glycogen, the ester accumulation is much greater in the case of the latter. Again, the rate of lactic acid production and ester accumulation is greater with glycogen than with soluble starch in the earlier stages of the reaction, although finally the lactic acid formation is the same with both. Irradiation of the muscle extract with ultra-violet rays from a quartz mercury vapour lamp for short periods increased the rate of lactic acid production from glycogen; at first ester accumulation increased, but later decreased, coincident with the maximum rate of formation of the acid; longer exposures destroyed the enzyme. These results differ in some respects from those obtained by previous observers, and further work will be necessary before the details of the chemical changes produced by muscle or muscle extracts upon carbohydrates are finally and completely elucidated.

The Psychology of Adolescence.

THE psychology of adolescence has not received from psychologists that attention which its popularity with novelists, poets, and painters would seem to merit. It is, therefore, a matter of interest that, at the Bristol meeting of the British Association, Section J (Psychology) devoted the whole of a morning's session to hearing and discussing four papers on this subject.

In his paper on "The Basis of Social Adjustment", Dr. R. G. Gordon maintained that the problems of adolescence were largely problems of adjustment to society, and that the success of such adjustment depended on the formation of a sentiment of a social self which should in large measure dominate the other sentiments in the personality. The organisation of this sentiment, he said, depended on certain emotional dispositions or instincts: suggestibility, passive sympathy, imitation, and the herd instinct—the last of these being of first importance. These, however, were not enough, for the mentally defective often exhibited them in no small degree and yet was almost totally ineducable: he showed no particular peculiarities in respect of the instinctive bases of social adjustment; he was, for example, no more suggestible than normal people. Nor was the tale completed by the sex instinct. "To describe social intercourse as a manifestation of sexuality", said Dr. Gordon, "is, to my mind, a mistake. What the sex instinct does is to give a tremendous impulse to extraversion: it directs the individual's interest away from himself." He made the interesting suggestion that differences in the strength of the herd instinct were largely responsible for differences between the introvert and the extravert. These emotional dispositions, he said, had to be controlled and organised, and the individual had to learn to discriminate between what met with social approval and what did not. This control, integration, and discrimination depended on the acquisition of knowledge, the organisation of beliefs, and the development of the power of making sound judgments. It was in these respects that the mentally defective was lacking. They were associated with the proper development of the cerebral cortex; so social adjustment had to be regarded as of gradual development and only coming to fruition with a full functional activity of the cortex.

Dr. Gordon made an interesting distinction between the control, integration, and discrimination implied in social adjustment and what is commonly called intelligence, and suggested that some intelligent people never developed the capacity for social adjustment, because they were lacking in the special cortical development necessary for the integration of their instincts and the formation of the social sentiments: they were aments in spite of their intelligence. Such people might compensate either by an intense integration of the ego-centric sentiment, as in the typical epileptic personality, or by failure to adjust to life, as in many psychasthenics and chronic hypochondriacs, who preferred illness to health, finding

that a convenient way of escape from social adaptation.

Prof. Olive Wheeler, in her paper on "Variations in the Emotional Development of Normal Adolescents", gave some account of the results of her own inquiries, in which she used the questionnaire method. The replies to her questions pointed to an increase of emotionality during the period of adolescence, which showed itself in three directions: first, an increased feeling of self, tending towards psychological independence and the finding of a vocation; second, a rise or intensification of sex emotions, tending towards the development of a hetero-sexual attitude and the finding of a mate; and third, the development of social, æsthetic, and religious emotions, tending towards the formulating of a point of view on society and on life in general. There were great variations in the time and rate of this emotional development, and equally great variations in the intensity of the new experiences; in some cases there appeared to be a great accession of energy along each of the three chief channels of experience and adjustment, an observation which supported Burt's hypothesis of a central emotional factor.

As regards emotional differences between the sexes, Prof. Wheeler thought that, apart from the earlier emotional maturity of the girl, the most striking difference between the sexes was to be found in a difference of emphasis on the active and passive groups of emotions: boys tended to be more aggressive; their misdemeanours were aggressive (pugnacity, acquisition), while those of girls were passive (lying, sex offences, and attempted suicides). This difference, it was suggested, might be partly responsible for the fact that highly intelligent girls and women found it more difficult to attain that eminence in professional, business, or cultural life justified by their intellectual ability: in boys there was a harmony between the egoistic and the sex emotions which resulted in activity, while in girls there was a perpetual liability to conflict between them, which tended to a passive resultant.

Concerning environmental influences, Dr. Wheeler expressed the opinion that emotional maturity was much more affected by training and circumstances, particularly by the home, than is any other phase of development. Many parents delayed the psychological weaning of their children, with serious consequences; they tended to keep their sons and daughters in emotional leading-strings and to allow them too little freedom of thought and action. The long preparation period necessary for entrance into the professions made difficult the harmonious development of some adolescents: biological maturity was attained before economic independence was reached. Hence the self-help movement, which largely arose through stress of economic circumstances and was beginning to be a feature of English (as of American and Scottish) university life, was psychologically sound: in their vacations, at any rate, students could get a taste of real work, responsibility, and economic independence. The difficulties were very much greater for the youth who was unemployed and sometimes found a mate before he found a vocation and had been trained by work to accept responsibilities and to consider the rights and needs of others.

The development of the young industrial worker of the continuation school was discussed by Miss M. Phillips in a paper entitled "The Adolescence of the Young Wage-earner". His social development, she said, was hampered by his limited environment. Repetitive work provided an even more restricted environment than did the school-room: it provided him with few opportunities of expressing his initiative. Most of these workers resigned themselves to the world as they saw it, and resorted to fantasy: some sought opportunities for development in personal relationships outside of the workshop: a few carried the unadventurous, spiritless attitude of the workshop into their personal relationships.

The fourth paper, by Miss A. H. M'Allister, on "Adolescent Modes of Thinking", gave an account of her own observations made with a method of studying adolescent thought, which seems very promising. She compared some 400 stories written by girls of 18 and women of 30 to be told to children, thinking that the writers would in the selection and treatment of their material reveal their own attitude of life; and her expectations were fully realised, for there were distinct differences between the stories of the younger women and those of the older, which can only be explained by their difference of outlook. Fairy stories were more popular with the adolescents and were treated somewhat differently: they depicted a beautiful, busy, but secret world, a place of feasting and dancing and all sorts of wild impossibilities; it was an expression of the adolescent's growing interest in the world, of her hopes, and realisation of her own independence: those of the older women were more sober by comparison. A curious feature of the adolescent stories, one which raises a problem for the psychoanalyst, was the comparative absence of 'fathers'; 'mothers' were plentiful, but 'father' was seldom introduced, and then usually to explain his absence.

