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CONTENTS.

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The International Research Council.

THE International Research Council, of which the fourth general assembly was held at Brussels in July, was formed in 1919, and the convention under which it carries on its work will terminate at the end of 1931 unless it has been previously renewed by the countries represented on the Council.

Designed to replace some of the international scientific associations that had lapsed during the War, its aims have been defined to be to co-ordinate international efforts in the different branches of science ; to initiate the formation of international scientific associations ; to direct international scientific activity in subjects not falling within the purview of any existing association ; and to enter into relation with the governments of the countries adhering to the Council in order to promote investigations falling within its competence.

The countries which joined the Council at its formation were fifteen in number, but since then many others have notified their adhesion to it, until at the present time thirty-five countries are represented on the Council and take part in its deliberations.

One of the first acts of the Council was to promote the formation of international associations, or Unions, for the furtherance of certain branches of science in which international co-operation is essential, with the result that the Unions of Astronomy, of Geodesy and Geophysics, of Pure and Applied Chemistry, of Mathematics, and of Radio-Telegraphy were formed in 1919. Later, in 1922, others dealing with Pure and Applied Physics, Biological Sciences, and Geography were organised, thus bringing the total number up to eight.

These Unions are practically autonomous, arranging their own meetings, appointing their own officers, collecting and dispensing their own funds, and initiating research and co-operative work in their own fields of scientific activity, very much as did the earlier associations the work of which they are carrying on.

During the past nine years, each of these Unions has held several meetings at which addresses have been delivered, scientific communications have been discussed, and arrangements have been made for future co-operation and research. The Astronomical Union, which has now been joined by 24 countries, has met at Rome, Cambridge, and Leyden ; the Geodetic and Geophysical Union, which has a membership of 32 countries, has held meetings at Rome, Madrid, and Prague ; the Chemical Union, representing 28 countries, has

hitherto met annually, and has visited Rome, Brussels, Lyons, Cambridge, Copenhagen, Bucarest, Warsaw, and the Hague. The Mathematical Union, to which 18 countries belong, has held meetings at Strasbourg and Toronto, and has just met at Bologna. The Union of Radio-Telegraphy, with a membership of 11 countries, has met at Brussels and at Washington. Of those which were formed later, the Physical Union has met at Paris and Brussels; the Geographical Union has met at Brussels, Cairo, and Cambridge; and the Biological Union at Brussels, Paris, and Geneva. The membership of these three Unions is now 18, 19, and 14 countries respectively.

Thus it will be seen that all these associations are now well supported, and are operating actively and effectively in the promotion of science and in the encouragement of international co-operation. In none of their work does the Research Council intervene. A reference to the published accounts of its meetings will show that most of the questions with which it has dealt are of an administrative rather than of a scientific character. They include invitations to join the organisation, the appointment of its officers and of committees, approval of statutes or of modifications to statutes which have been proposed by any of the Unions, and other matters affecting the Council and the Unions related to it as a whole. On occasions it has appointed committees to carry out special inquiries, such as the one which is studying the relations between solar and terrestrial phenomena, but generally the delegates, of whom it is composed and who are almost without exception delegates also to one Union or another, are called upon to decide questions of administration and not scientific matters. The conception of the Council as a small body which aims at exercising a control in scientific matters falls very wide of the mark, since it is one on which all the thirty-five countries are represented.

In 1926 the delegates of the countries adhering to the Council unanimously decided to invite Germany, Austria, Hungary, and Bulgaria to join the Council and the Unions related to it, and to give effect to this, invitations were sent out immediately after the meeting. At the meeting of the general assembly in July, it was reported that Hungary had accepted the invitation and had joined the Council, but that Bulgaria, for reasons of economy, was unable to do so at present. Germany and Austria had not yet replied. In Germany the matter is believed to be still under consideration by the five scientific academies of that country, namely, those of Berlin, Munich, Leipzig, Göttingen, and Heidelberg; the Academy of Sciences of Vienna is also affiliated to this group of academies. The situation no doubt presents some difficulties, but it is to be hoped that either by the formation of a Research Council for Germany on which the academies would have representation, or by some other means, a satisfactory solution may be found whereby German men of science may co-operate in the work of the Council and of the Unions.

At the meeting of the Astronomical Union, which was recently held at Leyden, German astronomers accepted an invitation to be present, and their co-operation in the discussions was most welcome. Similarly, German and Austrian chemists were invited to and attended the recent congress of the International Union of Pure and Applied Chemistry which was held at the Hague. On the other hand, a similar invitation which was extended to German geographers to attend the International Geographical Congress, which met at Cambridge in July, was declined by them on the ground that it was organised by the International Union of Geography, one of the Unions related to the International Research Council. Their objection to the Council was based on the ground that it was not wholly a scientific association, but was to some extent a political one, since a government may be the body holding membership. But this only occurs in a few cases where there is not at present a national academy to represent the country. As was stated by the general secretary in his report to the general assembly at the recent meeting of the Council at Brussels, out of the thirty-five countries which have joined the International Research Council, fourteen are represented by their scientific academies, six by national research councils composed of representatives of the national academies, one by a scientific society, and seven others by a scientific department connected with its government. In seven cases only out of the thirty-five is the government the adhering body.

The first twelve-year period of the convention under which the Council and the Unions have been working since 1919 is now drawing to its close, and the Council as well as each of the Unions have to consider the renewal of the convention before its expiration on Dec. 31, 1931. The experience of the past nine years has shown that some modification of the statutes, which were adopted in 1919, may be desirable; the Research Council and the Unions are, therefore, occupying themselves with the revision of them where necessary, in order that any changes that may be advisable may be adopted before the present convention expires.

This should provide a very favourable opportunity for clearing up any misunderstandings that may exist, and for an extension of international co-operation on lines that are acceptable generally. It seems unlikely that the right of governments to adhere to the Council and the Unions can be the sole obstacle to Germany's acceptance. The International Geodetic Association and the Seismological Association of former days were both supported by grants furnished by the governments of the States which were members of the associations; and so in this respect there has been little change. There may be other matters which are not acceptable, but it does not appear that up to the present any definite and authoritative statement of them has been made public.