Anthropology and Archæology in the "Encyclopædia Britannica".

AS a survey of natural and applied science the "Encyclopædia Britannica" is a record of stupendous achievement by the human intellect in probing Nature's secrets and in the reduction of material conditions to subservience to man's needs. When we turn to the sciences which deal specifically with man himself and his past, we enter upon a field of discovery in which the results, if less spectacualr, offer no lesser appeal to the imagination, and redound no less to the credit of those to whose genius and patient piecing together of the evidence they have been due.

In those branches of science which deal with the origin and development of man and the growth of civilisation, there is one name which dominates all others, one man whose influence and example, explicit or merely implied, permeate the whole and determine the attitude of the investigator towards his material. That man is Darwin. In his article on the evolution of man, Sir Arthur Keith, in paying a tribute to Sir Edward Tylor, the greatest of the early anthropologists, emphasises the effect of his acceptance of the evolutionary theory of human descent as a working hypothesis. He goes on to demonstrate that Darwin's views on the descent of man have withstood all attack, remaining the only sound guiding principle in interpreting the facts.

An earlier generation, apt to facile generalisation, found in the Darwinian theory a ready key to the solution of all its difficulties. Since then as the facts have accumulated they have been seen to conflict with the crudities of premature theorising, and this has led to a popular misconception that the Darwinian position has been discredited. Far from this being the case, as Sir Arthur Keith shows, for example, in his review of the evidence of embryology on the descent

of man, the facts on a subtler interpretation only serve to confirm it. The tree of human descent still flourishes, but instead of a single stem, it has put forth many branches, each a specialised adaptation to its environment. We may no longer believe that men are descended from monkeys, but rather that in the line of descent the anthropoids are early forms which branched off, and have had to pay the penalty of too early specialisation.

It must not be concluded that there are no gaps in our theories, that no difficulties remain to be solved. There are still divergences of view. For these we refer the reader to Sir Arthur Keith's article, in which he pilots a way through the evidence from the anthropoids, *Pithecanthropus erectus*, Piltdown, Neanderthal, Rhodesian man, and the rest. Unfortunately, Peking man came too late to fit into Sir Arthur Keith's chain of evidence. A mere reference to the articles on "Heredity" and "Eugenics" for the place of Darwin in other fields must suffice as we pass to the study of man in its wider aspects. Dr. Marett in his article on "Anthropology" largely attributes the foundation of anthropology in its modern sense to Darwin's revolution in the study of biology. Man and his customs and institutions, it is true, have been a subject of curiosity from time immemorial. Herodotus is the father of anthropology just as much as of history. The study of archæology goes back at least to the Renaissance, as is pointed out in the article "Archæology" by Dr. Hall. But when Darwin published his "Origin of Species", as Dr. Marett says, "the time was at length ripe for a world-wide, age-long survey of the human record". Hence Dr. Marett has taken human survival as the prime object of anthropological study. It was the Darwinian theory of the struggle for existence and the survival of the fittest which provided method, a unity of aim, and a consequent strictness of procedure in dealing with the enormous range and diversity of the material for such a survey, and it is in the light of their survival value that Dr. Marett deals with the study of race and culture, language, social institutions, religion, and morals. It may be noted that Dr. Marett eschews the practically convenient but theoretically unjustifiable arbitrary divorce between prehistoric man, the modern savage, and civilised man, All are equally subject to the same biological canon.

In accordance with the scheme of arrangement of the "Encyclopædia", Dr. Marett has dealt with general principles only. Subsidiary articles cover the question of racial characters, racial distribution, social institutions, and culture under continents or countries as circumstances dictate. Others deal with special subjects of inquiry such as exogamy, kinship, marriage, totemism, and the like. Dr. Harrison's article on "Material Culture" is of special interest at the moment in its bearing upon the question as to how far development in material culture is to be regarded as due to independent invention or to a diffusion from a given centre—a subject which he developed further in his recent address to the anthropological section of the British Association at Bristol.

Those who are prone to ask what is the practical outcome of research and to demand some ultimate utility from academic studies may refer to Prof. Seligman's "Anthropology, Applied", in which he deals with the bearing of anthropological studies on the problems of the administrator in dealing with primitive races in our dependencies, drawing instances from his experience in the field.

When we turn to the treatment of archæological studies in the "Encyclopædia", it is inevitable that attention should be directed in the first instance to the general article by the late Dr. H. R. Hall, whose untimely death we all deplore. In accordance with the general scheme for strengthening the appeal of the scientific articles to a wider public, Dr. Hall has opened with a brief history and methodology of his subject. Two points are immediately presented to the reader with no little force. First is the astonishingly rapid increase in our knowledge in recent years, particularly since the War; and second, the need now felt for technical training in the practical archæologist and the wide range of knowledge which that training must cover, not merely within the four corners of the subject, but also in a wide variety of subjects which impinge upon work in the museums, and still more in the field, and involve problems ranging from practical chemistry to engineering. Dr. Hall is in accord with the spirit of the "Encyclopædia", though he may, perhaps, have felt a little ill at ease in seeking a practical end for archæological studies which he justifies, were justification needed, as one of the 'things of the spirit'.

The final word on method rests with Mr. O. G. S. Crawford, who from the fund of his practical experience deals with archæological discovery from the aeroplane.

The general survey of the stone ages by Mr. M. C. Burkitt, the bronze age by Mr. H. J. E. Peake, and the iron age by Mr. Reginald Smith are synthetic rather than analytic. Even more than in their detail, their general trend marks the advance in archæological studies of recent years. It is of no little significance that the treatment of the larger problems of archæology tends to expand in range until, in the earlier phases at least, it is little short of world-wide. This would have been even more evident had publication been delayed by a little to include discussion of recent evidence from China, India, and Africa which holds out possibilities of world-wide correlations in prehistoric times based on climatological and meteorological argument. As it is, Prof. Seligman could barely touch on Mr. L. S. B. Leakey's discoveries in East Africa.

It is when reference is made to the departmental articles, mostly under geographical headings, that the increase in the sum of detailed knowledge becomes impressive. In this connexion Mesopotamia with its record of recent excavation must hold first place; but Egypt with Badari and the Faiyum, India with Mohenjo-daro and Harappa, China, and Palestine each contribute no less significantly if less sensationally to the archæological picture of the growth of civilisation in prehistoric times which gradually is being pieced together. By no means less important is the eastern European area, of which the prehistoric archæology is ably surveyed by Prof. Gordon Childe. Less attractive, perhaps, to any but the expert because of its difficulties, of which not the least is the language in which most of the original records of research are published, it assumes its proper perspective in Prof. Childe's hands in linking up the cultures of Central Europe, the Danubian area, and the eastern Mediterranean.

It would be impossible even to glance in passing at the many fascinating problems which now engage the attention of the archæologist and are here recorded —the Hittite empire and its ramifications, which the archæological and philological evidence carries, on one side to India, and, on the other, to the peoples of the Mediterranean; the cultures of the south-western United States, in which an archæological method and framework develop as evidence accumulates; and the great pre-Columbian civilisations of Central and South America. As a whole, archæology in the "Encyclopædia" is a record of great achievement reared upon a sound basis of carefully observed and recorded fact.

Fog and Mortality in the Meuse Valley.

FOR three days last week, Dec. 3–5, a heavy fog occurred in part of the Meuse valley, in the industrial area between Huy and Seraing, south-west of Liège, as a result of which sixty-four persons and a number of cattle are dead. An official medical commission which investigated the circumstances has reported that the deaths were due to fog alone; the victims were persons who, by reason of old age or ill health, were in a low state of health.

The Ministry of Health has been in communication with the health authorities in Belgium and is informed that the recent deaths in the province of Liège are not due to any communicable disease; the occurrence is clearly a matter of local conditions, but it may be some days before the cause is fully and authoritatively ascertained.

The fog formed part of a very extensive area of fog associated with an anticyclone that extended westwards from eastern Europe. Precise information as to the density of the fog in the afflicted area is wanting, but the accounts do not suggest that it was any greater than that of the worst London fogs, in which visibility is occasionally reduced to less than two yards. A number of upper air soundings made in Great Britain and on the Continent at this time showed that above a superficial layer of low temperature there was a rapid rise of temperature with height, the air above a height of 5000 ft. being about as warm as on an average day in August, when the annual maximum occurs at these levels. This state of affairs is, of course, very favourable for maintaining a fog, because of the extreme vertical stability that results. The atmospheric eddies that under ordinary conditions cause a constant interchange of air at different heights cannot be present, for any cold air from near the ground if raised to a higher level would have its deficit of temperature increased by dynamical cooling, and its increasing excess of density would introduce a powerful restoring force.

Fog, however, does not originate because of such conditions; it is generally caused by the cooling of the surface layers under a clear sky in the absence of strong wind. The evidence points to this having been the mode of origin of the fog area in Europe as a whole on this occasion. Apart from the fact that the general level of temperature was much higher than is usual in a December fog and that there was an unusually large 'inversion of temperature', the meteorological conditions appear to have been characteristic of the type of weather. If any poisonous fumes or solid particles are present in the surface layers of the atmosphere, they will remain there for so long as the state of exceptional stability lasts. The presence of some such fumes as the cause of the deaths near Liège seems a more reasonable supposition than the alternative one of suffocation through sheer density of fog, because the ordinary particles of fog, whether these are drops of water or minute particles of solid matter, or, as often happens in industrial areas, a mixture of the two, occupy only a minute proportion, by volume, of the atmosphere, and can scarcely be supposed to prevent a due amount of oxygen from being inhaled even by people with impaired lungs.

If these conclusions are correct, the cause of recent deaths in the Meuse valley will be found only by more thorough investigation into the manner of the victims' death. The possibility must also be taken into account that recent industrial developments may have resulted in the liberation of poisonous products on a scale that will become destructive whenever scavenging of the air by turbulence is reduced by exceptional temperature conditions aloft.

University and Educational Intelligence.

CAMBRIDGE.—The Council of the Senate has appointed the following Committee for the James Clerk Maxwell centenary celebration: The Vice-Chancellor; Sir J. J. Thomson; Mr. W. Spens, Master of Corpus Christi College; Sir Joseph Larmor, Sir Ernest Rutherford, Dr. C. D. Broad, Prof. H. F. Newall, Sir Arthur Eddington, Prof. C. T. R. Wilson, Prof. F. J. M. Stratton, Dr. J. Chadwick, Dr. J. D. Cockcroft, Sir James Jeans.

The Managers of the Balfour Fund, with the approval of the Faculty Board of Biology "A", have made a grant of £30 from the Balfour Fund to Miss P. M. Jenkin, of Newnham College, for research on "The Biology of the Smaller African Lakes".

H. G. Wager, of Emmanuel College, has been appointed to the Frank Smart University Studentship in botany.

SCHOLARSHIPS, each of the annual value of £300, plus an allowance for apparatus and other expenses, are being offered by the Grocers Company, the object being the encouragement of original research in sanitary science. Forms of application and particulars can be had from the Clerk to the Grocers Company, Grocers Hall, E.C.2.

A SERIES of twelve Swiney Lectures entitled "The Life of the Past" will be given by Dr. T. M. Finlay in the lecture theatre of the Imperial College of Science (Royal College of Science, Old Building) at 5.30 on Mondays, Wednesdays, and Fridays, on Dec. 8–19 and on Jan. 5–16. Admission is free.

UNIVERSITY entrance tests and initial degrees form the subject of a report recently adopted by the council of the Association of University Teachers and published in the October number of the Association's *Universities Review*. The report surveys the existing arrangements for matriculating students in the various universities and finds them unsatisfactory, in that, on one hand, they fail to exact from every entrant valid evidence of preparedness for university work, and on the other, they exert an unhealthy influence on schools in the direction of premature specialisation. It recommends the prescription of a minimum entrance age of about eighteen years; an efficient test in the use of English; a test, to be passed shortly before entry, in four subjects, not involving such a high degree of specialisation as the higher school certificate examinations; and a certificate by the candidate's school authorities as to his powers and interests and general fitness for university work. As regards the test in English, the report expresses approval of the general principles of recommendations embodied in an article by Miss Maitland Smith which appears in the same number of the *Review* under the title "Entrance Examination in the Understanding and Use of English". Although the suggested improvement of the efficiency of entrance tests might be expected to rehabilitate to some extent the depreciated pass degrees of the new universities, the report urges these bodies to retrieve the mistake they made in reserving 'honours' exclusively for success in highly specialised courses, with the result that every ambitious student, whether he really wishes and is fitted to press on to the frontier of knowledge in one particular direction or not, is driven to do so.

Historic Natural Events.