As Sir Austen Chamberlain said at the dinner given by the British Government to the delegates to the International Geographical Congress at Cambridge, German statesmen had been welcomed to the Society of Nations as colleagues and as friends; they had contributed fully to the discussions, and he hoped that, before long, German men of science would accept the welcome which awaited them. If a solution of the present difficulties can be found, and they are enabled thereby to accept the invitation to join the Research Council, they will be able to take part in the discussions on the existing statutes and to assist in drafting such modifications in them as will make for the greater efficiency of the organisation as a whole.

Harrison of Ightham.

Harrison of Ightham: a Book about Benjamin Harrison, of Ightham, Kent, made up principally of Extracts from his Notebooks and Correspondence. Prepared for publication by Sir Edward R. Harrison. Pp. xvi + 395 + 12 plates. (London: Oxford University Press, 1928.) 15*s*. net.

IN writing to Benjamin Harrison, grocer, in the village of Ightham, Kent, in 1906, Sir E. Ray Lankester ended his letter thus: "Good health and happiness to you—courageous and indomitable discoverer of pre-Palæolithic man." Never were words of cheer more timely or better deserved. When this letter reached Harrison he was approaching his seventieth year; he had retired from the counter behind which he had stood for fifty-five years—or to state the matter more truthfully, the counter had retired from him, for the business in which his ancestors had prospered for many generations had become in his hands a rich museum but a poor shop. His only certain source of income then was his Civil List pension of £26 a year granted in 1899, with, in addition, the annuity of £25 given to him in the same year by the Royal Society. In 1918, being then in his eightieth year, his Civil List pension was doubled, and this he continued to enjoy until his death in 1921.

Harrison's activities cover a period in which our conception of human history underwent a revolutionary change. His career began in 1851, while as a schoolboy of thirteen he listened to his eldest brother Tom and his schoolmaster—Stephen Constable—discuss the geology of the Weald, until 1921—a period of seventy years. During this long period, scarcely a morning, an evening, or a Sunday passed without finding him searching his native district for evidence of its prehistory. His pursuits brought him into close contact with the leading geologists, archæologists, and naturalists of the time—Rupert Jones, Grant Allen, Lord Avebury, Sir John Evans, F. C. J. Spurrell, Worthington Smyth, Ray Lankester, Charles Dawson, Lewis Abbott, A. S. Kennard, W. J. Sollas, Smith Woodward, Reid Moir, Russel Wallace, and, above all, Sir Joseph Prestwich, who became his adviser, mentor, and protagonist. It was therefore important that the story of Benjamin Harrison's life should be well and fully told; this has now been done most ably by his son, Sir Edward R. Harrison.

It is quite true that a modern Samuel Smiles could have thrown the glamour of romance over the details of Benjamin Harrison's life, but it is not romance which the historian of science needs, but the sober statement of pertinent facts set out in an orderly and natural manner, and it is this which Sir Edward Harrison has done in the biography of his father. Nowhere does the biographer obtrude himself on the reader; he permits well-chosen extracts from his father's diaries and correspondence to tell the story of a man who was at once one of the most peculiar, yet one of the most outstanding of all the amateurs in science ever bred in England. No claims are made, no defence is set up, no situation is shunned; yet long before the last page is reached it becomes patent to the reader that the biographer is whole-heartedly in sympathy with all his father's labours and aims, and has measured with accuracy their bearing on the trend of scientific discovery. From the pages of this biography emerges the picture of a man, lacking confidence in himself and ever struggling to serve two mistresses—business with her promise of ease, and science with her threat of poverty. Science won every time.

With all the facts now before us, we see that the

chief events of Benjamin Harrison's life form a logical sequence. In a letter to Rupert Jones he wrote (1884): "When I tell you that I have secured 250 implements from this district, it will be seen what an interesting chunk of an old world I am fortunate enough to live near." Ightham did not 'make' Benjamin Harrison; it only gave him his opportunity. Thousands of men had lived in Ightham and saw it only as a village of the Weald, situated between the upper waters of the Darenth and of the Medway near the North Downs. For Harrison it became a page of history crowded with hieroglyphs of various dates. An inborn desire for knowledge came to him from his mother's family; he devoured in his boyhood Lyell's "Elements of Geology," Chambers's "Vestiges of Creation," Cassell's "Popular Educator," White's "Natural History of Selborne," and presently began to interpret his native village and surrounding district for himself.

Then in 1863, as a young man of twenty-five years, Harrison read of Boucher de Perthes' discoveries in the ancient gravel beds of the Somme valley, and at once set out to search the gravel deposits of his native valley. His search was speedily successful; he continued his search day after day and year after year, keeping records of his finds. Having exploited the lower gravels of neighbouring valleys, he moved his search to the higher and older gravels on the watersheds of the Weald, and was again successful. Then in 1878 he moved on to the dome of the North Downs to seek in its ancient gravels for what he called the 'pot hooks' of man's endeavours at implement making.

It was at this time that Harrison succeeded in making Sir Joseph Prestwich interested in his search. Although Prestwich then occupied the chair of geology in the University of Oxford, he lived at Shoreham, in the Darenth valley, eight miles from Ightham, and was deeply interested in the origin of gravel and other deposits which were found on the neighbouring Downs. As Harrison searched the gravel spreads of the Plateau, he found worn palæoliths, but he also observed implements of a ruder kind—flat flints with chipped edges—the type of implement to which Prestwich at a later date gave the name of *eoliths*. Prestwich disciplined Harrison; he would have nothing to do with surface finds; implements which were to be reckoned of historical value must be found *in situ*, and the deposit of gravel which contained them must be determined accurately as to level, distribution, and nature.

In 1882, Harrison commenced a systematic search of the Plateau gravels for eoliths; it was not until 1885 that he was convinced that they had been shaped and used by primitive man. He showed them to Sir John Evans, who gave them his consideration but rejected them. Sir Joseph Prestwich was then closely engaged on his "Text-book of Geology," and it was not until this was finished in 1888 that he found time to examine the results of Harrison's intensive search on the Plateau. On examining Harrison's collection, and after verifying all the sites of discovery, he became convinced that Harrison's contention was justified; eoliths were the work of man's hand, and that man had lived in England at an infinitely more remote date than had hitherto been supposed.