Dec. 14, 763. Cold Winter in Western Europe.—The winter of 763–4, the first concerning which details are extant, appears to have been very cold in western Europe. Winter began early in October, but the greatest cold continued from Dec. 14 until Mar. 16. It extended over the whole of Europe, from England to the Black Sea. The Bosphorus and neighbouring parts of the Black Sea were frozen; in several countries the snow was 30 ft. deep in places, and in Gaul the olives and figs died, the corn froze in the soil, and in 764 a terrible famine desolated a vast region and cost a multitude of lives. The Danube and other rivers were frozen, as was the sea for a long distance from the land. Holinshed records: "There fell such a marvellous great snow, and therewith so extreme a frost, as the like had not been heard of, continuing from the beginning of the winter almost till the midst of spring, with the rigour whereof trees and fruits withered away, and not only feathered fowls, but also beasts on the land and fishes in the sea died in great numbers." It is not mentioned in the Anglo-Saxon Chronicle, but an entry in 761 records: "This year was the severe winter", and there may be some confusion of dates.

Dec. 16, 1857. Neapolitan Earthquake.—This earthquake is notable as the first in which an attempt was made to estimate the depth of the focus. By numerous measurements of the inclination of fissures in buildings, etc., Mallet found that the depth was about 6½ miles.

Dec. 16, 1877. High Pressure over Siberia.—At Semipalatinsk in Siberia the barometer at 9 P.M. read 784·5 mm., equal to 1046 mb. or 30·886 in. The height of the station is not known exactly, but is estimated as 590 feet, and on this basis the pressure corrected to sea level is 1075 mb. (31·75 in.). This is the highest known pressure at sea level. At 7 A.M. on Dec. 17, a reading of 787·4 mm. (1050 mb. or 31·00 in.) was recorded at Barnaoul, a few degrees east of Semipalatinsk. The height of this station is 480 feet, and the pressure reduced to sea level, 1073 mb. (31·69 in.).

Dec. 16, 1920. Great Chinese Earthquake.—One of the greatest earthquakes known to us occurred in the provinces of Kansu and Shensi in north-west China. The area disturbed must have been more than three million square miles, the largest yet known. The number of persons killed, chiefly residents in caves in the river-banks, was estimated at 180,000.

Dec. 16-21, 1925. Tropical Cyclone in Pacific.—A violent cyclone visited the Union, Samoa, and Cook Islands. A cyclone wave swept over Atafu in the Union Islands, and great damage was done by the wind at Rarotonga (Cook Islands).

Dec. 17, 1664. Comet.—Under this date Pepys wrote: "Mighty talk there is of this Comet that is seen a' nights, and the King and Queene did sit up last night to see it, and did, it seems."

Dec. 18, 1896. Ball Lightning in Devon.—During a thunderstorm at Brixham, Devon, a globe of light appeared in a field, travelling from west to east, tearing up the ground. It reached a small house, broke a hole in the closed door, knocked a hole in the wall, and continued along a rope walk, where it killed one man and gravely injured another.

Dec. 19-22, 1929. Snowstorm in Texas.—Snow is rare in central Texas, but in this storm the depth of snow exceeded two feet in places and traffic was disorganised; at Hillsboro 26 inches fell in less than 48 hours. Two inches of snow fell even on the coast, where such a phenomenon is almost unprecedented. The pressure distribution on Dec. 18 showed a deep depression over the Gulf States, bringing in large quantities of moist air, while a cold wave was advancing from an intense anticyclone over Montana, associated with temperatures below 0° F. The snowstorm accompanied the progress of this cold wave, first southwards and then eastwards to the coast.

Dec. 20, 1564. Severe Winter in Europe.—The winter of 1564–65 was very severe over the whole of Europe. The cold began about Dec. 20, and Holinshed states that on New Year's Eve "people went over and alongst the Thames on the ise, from London Bridge to Westminster. On Jan. 3 at night, it began to thaw, and on the fifth there was no ise to be seene betweene London Bridge and Lambeth, which sudden thaw caused great floods, and high waters, that bare downe bridges and houses, and drowned manie people in England, especially in Yorkshire. Owes Bridge was borne awaie, with others." The Zuider Zee and all the great waters of western Europe were frozen; on the Continent the cold continued until Mar. 24.

Societies and Academies.

LONDON.

Physical Society, Oct. 17.—J. P. Andrews: (1) A simple approximate theory of the pressure between two bodies in contact. The approximation makes use of two principles: (*a*) The displacement at the centre of the circle of contact is twice that at its edge, and (*b*) for the purpose of calculating the stresses we may replace the two bodies by a single sphere of which the circle of contact is a diametral section, and write the strain at any point as the ratio of the displacement of that point to the length of the line drawn from the point to the sphere in the direction of displacement. When the elastic modulus by which this is multiplied is taken as that appropriate to a rod with sides fixed, the agreement with accurate theory is close. Principle (*a*) remains nearly true for elliptical areas of contact.—(2) Experiments on impact. For soft metallic bodies and impact of equal spheres, for small velocity of approach v, duration of contact varies inversely as $v^{1/5}$, while the coefficients of restitution e are unity for all speeds below a value characteristic of each material. Duration of contact has no effect upon the size of the permanent deformations. For variation of duration of contact t with mass of sphere at high speeds of approach, t varies as the square root of the mass, as theory predicts.—(3) Observations on percussion figures. Steel ball on glass blocks. Diameter of innermost circular or part-circular crack remains constant for one specimen of glass, and is independent of the maximum pressure exerted by the ball on the glass; diameter of outermost circular or part-circular crack varies with the maximum pressure in a manner which suggests that the crack tends to keep to the outer edge of the area of contact. No crack is formed until the pressure exceeds a value characteristic of the glass.

Geological Society, Nov. 5.—H. Williams and O. M. B. Bulman: The geology of the Dolwyddelan Syncline (North Wales). The syncline lies east of Snowdon and south of Capel Curig, extending along the Lledr Valley westwards from the village of Dolwyddelan. The rock-sequence is closely comparable with that determined by the senior author on Snowdon, and the pyroclastic rocks of Dolwyddelan are, in effect, the attenuated and ragged margin of the great Snowdonian volcanic mass. The central portion of the northern limb of the syncline has been

overturned, accomplished probably by a kind of 'underdrive', much of which took place prior to and during the impression of cleavage, but the final stages of which seem to have been part of a general post-cleavage movement. Large bodies of fresh augite-dolerite, well developed along the northern limb of the syncline, testify to the post-cleavage intrusion of basic magmas.—**L. R. Wager**: Jointing in the Great Scar Limestone of Craven, and its relation to the tectonics of the area. The Great Scar Limestone of Craven is traversed by two sets of nearly vertical joints, which are usually at right angles one to the other. Some 4 miles north-west of Grassington-in-Wharfedale, the lead-veins run parallel to one set of the joints, and were in fact deposited in widened joints. The joints and mineral veins are constant in direction over a considerable area; but as the North Craven Fault is approached, their direction is modified. These preliminary observations showed that the formation of the joints preceded the mineralisation, which is probably of Pre-Permian age, and suggested that the jointing and the Craven Faults may be related, since the modification in the direction of the joints is localised near the faults. In order to test this hypothesis, the joints have been examined over a wide area.

CAMBRIDGE.

Philosophical Society, Oct. 27.—**Sir A. S. Eddington**: On the masses of the electron, the proton, and the universe. The opposite cyclic behaviour of protons and electrons, expressed by symbols of the type $e^{i\theta}$, $e^{-i\theta}$, would involve reciprocal behaviour in the corresponding real transformations e^{θ}, $e^{-\theta}$. A theory of the masses is proposed, according to which the representation of a microscopic system with 136 cyclic momenta in a microscopic space-time with only 10 cyclic momenta increases the natural mass of the proton in the ratio $136 : \sqrt{10}$ and diminishes that of the electron in an equal ratio. The $\sqrt{10}$ is due to the 10 momenta occurring in a quadratic Hamiltonian, whereas the 136 occur in a linear Hamiltonian. This gives $M/m = 1849{\cdot}6$. A certain amount of check is provided by (1) the 'packing fraction', which corresponds to the increase from 136 to 137 cyclic momenta when the charges are in a perfectly rigid nucleus; (2) the 'original' mass of a charge being $\sqrt{Mm}$, the square of the ratio of electrical to gravitational energy ($5{\cdot}2 \times 10^{78}$) comes to be of nearly the same order as the number of particles in the universe ($1{\cdot}4 \times 10^{79}$) determined from the recession of the spiral nebulæ.

PARIS.

Academy of Sciences, Nov. 10.—**Emile Borel**: The extension of the properties of irreducible polynomials to integral functions.—**Georges Perrier**: The section of geodesy of the International Geodetic and Geophysical Union at the general meeting at Stockholm, Aug. 11-23, 1930.—**Georges Claude**: The utilisation of the thermal energy of the sea. Additional results obtained in the experiment at Matanzas.—**B. Berloty**: The localisation of the epicentres of earthquakes. From theoretical considerations, the parallel of articulation and deformation of a flattened ellipsoid such as the earth, is 35° 15′ 52″. Data extracted from nine years of the International Seismological Summary are discussed and the conclusion drawn that the parallel of deformation is only 16″ from that indicated by theory.—**Paul Delens**: Functions with complex variable and geometrical representations.—**Marcel Vasseur**: The deformation of congruences of normals.—**Georges Bouligand**: Applications of the idea of the contingent.—**Georges Durand**: A type of points of the envelopes of spheres.—**Nikola Obrechkoff**: The exponential summation of Borel.—**M. Lavrentieff**: A problem of maximum in conformal representation.—**F. E. Myard**: A generalisation of Cardan's joint.—**R. Mazet**: The stability of certain isolated vortices.—**Lyot**: The solar corona studied apart from eclipses. This work was carried out at the Observatory at the Pic du Midi, on account of the purity of the atmosphere at this elevation. The sun's image was formed on a metallic screen extending 30″ over the sun's border. Protected by this screen, observations could be made directly with the eyepiece. The prominences were visible without the assistance of the spectroscope and showed the same pink colour seen during eclipses. The polarisation of the corona was examined under these conditions. The polarisation found was not instrumental or of atmospheric origin: the results are given graphically.—**Ernest Esclangon**: Remarks on the preceding communication. The author considers that this marks a new stage in the study of the solar corona.—**H. Deslandres**: Remarks on M. Lyot's communication.—**Jean Becquerel, W. J. de Haas, and H. A. Kramers**: The law of paramagnetic rotation in xenotime and its experimental verification. Comparison of the experimental results obtained at absolute temperatures of 4·22° and 1·38° with those calculated from the modified formula given in an earlier paper.—**J. Cichocki**: The diffusion of the ions of salts in aluminium. The phenomena described by Peczalski for copper and iron are reproduced in the case of aluminium, except that no negative thermionic emission has been observed for the last-named metal.—**M. and Mme. Clément Duval**: The isomerism of radicals.—**Raymond Delaby and Mlle. Jeanne Hiron**: The generalisation of Skraup's reaction applied to α-alkylglycerols. A description of the preparation and properties of α-ethylquinoline, α-propylquinoline, and α-butylquinoline.—**Maurice Marie Janot**: Sclareol and its derivatives. The formula deduced from the analyses given is $C_{17}H_{30}O_2$. The physical properties and chemical reactions are given.—**Fernand Blanchet**: Some new or little known facts concerning the geology of the southern Briançonnais (Massif d'Escreins, Hautes-Alpes).—**A. Mailhe and Renaudie**: The transformation of propylene into liquid hydrocarbons. A study of the effect of silica gel at 650° C. on propylene.—**René Truchet**: A method of preparation of substituted acetylene hydrocarbons. The methyl esters of benzenesulphonic acid and of *p*-toluenesulphonic acid can replace methyl sulphate as a methylating agent in many cases. By the reaction

$$R.C \vdots C.Na + C_6H_5SO_3R' = R.C \vdots C.R' + C_6H_5SO_3Na$$

the author has prepared nonine, decine, and undecine.—**C. P. Nicolesco**: Discovery of the Senonian on the banks of the Seine between Gonfreville-l'Orcher and Bacqueville, to the east of Tancarville.—**André Ike Duninowski**: A new method for the optical estimation of atmospheric ozone. The usual method of measuring atmospheric ozone is based on the absorption in the ultra-violet, but Cabannes and Dufay, working on observations made at the Mount Wilson Observatory, have deduced the proportion of ozone from the atmospheric absorption in the visible region of the spectrum. The author has developed the latter method, using a linear thermoelement placed in a vacuum. The method has proved sufficiently sensitive to give accurate daily means, the accuracy being sufficient to give the thickness of the ozone to 0·2 mm. (at atmospheric pressure).—**Pierre Lesage**: The growth of *Lepidum sativum* cultivated at different latitudes in 1930.—**Robert Lami**: The liberation of iodine from the *ioduques* of *Bonnemaisonia asparagoides* under the action of the ultra-violet rays.—**Ph. Joyet-Lavergne**: The ratios between the intracellular