Prestwich soon realised that if ever Harrison's discoveries were to be made known to scientific men, he himself must act as Harrison's spokesman. Hence, early in 1889, Prestwich brought Harrison's implements to the notice of the Geological Society, and later, in 1891, he placed the discoveries on the plateau of the North Downs before the fellows of the Anthropological Institute. In this way the problem of eoliths was launched on the world of debate. Sir Joseph Prestwich fired the gun, but it was the diffident, modest, but indomitable grocer of Ightham who filled the cartridges.

Nature and Man.

(1) *A Naturalist at the Dinner Table.* By E. G. Boulenger. Pp. 160. (London: Gerald Duckworth and Co., Ltd., 1927.) 6*s*. net.

(2) *Animal Life of the Carlsbad Cavern.* By Vernon Bailey. (Monographs of the American Society of Mammalogists, No. 3.) Pp. xiii + 195 (38 plates). (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1928.) 13*s*. 6*d*. net.

(3) *Natural History of Canterbury: a Series of Articles on the Early History of the Province and on the History of Scientific Investigation, up till 1926, as well as on some Results of this Investigation.* R. Speight, Arnold Wall, and R. M. Laing, Honorary Editors. (Issued by the Philosophical Institute of Canterbury.) Pp. x + 299 + 29 plates. (Christchurch, N.Z.: Simpson and Williams, Ltd., 1927.) n.p.

(4) *Birds and Beasts of the Roman Zoo: some Observations of a Lover of Animals.* By Th. Knottnerus-Meyer. Translated by Bernard Miall. Pp. vii + 378 + 40 plates. (London: George Allen and Unwin, Ltd., n.d.) 16*s*. net.

NATURAL history continues to revive quite vigorously after its long sleep. A great many people are coming to see that human affairs

depend in an enormous number of ways upon the activity of plant and animal life, and that man is one member of a community of other species, which either threaten him or else are exploited by him.

(1) If one wished to express a solemn opinion (and most ecologists are rather solemn, at any rate about their own subject), one could call Mr. Boulenger's book a text-book on the ecology of human food-habits, the equivalent of Collinge's "Food of British Birds," or of Hardy's studies on the food of the herring in the North Sea. However, any comparison of this sort would obscure the fact that "A Naturalist at the Dinner Table" is written in an extremely amusing way, and is remarkable not only for its profound, and even disturbing, knowledge of the nature and origins of the different kinds of food that one can eat (though not necessarily digest), but also for its light touch.

On a bookshelf, it might sit between Huntington's "Civilization and Climate" on one hand and Prof. Saintsbury's "Notes from a Cellar Book" on the other. Perhaps it is the obvious fact that Mr. Boulenger has had a first-hand knowledge of so many of the things of which he writes that gives this book its freshness; perhaps it is also the restraint with which he makes scientific and historical facts amusing to the reader. You may be aware that ass's milk has medicinal qualities; or of the pull that is exerted by the suckers of an octopus; or that a load of Portuguese oysters was once wrecked off the mouth of the Garonne, and afterwards established a local colony there (one 'oyster park' now covering ten thousand acres). But if you know these commonplaces, you cannot at the same time also know who first started snail farms; or what Ahenobarbus said to Crassus in the Senate when Crassus wept publicly over the death of his favourite eel; or that Roquefort cheese is made from the milk of ewes, Gruyère from goats, and most other cheeses from cows; or that fat-tailed sheep were known to Aristotle, who referred to sheep with broad tails a cubit long.

(2) The second book is also about food, although one may not at first sight perceive this fact from its title and arrangement. The Carlsbad Cavern, a mammoth cave in the heart of the New Mexico desert, is inhabited by a vast colony of bats, which roost there at night in summer and hibernate there during the winter. The bats inadvertently covered the floor of the biggest cave with a layer of guano which was formerly about a hundred feet wide, a quarter of a mile long, and up to a hundred feet deep. The guano was removed after twenty years' hard work, and presumably made someone's fortune; but it soon began to accumulate again, at an estimated rate of about three-quarters of an inch per year. The guano supports a curious fauna, starting with cave-crickets, which are eaten by a cave species of deer-mouse (*Peromyscus*); while the mice are pursued and eaten by a kind of small carnivorous animal, the Ring-tailed Cave-cat (*Bassariscus astutus*). All these animals live in total darkness. There are other inhabitants of the cave, but they are mostly strays from the desert around.

The account of this cave fauna will be found in a rather scattered way throughout the book; for, in order to give a correct perspective, the author has devoted about three-quarters of the book to a description of the life-zones of the surrounding desert region, together with an account of all the species of mammals found there. The more important birds and reptiles are also mentioned. Most of these animals play no part at all in the ecology of the cave, and to this extent the title of the book is misleading. However, such a method of treatment is doubtless sound, and is certainly the best one for American readers, who may have an opportunity of actually visiting the region. For people who do not live in America, the chief interest of Mr. Bailey's book will centre round the cave and its animals, which form an extraordinarily interesting story (see pp. 69-70, 105-120, and 171-185).

(3) The example of the United States has now been followed by several other countries, which have started more or less systematic biological surveys. The third book, on the natural history of Canterbury, a region in the North Island of New Zealand, represents an effort to take stock of the present scientific knowledge of that region, in order that the results may be reviewed and future lines of research indicated. Since there are above twenty articles, by more than fifteen contributors, on a wide range of subjects, it is difficult to give here an adequate review of all the different lines of investigation. The subjects dealt with are as follows: biographies of men of science from the province; early history, exploration, and surveys; geology and palæontology; plant ecology and distribution; the fate of native and introduced animals (fish, birds, and agricultural stock); the history of zoological work; forestry; and agriculture.