*r*H and the cytoplasmic sexualisation of the spores of horsetails.—St. Ionesco: The presence of tanoids in flowers.—Raymond-Hamet: The physiological action of aminomethyl-3 . 4-dioxyphenol carbinol.—Louis Rapkine: The chemical processes in the course of cell division.—Lespes, Regnier, and Rungs: Contribution to the study of the phases of the locust, *Schistocerca gregaria*.—Mlle. Simone Mouchet: The comparative morphology of the deferent canals of *Pagurus*.—Etienne Rabaud: The standing of *Argiope bruennichi* on its cobweb.—L. Lutz: The soluble ferments secreted by the Hymenomycetes fungi. The quinones and the antoxygen function.—M. Javillier and Mlle. L. Emerique: Biochemical researches on rubrene. Rubrene exerts no toxic action on rats, and does not replace vitamin A.—Constantino Gorini: Acidoproteolytic bacteria in pasteurised milk.—Maurice Piettre and Pierre Villedieu: The attenuation of the anthrax bacterium as a function of the nutrition.—E. Brumpt: The transmission of Marseilles exanthematic fever by the dog tic, *Rhipicephalus sanguineus*.—J. Verge: The second intradermomalleination in the glandered horse.

Official Publications Received.

BRITISH.

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin No. 2: Miscellaneous Information relating to Herbage Plants. Pp. 24. (Aberystwyth: Agricultural Buildings.)

Union of South Africa: Department of Agriculture. Sixteenth Report of the Director of Veterinary Services and Animal Industry, Onderstepoort, Pretoria. Pp. vi+592. (Pretoria: Government Printing and Stationery Office.) 10*s*.

Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1928–1929. Pp. 247. (London: Ministry of Agriculture and Fisheries.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1324 (E. 36): Experiments on the Ignition of Gases by Sudden Compression. By R. W. Fenning and F. T. Cotton. (I.C.E. 731 and A.) Pp. 43+18 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Notes from the Botanical School of Trinity College, Dublin. Vol. 4, No. 3, November. Pp. 81-144. (Dublin.)

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Seventh Conference held at New College, Oxford, September 19th-22nd, 1930. Pp. 116. (London.) 5*s*.

Report on the Agricultural Department, Grenada, for the Year 1929. Pp. ii+15. (Grenada, B.W.I.: Government Printing Office.) 6*d*.

Heriot-Watt College, Edinburgh. Calendar for Session 1930–1931. Pp. 302. (Edinburgh.)

Indian Journal of Physics, Vol. 5, Part 4, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 14, Part 4. Conducted by Sir C. V. Raman. Pp. 385-471. (Calcutta.) 1.4 rupees; 1*s*. 8*d*.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1929. Pp. iv+28. (Trinidad.) 6*d*.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 26: The Carboniferous Rocks of Hook Head, County Wexford. By Dr. Louis B. Smyth. Pp. 523-566+plates 15-20. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1200 (Ae. 361): On the Problem of Hydro-dynamic Stability. 1: Uniform Shearing Motion in a Viscous Fluid. By R. V. Southwell and Letitia Chitty. (T. 2754.) Pp. 54. 2*s*. 6*d*. net. No. 1247 (Ae. 401): Tail Flutter of a particular Aeroplane. By Dr. W. J. Duncan and A. R. Collar. (T. 2959.) Pp. 24. 1*s*. 3*d*. net. No. 1310: The Aeroplane as a Source of Sound. By Morris D. Hart. (N. 26.) Pp. 38+5 plates. 1*s*. 9*d*. net. No. 1322 (M. 68): Further Experiments on the Behaviour of Single Crystals of Zinc subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. (T. 2826.) Pp. 20+16 plates. 1*s*. 6*d*. net. No. 1323 (M. 69): The Behaviour of a Single Crystal of Antimony subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. (T. 2861.) Pp. 18+19 plates. 1*s*. 6*d*. net. No. 1333 (Ae. 465): A Simplified Analysis of the Stability of Aeroplanes. By W. L. Cowley and Sylvia W. Skan. (T. 2928.) Pp. 13. 9*d*. net. (London: H.M. Stationery Office.)

FOREIGN.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 169: First-Order Leveling in Alaska. By Howard S. Rappleye. Pp. 31. (Washington, D.C.: Government Printing Office.) 10 cents.

Field Museum of Natural History. Botany Leaflet No. 16: Fifty Common Plant Galls of the Chicago Area. By Carl F. Gronemann. Pp. 30. (Chicago.) 25 cents.

Bulletin of the Geological Institution of the University of Upsala. Founded by Hj. Sjögren. Vol. 21. Pp. iii+480+9 plates. (Upsala: Almquist and Wiksells Boktryckeri A.-B.)

Forty-fifth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1927–1928, with accompanying Papers: The Salishan Tribes of the Western Plateaus, by James A. Teit, edited by Franz Boas; Tattooing and Face and Body Painting of the Thompson Indians, British Columbia, by James A. Teit, edited by Franz Boas; The Ethnobotany of the Thompson Indians of British Columbia, by Elsie Viault Steedman; The Osage Tribe—Rite of the Wa-xo'-be, by Francis La Flesche. Pp. vii+857+29 plates. (Washington, D.C.: Government Printing Office.) 2.35 dollars.

Sudan Notes and Records. Vol. 13, 1930, Part 1. Pp. 148. (Khartoum.) 30 P.T.; 6*s*.

Japanese Journal of Botany. Transactions and Abstracts, Vol. 5, No. 2. Pp. iv+133-252+31-53. (Tokyo: National Research Council of Japan.)

Havsforskningsinstitutets Skrift. No. 58: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1927. Herausgegeben von Gunnar Grunquist. Pp. 48. 20 Fmk. No. 61: Über den Einfluss der Temperatur auf die p_H-Bestimmung des Meerwassers. Von Kurt Buch. Pp. 23. 20 Fmk. No. 62: Vedenkorkeusarvoja 1926 (Vattenståndsuppgifter 1926). Av S. E. Stenij. Referat: Wasserstandsangaben 1926. Pp. 50. 20 Fmk. No. 63: Havsforskningsinstitutets värksamhet år 1928. Redogorelse avgiven av Rolf Witting. Pp. 17. 10 Fmk. No. 64: Översikt av isarna vintern 1928–29. Av Gunnar Grunquist. Referat: Übersicht der Eisverhältnisse im Winter 1928–29 an den Küsten Finnlands. Pp. 48. 20 Fmk. No. 65: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres, Januar 1928–Juni 1929. Herausgegeben von Gunnar Grunquist. Pp. 60. 25 Fmk. No. 66: Croisière thalassologique et observations en bateaux routiers en 1928. Rédigé par S. E. Stenij. Pp. 36. 20 Fmk. No. 67: Vedenkorkeusarvoja 1927 (Vattenståndsuppgifter 1927). Av Henrik Renquist. Referat: Wasserstandsangaben 1927. Pp. 51. 20 Fmk. No. 68: Bathymetric Chart of the Bothnian Bay and the North Kvark—Echo Soundings in the Years 1927–1929. By Henrik Renquist. Pp. 28. 15 Fmk. No. 69: Zur Reduktion von Echolotungen. Von Gustav Elfving. Pp. 11. 10 Fmk. No. 70: Croisière thalassologique et observations en bateaux routiers en 1929. Redigé par Gunnar Grunquist. Pp. 36. 20 Fmk. No. 71: Översikt av isarna vintern 1929–30. Av Gunnar Grunquist. Referat: Übersicht der Eisverhältnisse im Winter 1929–30 an den Küsten Finnlands. Pp. 33. 20 Fmk. No. 72: Havsforskningsinstitutets värksamhet år 1929. Redogorelse avgiven av Rolf Witting. Pp. 15. 10 Fmk. (Helsinki.)

CATALOGUES.

A Rough List of Selected Works on Natural History, including Periodicals and Publications of the Learned Societies. Third Portion. (New Series, No. 23.) Pp. 109-152. (London: Wheldon and Wesley, Ltd.)

A Selection of Valuable Books. (Catalogue No. 31.) Pp. 100. (London: William H. Robinson, Ltd.)

A Catalogue of Books on British and Foreign Birds. Pp. 16. (London: Francis Edwards, Ltd.)

Choice Books: XVI-XVII Century, First Editions, Modern Presses. (No. 454.) Pp. 42. A Catalogue of Works on Political Economy. (No. 455.) Pp. 64. (Cambridge: Bowes and Bowes.)

Diary of Societies.

FRIDAY, DECEMBER 12.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department Lecture Room, Imperial College of Science and Technology), at 2.30.—The Purification of Waste Waters from Beet-Sugar Factories:—D. W. Cutler: Microbiological Aspects.—E. H. Richards: Biochemical Aspects.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—Major W. Gregson: Waste Heat Recovery from Internal Combustion Engines, with particular reference to Marine Oil Engines.

ILLUMINATING ENGINEERING SOCIETY (in Lecture Theatre of Holophane, Ltd., Elverton Street), at 4.30.—Dr. S. English: Glasses for Use with Invisible (Ultra-violet and Infra-red) Rays.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30—A. Wigglesworth: India's Commercial Fibres.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. A. Kreiken: (*a*) On the Relation of Colour and Spectral Type in the Different Galactic Latitudes; (*b*) On the Axial Rotation of the Stars; (*c*) Some further Remarks on the Rotation of the Stars.—Prof. H. N. Russell and R. S. Dugan: Apsidal Motion in Y Cygni and other Stars.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Central London Ophthalmic Hospital), at 5.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY (at Linnean Society), at 6.—Dr. B. Prashad: Further Notes on Indian *Ampullariidæ*.—L. G. Hertlein: Changes of Nomenclature of some Recent and Fossil *Pectinidæ*.—Dr. F. F. Laidlaw: On a suggested New Sub-Family, *Dyakiniinæ*, and a New Species.—Sir Joseph C. Verco and B. C. Cotton: The Spermatophore of *Sepioteuthis australis* Quoy & Gaimard.—R. Winckworth: Notes on Nomenclature. No. VII. *Helicella*.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—V. E. Pullin: X-Rays in Engineering Practice.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. J. Rees: Refractories for Boiler Furnaces.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—W. D. Oliphant: Laboratory Method as met with in Wireless Technique.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—J. M. Preston: Theories of Lustre.—W. F. A. Ermen: Notes on the Iodine Mercerisation Test.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Royal Institution, Liverpool), at 7.—A. W. C. Harrison: The Incorporation of Dry Pigments into the Medium.

INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 7.—A. C. Ansell and others: Discussion on Some Problems in the Design of Roof Truss Members.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Section of Institute of Chemistry) (at Thomas' Café, Swansea), at 7.30.—Dr. P. M. Davidson: The Structure of Molecules (Lecture).

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Henry George Lyons: Technical Museums and their Value to Engineers (Presidential Address).

INSTITUTE OF FUEL (East Midlands Section) (at Derby Technical College), at 7.30.—T. F. Hurley: Some Factors influencing the Design of a Combustion Chamber for Pulverised Fuel.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Queen's Hotel, Keighley), at 7.30.—A. Brier: Electrical Driving of Textile Machinery.

INSTITUTE OF METALS (Sheffield Section) (in Non-Ferrous Section of Applied Science Department, University, Sheffield), at 7.30.—R. H. D. Barklie and A. E. Nicol: Studies in the Electrodeposition of Silver. Throwing Power. The Behaviour of Silver Anodes, with special reference to Blackening and its Prevention.

INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers' Technical College, Bristol), at 7.30.—E. S. Andrews: A Comparative Study of Retaining Walls.

SATURDAY, DECEMBER 13.

BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at University College), at 2.30.—Prof. Heidbreeder: Thinking as an Instinct.—Dr. Stephenson: Application of the Theory of Two Factors to Non-verbal Tests.—Dr. Fortes: Perceptual Tests of 'G'.—Mr. Drake: Demonstration of some new Tests of Musical Ability.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—W. H. Connell: Some Recent Improvements in Surveying Instruments.—*Papers open for further discussion*:—Machine Mining in Faulted Ground, A. L. Ford; A Record of the Upper Carboniferous Non-Marine Lamellibranchs of Northumberland and Durham, and a Record of their Sequence, Dr. W. Hopkins.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persia and the Persians (2): Art and Literature.

MONDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London) (jointly with Students' Sections of Institution of Civil Engineers and Institution of Electrical Engineers), at 6.45.—W. H. Evans: Industrial Psychology.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Informal Discussion on Heating in the Home.

INSTITUTE OF FUEL (North-Western Section) (jointly with Institution of Electrical Engineers, Institution of Mechanical Engineers, and Association of Engineers) (at Engineers' Club, Manchester), at 7.—Major E. Ivor David: Private Generation of Electricity *versus* the Grid.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Group-Capt. the Hon. R. A. Cochrane: An Air Reconnaissance of the Hadhramaut.