Practically no attempt has been made to co-

ordinate these diverse paths of research; but this is perhaps not surprising, since scarcely anyone seems to attempt this anywhere. It follows that one cannot easily read this book without some special interest, such as a local knowledge of the place or the people concerned. All who are interested in New Zealand itself will find in these collected articles much to interest them; the general reader will scarcely find in it more than a very valuable work of reference on special points. On the biological side, which alone the reviewer is competent to assess, the parts of most general interest are the notes on native and introduced animals, and their interactions; and the notes on fossil birds by Mr. R. Speight.

(4) The recognition of the scientific importance of natural history often seems to pass through a series of cultural stages; first, private field naturalists with unprejudiced minds, working in isolation, secondly, natural history societies and zoological gardens, which start as a mixture of scientific interests and herd instincts, usually tinged with an educational bias. Stage three produces ecological surveys, run in different ways, according to the psychological habits of the country concerned. In the United States there are government surveys; in England, most of the work is done by private individuals or by professional workers co-operating with private naturalists. Stage four (seldom reached) is the eager co-operation of all people concerned, with the object of solving the urgent problems raised by variations in the numbers of injurious or beneficial animals. England has remained in stage two for about eighty years and is just graduating into three. It appears from Dr. Knottnerus-Meyer's book that Italy is just entering on the stage that we are leaving.

Books on zoos are usually of an extraordinarily sterile character, chiefly because they consist so largely of anecdotes about animals which, after all, are kept under very unnatural conditions. If we knew how they behaved in a wild state, we should have an interesting sort of controlled experiment; but as most of the inhabitants of zoos are there because they are hard to get, and still harder to study when they are wild, this advantage disappears. Another drawback to most books on zoos is the tendency to interpret the actions of animals in terms of human psychology. Dr. Knottnerus-Meyer, while avoiding the latter trap, cannot be wholly acquitted of the first charge, for a large part of the book consists of anecdotes of more or less interest. One might say that they hold the attention, but do not impinge on the intellect. At the same time, embedded in this lighter substance, there are a number of curious observations, which are difficult to fit into existing scientific theories, and therefore of value. For example, we learn that chloroform acts quickly on baboons, but has only a very small effect on lions and tigers; that camels always bite one another in the legs, and therefore kneel when fighting; and that "ostriches are seldom cordial in their relations to men"; and so on. Perhaps the most interesting part of the book is the short introduction, in which Dr. Knottnerus-Meyer states his views on the psychology of animals. One also gets the point of view of a trained Prussian towards the Italian behaviour to animals.

CHARLES ELTON.

Mining Stratified Deposits.

The Working of Coal and other Stratified Minerals. By H. F. Bulman. (Benn's Mining Series.) Pp. 338. (London: Ernest Benn, Ltd., 1927.) 42*s*. net.

IT is difficult to select any other vocation into which so many branches of science enter as mining. Some subjects which originally were thought to be parts of mining are now complete courses of study in themselves, and there are many subjects necessarily grouped together to form a complete training for a would-be mining engineer, including a part of each one of the subjects withdrawn. Formerly, it was the fashion for writers of text-books on mining to try to give a comprehensive view of the subject as a whole, but such has been the growth of knowledge and inquiry in this direction, that it is now impossible to give more than a very elementary view in a single volume.

This is borne out by a series of books recently published of which the volume under review is one, in addition to a vast number previously published and those in preparation; each of these new books specialises on a single branch, or, in some cases, on a further subdivision of the branch. The book by Mr. Bulman is on methods of mining, the subject which forms the heart of the work of the mining engineer, and around which all the other branch subjects used to be arranged in the old comprehensive text-books, but it should be noted that it professes to deal only with stratified deposits, as against veins and deposits of mineral having no particular shape, known as masses; and even then it only does so incompletely.

The book contains the greatest number of ex-

amples of methods of mining stratified mineral deposits of any book yet written, but it covers so wide a field that the author has had difficulty in selecting the matter to be included from the large amount at his disposal. It follows that because the matter is technical in a high degree, and may only be read by persons closely interested, that it might lead an author into leaving too much to be assumed by the reader, but this has been avoided; much detail is given, and the importance has obviously been recognised of adequate illustration by means of line drawings in at least three most important planes.

There is an introductory chapter, followed by discussion of the diverse conditions met in practice, and 'opening-out,' in the two succeeding chapters. The matter of shaft pillars is dealt with in Chapter iii., where it will be found that the opportunity has not been taken to use this as an introduction to the most important subject of earth movements induced by removal of mineral. This portion of the work would produce sufficient matter for the making of a book of fair dimensions alone, so that although some students and engineers may be disappointed at the omission of what appears to be almost essential matter in a work of this kind, it may be that the author had good reasons for the treatment given.

Chapter iv. deals with development, Chapter v. gives an account of the support of the roof by means of packing with debris obtained underground, or in some cases sent from the surface, and Chapter vi. describes the packing of the goaf by means of water-borne material sent down from the surface. The costs of operation are added to the account of hydraulic stowing, thus enhancing its instructive value. From this point up to Chapter xii., methods of mining coal as carried out in Britain are given, clearly dividing the first twelve chapters into two parts. Between these two sections it is difficult to understand for whom the work has been written. The opening chapters seem to promise something useful for the student, but the inclusion of hydraulic stowing early in the book suggests a desire on the part of the author to help seniors in practice; and at other points it would seem to have been designed for the layman or novice. There is a paragraph on 'Bumps' on p. 146 which requires revision at the earliest opportunity.

Chapter xiii. is on methods of mining in the United States of America, and it ought to serve as a reminder that, having the premier coal output for the world, in the United States there must exist a vast amount of literature on methods of mining, which would certainly prove interesting to students of mining in Britain. Over there the much greater use of machinery in the actual mining entails the need for intensity of production, which has to be obtained with labour a large percentage of which does not speak the language of the country, and hence cost of supervision, always at a maximum with mechanical production, must be very high compared with Britain. The success of a method of mining depends on many things, and the more intensive it is, the better must be the lay-out of the workings; therefore, this might be a point at which something useful could be learned; though, on the whole, it is well known to British mining engineers that comparisons of the methods of the two countries from the economical point of view are scarcely possible on account of the difference of general conditions.