TUESDAY, DECEMBER 16.

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

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—E. J. Loveridge and others: Informal Discussion on Commutator *versus* Slip-Ring Motors.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—G. Henderson: Modern Developments of the Metal-cylinder Mercury-Arc Rectifier.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—L. V. Chilton: The Efficiency of the Safelights for Darkroom Use.—Dr. S. O. Rawling and Dr. G. B. Harrison: A Simplified Method of Measurement of *p*H by means of a Triode Valve and Glass Electrode.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (jointly with Coke Oven Managers' Association, Northern Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. E. F. Armstrong: Coal as a Raw Material.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (at Cleveland Scientific and Technical Institution), at 7.30.—J. Lang: Metallography of some Engineering Materials.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Extraordinary General Meeting.—At 8.30.—A. Goodwin: The Stone Age in South Africa.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre).—Dr. J. J. Rudra and Prof. Miles Walker: The Theory and Performance of Phase Advancers.

WEDNESDAY, DECEMBER 17.

SOCIETY OF GLASS TECHNOLOGY (in Chemistry Theatre, University College), at 2.—Discussion on The Flow of Glass in Tank Furnaces:—B. P. Dudding: Preliminary Statement.—E. A. Coad-Pryor, A. L. Marden, and J. B. Murgatroyd: Reports on the Results of Some Experiments made at the Works of United Glass Bottle Manufacturers, Ltd., Osram G.E.C. Glass Works, and Rockware Glass Syndicate, Ltd.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. J. Glasspoole: Heavy Falls of Rain in Short Periods (two hours or less).—W. D. Flower: An Analysis of the Cold Front over Egypt on March 7th, 1929.—M. T. Spence: The Factors Affecting Visibility at Valencia Observatory.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. Harold Jeffreys: The Mechanics of Mountains.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—A. Titley: Cornish Mining: Notes from the Account Books of Richard Trevithick, Senior.

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—S. C. Akehurst: Observations on Pond Life, with Special Reference to the possible Causation of Swarming of Phytoplankton.—J. M. Preston: A New Top Light Illuminator.

INSTITUTION OF LOCOMOTIVE ENGINEERS (London Section) (at 296 Vauxhall Bridge Road), at 6.—H. I. Andrews: Possibilities of Condensing on Locomotives.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (a Engineering and Scientific Club, Wolverhampton), at 7.30.—H. C. Armitage: Machine Tools from the Manufacturing Users' Point of View.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (in Chemistry Theatre, Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. E. F. Armstrong: Coal as a Raw Material.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.

THURSDAY, DECEMBER 18.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—Prof. J. W. Gregory: The Copper Shale (Kupferschiefer) of Mansfeld.—G. Trestrail: (*a*) The Witherite Deposit of the Settlingstone Mines, Northumberland; (*b*) A Device for Controlling Mine Dams.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. J. J. Rudra and Prof. Miles Walker: The Theory and Performance of Phase Advancers.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—S. W. Melsom, A. N. Arman, and W. Bibby: Surge Investigations on Overhead Line and Cable Systems.

INSTITUTE OF RUBBER INDUSTRY (at Manchester Ltd., Manchester), at 7.—J. H. Carrington: The Use of Concentrated Latex in the Rubber Industry.

CHEMICAL SOCIETY, at 8.—R. Child and Prof. F. L. Pyman: 1-ω-halogenoalkylisoquinolines and their Derivatives.—E. Hope, Prof. F. L. Pyman, F. G. P. Remfry, and R. Robinson: A Synthesis of Hydrastine. Part I.

FRIDAY, DECEMBER 19.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (in Mining Institute, Newcastle-upon-Tyne), at 7.15.—E. L. Champness and others: Are we justified in using Steel and other Materials of Foreign Manufacture in the British Engineering Industries?

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics and Comparative Medicine Sections), at 8.30.—Major A. A. Pryer, Dr. R. W. A. Salmond, Lieut.-Col. E. Middleton Perry, Dr. J. B. King, and others: Discussion on A Comparison of Radiological Problems in Man and Animals.

PUBLIC LECTURES.

FRIDAY, DECEMBER 12.

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Institute of Hygiene, 28 Portland Place), at 5.30.—A. S. Comyns Carr: Education for Management, to be followed by a discussion.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—H. Ll. Bassett: Nitrogen in Nature and Industry.

SATURDAY, DECEMBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Bird Life in and around London.

MONDAY, DECEMBER 15.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—W. S. Vernon: Liquid Air.

WEDNESDAY, DECEMBER 17.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. E. L. Collis: The Prevention of Industrial Diseases.

BELFAST MUSEUM AND ART GALLERY, at 8.—E. J. McKean: Ulster Folk Lore.

FRIDAY, DECEMBER 19.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—J. Pryde: Human Engines.

CONFERENCE.

DECEMBER 19 AND 20.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Bedford College).

Friday, Dec. 19, 10 A.M. to 1.—Dr. M. C. Rayner: Observations on *Armillaria mellea* in Pure Culture with Certain Conifers.

J. G. Boswell: The Biochemistry of Dry Rot in Wood.

G. E. Blackman: The Effect of Nitrogen Compounds on the Botanical Composition of Grass.

Dr. W. H. Pearsall: Changes in the Constitution of *Beta* Leaves during Growth.

Dr. E. D. Adrian: The Activity of Isolated Nerves and Nerve Cells.

H. O. Bull: Conditioned Responses and Salmon Smolts.

2.15 to 4.—Dr. C. M. Yonge: The Relationship between Corals and Zooxanthellæ.

Dr. T. A. Stephenson: The Growth of Corals.

E. Hindle: Thermophilous Organisms.

W. H. Thorpe: Experiments on the Biology of the Petroleum Fly, *Psilopa petrolii*.

5.30 to 6.30.—E. Charles: Metabolic Changes associated with Pituitary Activity.

E. A. Spaul: Internal Secretions and Metamorphosis.

Saturday, Dec. 20, 10 A.M. to 1.—Symposium on the Permeability of Protoplasmic Membranes.

Prof. L. T. Hogben: Electrical Conductivity and the Permeability of Animal and Plant Tissues.

Prof. A. V. Hill: The Steady State across Biological Membranes.

A. D. Hobson: Changes in the Sea-Urchin Egg following Fertilisation.

R. J. Pumphrey: Electrical Potentials across the Membranes of the Trout Egg.

C. F. A. Pantin: Surface Permeability and the Evolution of the Blood Serum.