The inclusion of mechanical loaders in a separate chapter seems rather out of place, unless it be read as a continuation of American methods, for which there is justification in that the use of conveyor loaders and mechanical shovels underground is due largely to American engineers. Regarded as coal getting by machinery, it would appear to be very incomplete. Chapter xv. is on 'getting' the coal, and this chapter also cuts into the subject of the application of machinery at the coal face, in such a way as to suggest that it would have been better to have discussed coal cutting by hand, and then to have followed with a full account of the application of machinery at the coal face. Obviously, a book on modern methods of mining cannot ignore the application of machinery, so that a full account of coal cutters, conveyors, loaders, and mechanical shovels becomes essential.

The next two chapters deal with continental methods of coal mining and coal mining in South Africa, and they are followed by a chapter on the methods of mining the gold-bearing beds of the Rand. Each of these chapters opens up new and interesting ground for the average British mining engineer or student, who would do well to regard them as introductions to new ground, and not as completely organised accounts of the methods in use in those countries. Methods of mining coal in India are to be found in Chapter xix., but obviously the author has been hampered by the small amount of matter published, giving what might be termed the extraordinary methods rather than the usual everyday methods adopted in seams of about fifteen feet or less in thickness. Coal mining in Australia, methods of mining ironstone, Scottish oil shale mining, miscellaneous examples from various places,

and finally a chapter on quarrying, bring the book to a close. The final chapters should also be regarded as introductions to new branches of mining.

The author has attempted a difficult task, for he deals with many countries, and it is probable that a book could be written on mining stratified deposits in each of the countries mentioned without exhausting the subject, as might be shown by reference to the transactions of the mining societies of these countries. It would be possible to be critical on the score of faulty organisation of the matter, though in the chapters on British methods of mining there is systematic treatment. The treatment of this section would have been much improved by the introduction of a preliminary classification of the methods. It is a pioneer work, and should bring a large amount of information within the reach of many who are unable to obtain access to the sources of information available to the author.

C. HABBERJAM.

Our Bookshelf.

The Student's Guide to the Libraries of London: with an Account of the most Important Archives and other Aids to Study. By Reginald Arthur Rye. Third edition, revised and enlarged. Pp. xxv + 581 + 61 plates. (London: University of London Press, Ltd., 1927.) 10*s*. net.

THE material for the first edition of this handbook was collected in 1907 at the time when the Senate of the University of London was occupied with the task of organising, co-ordinating, and developing the libraries under its control. Accurate information was needed of the great resources offered by the libraries of the metropolis, and the small book of 76 pages published in 1908 was the first attempt to collect this information into a single volume. The present, much enlarged edition may be taken as some indication of the usefulness of the work.

Although probably no instruments are more essential than libraries to the advancement of knowledge, it is doubtful whether London was well provided with these necessary adjuncts to learning even in the eighteenth century. Thomas Carte, the historian, writing in 1747, said: "I am sorry to observe on this occasion that there is scarce a great city where learning is at all regarded, which is so destitute of a good publick library as London." Boswell's dictum in 1780 that "in London I suppose we may find every book that can be found anywhere" has certainly never been true; and although London is now probably better provided with libraries than any other great centre, their resources are sadly wasted for want of organisation, by restriction of access, or through ignorance of their existence. Most of those responsible for the six hundred and sixty libraries that have been considered sufficiently interesting to be included in this volume are working independently by multifarious systems to fulfil their individual aims, and there is no doubt that a great deal of money is spent on unnecessary duplication that might be laid out in procuring books that are not available in Great Britain. There are, moreover, too many indifferent or inferior libraries.

The volume before us offers a summary of the situation. The very interesting historical introduction begins with an account of the remains of the ancient libraries of Assyria, Babylonia, and Egypt; it traces the vicissitudes of libraries through the ages, and includes an account of many former London libraries which have now disappeared. Then follows a detailed account of existing libraries and an extensive index, which contains, besides the names of libraries and collections, the sources of information under the titles of their respective subjects. S. C. B.

Buddhism in Pre-Christian Britain. By Donald A. Mackenzie. Pp. xx + 178 + 12 plates. (London and Glasgow: Blackie and Son, Ltd., 1928.) 10*s*. 6*d*. net.

WHATEVER may be the readers' verdict on Mr. Mackenzie's views, and we fear it will not be favourable, they will not be able to deny that he has written what is in many ways a fascinating and stimulating book. Starting from the records of Asoka's *Western* Buddhist Mission, of which the extent is questioned by authorities on Indian history, and Origen's attribution of a knowledge of Buddhism to Britain, which is equally held in doubt, Mr. Mackenzie analyses our knowledge of the pre-Christian Celtic beliefs and culture to show that they contain a large element which he attributes to Buddhism.

A great deal of the material on which Mr. Mackenzie relies for the details of his thesis is colourless in itself. It is drawn to a great extent from Irish sources. Perhaps nowhere in the world has native legend and belief been refashioned by extraneous ideas as it has in Ireland. This is shown, for example, by the frequent allusions in popular legend to distant lands by names which would come as a surprise when found among an uneducated people unacquainted with classical learning and tradition. Ireland was the land of learning as well as the land of saints, and further, the British Church was an Eastern Church, as was demonstrated in the opposition to the missionary efforts of St. Augustine. In Ireland, without question, some of the monkish learning filtered through to the people.

On the other hand, this much must be said in favour of Mr. Mackenzie's views—if once the major premise of the existence of Buddhism in Britain could be proved, his interpretation of extraneous matter of uncertain origin might be justified. His argument really depends upon two things, one that the Druidic theory of transmigration came from the east and was not really derivative from Pythagoras, and secondly from the representation of a horned god, whom he identifies as, and equates with,

Cernunnos, on the Gundestrup silver bowl, which he calls Celto-Buddhist. To this the critic might reply that the bowl is neither Celtic nor Buddhist, though on the face of it it appears to show Buddhist as well as other influences. Further, is this horned deity distinctively Celtic? His cult existed in remoter Germany, in Charlemagne's day, and goes back to palæolithic times. In dealing with the 'Isles of the Blest,' Mr. Mackenzie does not mention the persistent tradition of an early settlement of Irishmen in Middle America.

Elements of Optical Mineralogy: an Introduction to Microscopic Petrography. By N. H. Winchell and A. N. Winchell. Entirely rewritten and much enlarged by Prof. Alexander N. Winchell. Second edition. Part 2: *Descriptions of Minerals, with Special Reference to their Optic and Microscopic Characters.* Pp. xvi+424. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 27*s.* 6*d.* net.

THE descriptive part of Winchell's "Optical Mineralogy" has been completely rewritten and much enlarged to form the second edition. With the exception of a few of the commoner opaque minerals, there are included only natural species the optical properties of which are sufficiently well known to permit their identification microscopically. The arrangement of the minerals has been changed, and the system now adopted is the familiar scientific classification of Dana, modified to some extent by advancing knowledge. Certain of the names used are rendered unfamiliar by the adoption of the termination '-ite'; for example, chrysotilite for chrysotile. No difficulties arise through such changes, however, owing to an adequate index, which includes synonyms.

An excellent feature of the work is the large number of diagrams, 333 in number, used in explaining the optical and chemical properties of the minerals. The description of very many mineral species is accompanied by a simple diagram to illustrate their optical orientation. In addition, there are many more complex figures showing the variation in chemical composition, and the relation between chemical composition and optical properties in different mineral series. Most of the new information is expressed by means of these diagrams, and a useful introductory chapter is devoted to an explanation of their mode of construction and uses. A small number of rather poorly reproduced photomicrographs of thin slices of minerals is included. The treatment of the more important rock-forming minerals is very full, that of the felspars, for example, occupying 64 pages.

The comprehensive and up-to-date nature of the work is indicated by the many references to original sources of information. The European and American literature appropriate to the subject appears to have been very thoroughly, if not quite exhaustively, searched. No determinative tables are included, but the book can be recommended as a work of reference for advanced students and research workers in petrography and mineralogy.

V. A. E.

Steel and its Heat Treatment. By D. K. Bullens. Third edition, rewritten and reset. Pp. xii+564. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 25*s.* net.

THE third edition of this well-known treatise has been greatly improved, and it is now almost indispensable to the steel metallurgist, on account of the detailed records of the heat treatment and properties of a very wide range of industrial steels which it contains. The specifications under which the steels are grouped are mainly those of the American Society of Automotive Engineers, but it is not difficult to correlate them with the corresponding specifications used in Great Britain. English readers will find a greater obstacle in the fact that all stresses are expressed in pounds (instead of tons) per square inch and all temperatures on the Fahrenheit scale, and it could be wished that an English edition might be prepared in conformity with metallurgical practice in Britain. However, a table of equivalents can always be kept at hand when the book is consulted, which is likely to be frequently. A new chapter on electric furnaces for heat treatment is included, and will prove of special interest, as it is not generally known that such furnaces have come extensively into use in the United States, in spite of the increased cost of operation. This section, which is fully illustrated, is very valuable. The theoretical side of the subject receives much less attention than the practical, but the microscopic structure is fully discussed, the photographs being good and in some instances excellent. It may be remarked that the wonderful properties of zirconium steel, of which much was heard during the War, have proved to be mythical, and the paragraphs which the author quotes from two cautious investigators, proving a certain effect in removing impurities, represent the truth concerning this element much more closely than the exaggerated statements which have sometimes appeared.

Glasgow: Sketches by Various Authors. Edited by J. Graham Kerr. General Handbook of the British Association for the Advancement of Science, Glasgow Meeting, 1928. Pp. x+357+12 plates. (Glasgow: Local Committee of the British Association, 1928.)

THE handbook for this year's meeting of the British Association is a modest volume compared with that issued on the occasion of the last meeting at Glasgow twenty-seven years ago. It consists of a series of essays by various authors on different aspects of the city, among which education has considerable space. The chapters on the city and on the harbour have particular value in tracing the growth of Glasgow and its activities. There are essays on the geology, fauna, and flora, but no attempt is made to deal exhaustively with these subjects. The absence of the floristic and faunistic lists, which used to be a feature of British Association handbooks in the past, is welcome, but an introductory chapter from the geographical point of view might well have been added. Topographical and geological maps are given in a separate cover. These are on a scale of one inch to a mile.

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.*]

Negatively Modified Scattering.

IN a paper published in 1923, Einstein and Ehrenfest discussed the general problem of thermodynamical equilibrium in an assembly traversed by light, which is subjected to scattering by the particles of the assembly. They deduced, in a way (which is quite analogous to Einstein's famous deduction of the laws of black body radiation by consideration of thermodynamical equilibrium in the presence of Bohr-type of vibrators), that the excited particles of the system would give rise to a type of modified scattering analogous to Einstein's negative absorption. Smekal pointed out in a letter to *Naturwissenschaften* (1923) that if light of frequency ν is scattered by the particles of the assembly, then in addition to unmodified scattering of frequency ν, scattered light should also consist of light of frequency $\nu+\nu_k$, $\nu-\nu_k$, where $h\nu_k$ is the energy difference between the excited state and the normal state of the scattering particles ("Handbuch der Physik," Bd. 23, pp. 93-99).

This last prediction has been very brilliantly confirmed by Raman and Krishnan, who exposed liquid benzene to the monochromatic mercury radiation $\lambda 4358$, and on examining the spectrum of the scattered light found modified scattered light of frequencies $\nu+\nu_k$ where ν_k is any one of the fundamental frequencies of liquid benzene. We wish to point out that Raman and Krishman's experiment is not, strictly speaking, a confirmation of Einstein's negative or stimulated emission, as mentioned by these authors (NATURE, June 30, 1928), but of the analogous case of negatively modified scattering (that is, scattering of light of frequency $\nu+\nu_k$) discussed by Smekal.

We wish further to point out that the theory of modified scattering affords a very simple and convincing explanation of the phenomena of resonance spectra of vapours of sodium, potassium, and the halogens discovered and so elaborately described by R. W. Wood in his numerous papers. He found that when vapour of these substances is illuminated by monochromatic light (lithium, cadmium, bismuth, or zinc arc), then the vapour emits laterally a partially polarised spectrum consisting of the original line, and a number of fine lines spaced at equal frequency intervals (of about 145 in the case of Na). The position of these excited lines in the spectrum depends upon that of the exciting light, though the frequency interval between the exciting line and its adjacent excited light is independent of the exciting frequency for the same substance. The remarkable fact is that there are also a number of lines on the shorter wavelength side of the exciting light, which have been styled by the German authors (Pringsheim and his students) the 'anti-Stokes' ' lines. These anti-Stokes' lines also show equal spacing, and they can be explained as being due to negatively modified scattering.

Pringsheim and his students have shown that the sodium vapour contains temporary Na_2 molecules and gives rise to banded spectra on excitation. One of the strongest vibration frequency intervals is $\Delta\nu=145$, which may be identified with the frequency of one of the fundamental modes of vibration of the component atoms. So the explanation of Wood's resonance spectra becomes evident now. When the exciting light traverses Na_2 molecules, the light is scattered by them, the scattered light having the frequencies $\nu\pm\nu_k$ where $h\nu_k$ is the energy difference between any excited state and the normal state of the Na_2 molecule; the excitation not involving any electron displacement, but being due only to the vibration of the component atoms which are easily produced under moderate heating. The plus sign refers to the negatively modified scattered light and accounts for the anti-Stokes' lines. Similar explanations hold good for the resonance spectra of K_2 and the halogens. These substances alone have been shown to be capable of giving rise to resonance radiation, as the molecules can be easily excited to higher vibration frequencies. But it can presumably be proved to be a general phenomenon in the case of all molecules.

We wish further to point out that though the phenomenon has been described as one of 'scattering,' it seems to be intermediate between pure scattering (as by fog-particles in which the agent responsible for scattering does suffer no physical change) and pure absorption (as, for example, the absorption of the sodium line by the sodium atom, resulting in the utilisation of the total energy of the energy-particle in lifting the electron to the higher orbit and production of a new system). This phenomenon is just intermediate between the two, as the incident light reacts on the particle, and robs it of its internal energy and is re-emitted as a new radiation of increased frequency.

It seems that the polarisation of the secondary rays is probably only a time effect, depending upon the intimacy of the reactions taking place between the incident light and the scattering particle. Therefore in pure scattering, the scattered light should be completely polarised in pure absorption and in re-emission unpolarised; and in phenomena intermediate between these two it should be partially polarised, as has been proved by Wood.

The phenomena of negative scattering should also be capable of extension to free electrons, and will thus probably afford an easy explanation of the origin of bright and broad bands in the spectra of Novæ, and of winged lines in the solar spectrum.

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The Scattering of Light by Free Electrons according to Dirac's New Relativistic Dynamics.

DIRAC and Gordon have given a quantum-dynamical treatment of the problem of the scattering of light by free electrons which seems to be in good agreement with experimental results. Since the development due to Dirac of a more rational relativistic dynamics of the electron, which automatically takes the so-called 'spin' phenomena into account, the basis of the theory of the intensity and polarisation of the Compton scattering is, however, somewhat modified. We have undertaken a calculation, based on the new theory, of the intensity of the light scattered by an electron under the influence of a plane monochromatic wave train. When the incident radiation is unpolarised—a case where the least deviation from the former theory would be expected—our result can be expressed by the following formula:

$$I=I_0\,\frac{e^4}{2m^2c^4r^2}\,\frac{(1+\cos^2\theta)}{\left\{1+\frac{h\nu}{mc^2}(1-\cos\theta)\right\}^3}\cdot\left(1+\left(\frac{h\nu}{mc^2}\right)^2\frac{(1-\cos\theta)^2}{(1+\cos^2\theta)\left(1+\frac{h\nu}{mc^2}(1-\cos\theta)\right)}\right) \quad (1)$$

Here I is the intensity at the distance r from the electron of the light due to a Compton process, where the secondary light quantum is emitted in a direction forming an angle θ with the incident beam of intensity I_0 and frequency ν. Further, e and m denote charge and mass of the electron, c the velocity of light, and h the Planck constant.

Formula (1) is seen to differ from the corresponding formula of the earlier theory by the last factor $\left(1+\left(\frac{h\nu}{mc^2}\right)^2 \frac{(1-\cos\theta)^2}{(1+\cos^2\theta)\left(1+\frac{h\nu}{mc^2}(1-\cos\theta)\right)}\right)$, *i.e.* the deviations between the two formulæ are of the order $\left(\frac{h\nu}{mc^2}\right)^2$, while the earlier expression differs from the classical expression given by J. J. Thomson by quantities of the order $h\nu/mc^2$. In the case $\frac{h\nu}{mc^2}=1{\cdot}1$, corresponding to a wave-length of 0·022 A., where

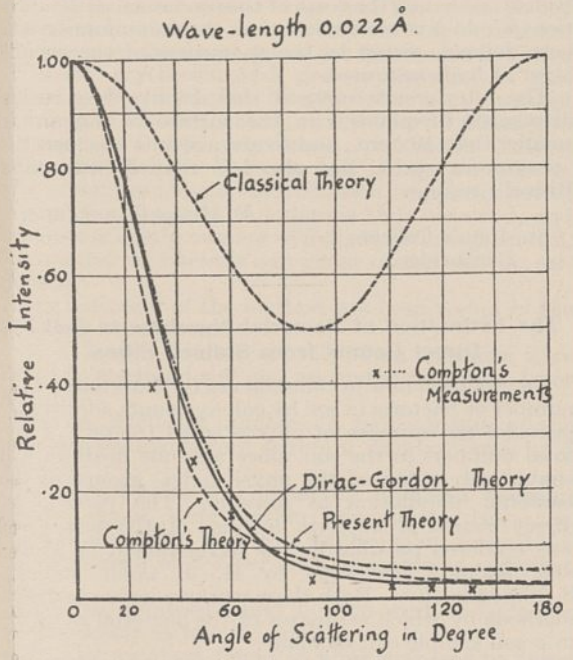

FIG. 1.

Dirac has compared his formula with the measurements of Compton, however, the deviations at the larger angles are not small—though perhaps within the experimental uncertainty—as shown by the above reproduction of Dirac's figure, where the —·—· curve corresponds to formula (1). The maximum deviation, which occurs near 125°, amounts to 82·5 per cent of the value obtained from the Dirac-Gordon formula.

From formula (1) we get the following expression for the scattering coefficient s, due to Compton effect, of a substance containing N electrons per unit volume:

$$s=\frac{2\pi Ne^4}{m^2c^4}\left\{\frac{1+\alpha}{\alpha^2}\left[\frac{2(1+\alpha)}{1+2\alpha}-\frac{1}{\alpha}\log(1+2\alpha)\right]+\frac{1}{2\alpha}\log(1+2\alpha)-\frac{1+3\alpha}{(1+2\alpha)^2}\right\}, \quad (2)$$

where $\alpha=h\nu/mc^2$. Here the last two terms $\frac{1}{2\alpha}\log(1+2\alpha)-\frac{1+3\alpha}{(1+2\alpha)^2}$ are absent from the corresponding expression given by Dirac. They mean again a deviation from the earlier theory of the order $(h\nu/mc^2)^2$. In fact, formula (2) for values of α small compared to unity gives

$$s=\frac{8\pi}{3}\frac{Ne^4}{m^2c^4}\left(1-2\alpha+\frac{26}{5}\alpha^2\right), \quad . \quad . \quad (3)$$

while Dirac's expression with the same degree of approximation gives

$$s=\frac{8\pi}{3}\frac{Ne^4}{m^2c^4}\left(1-2\alpha+\frac{21}{5}\alpha^2\right). \quad . \quad . \quad (4)$$

For $\alpha=1$ the deviation between the two theories is considerable, formula (2) giving a value about 50 per cent higher than that of Dirac. But for α small compared to unity they are seen to deviate very little from one another; already for $\alpha=\frac{1}{2}$ the deviation is only about 10 per cent.

A detailed account of the calculations also including the question of polarisation is under preparation.

Note added in Proof.—Since the above was written, we have considered the question of the comparison of the theory with the experiments more closely. Indeed, from recent experiments, it would appear that ascribing a wave-length 0·022 A. to the γ-rays from RaC, with which Compton's experiments were made, is scarcely justifiable for this purpose; the radiation in question being very complex with an average wave-length of only about half the above value. If this complexity is taken into account, the comparison of Compton's measurements with the theoretical formulæ comes out very differently; and formula (1) is found to agree with the measurements rather better than that of Dirac and Gordon. The experiments, however, seem too uncertain to decide between the two formulæ. In this connexion we should like to direct attention to the possible bearing of our calculations on the estimation of the wave-lengths of the cosmic penetrating radiation. In fact, if formula (2) is used for the calculation of the absorption coefficient, the wave-lengths obtained for the cosmic rays are considerably shorter than those ordinarily assumed.

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The Definition of 'Area' in the Case of Contact Catalysts.

As has already been pointed out (*Proc. Roy. Soc.*, A, vol. 119, p. 196; 1928), the area of an activated contact catalyst will vary with the method of measurement adopted. It is thus essential to the precise development of the methods of measuring area that the maximum area of a surface should be defined carefully, so that the results of all measurements may ultimately be compared with this standard.

The surface itself consists of atoms or molecules, continually in vibrational motion, having mean positions which are fixed. A minute investigation summing the area over each surface atom is valueless. For the purposes of physical chemistry the area of the envelope touching all atoms in the surface might be thought a good definition; but chemical reactions on contact catalysts mostly take place in a unimolecular film of absorbed gas molecules distributed over the surface; so that a knowledge of area is most valuable for the calculation of the maximum number of molecules of any given type that could be closely

packed in a unimolecular film over the rugged activated surface.

Since the smaller the adsorbed atom or molecule the more likely it is to fit into the smallest irregularities, a surface will appear to have its maximum area when covered by hydrogen atoms all in contact with each other, and with the catalyst surface. This conclusion is reached upon geometrical grounds simply. The maximum area of a contact catalyst for physical chemical purposes is the area of the envelope of the unimolecular film of hydrogen atoms closely packed, all in contact with each other, and with the catalyst surface, which completely cover it.

If the adsorbed molecules are large, then the area of a very irregular surface measured by the number of adsorbed molecules will appear to decrease, but the area of a plane surface will remain unchanged. There seems to be little meaning to be attached to the term 'true' surface, for each of various methods of measurement will give a correct result, but these results will be all different. At the present time it seems best to define the 'maximum' area of a surface as the envelope of hydrogen atoms covering it completely with a unimolecular film, because this gives as near as possible an absolute definition.

The measurement of this maximum value is a matter of great difficulty. One is faced with the heterogeneity of the adsorbing surface. The values obtained for the surface area of reduced copper by the interference method (cf. *Proc. Roy. Soc.*, A, vol. 115, p. 570; vol. 117, p. 376; vol. 119, p. 196), and from the quantity of hydrogen adsorbed at saturation at 0° C. are very nearly the same, in spite of the fact that the thickness of the film covering the copper is 10^{-5} cm. in one case and 10^{-8} cm. in the other. This confirms what is evident from the investigations of Pease, that portions of the surface do not adsorb hydrogen at all at 0° C. Thus the adsorption of hydrogen in this case gives no measure of the maximum area.

I have remarked that it seemed possible that an electrolytic method of deposition of hydrogen from solution might be used to measure this 'maximum' area of a catalyst; but that there was difficulty in obtaining experimental evidence of the completeness and unimolecular character of a film of hydrogen deposited by this means (*Proc. Roy. Soc.*, A, vol. 119, p. 197; 1928). This remark has been assumed by Bowden and Rideal to refer to their method (cf. *Proc. Roy. Soc.*, A, vol. 120, p. 89, Aug. 1928); but this is evidently not the case, since they state that they are measuring the 'accessible' area of the surface to hydrogen ions which cover only a fraction of the 'maximum' surface. With considerable experimental and technical skill, using an Einthoven string galvanometer with a camera, they have followed the changes of potential of platinum, silver, and mercury in $N/5$ sulphuric acid against saturated calomel electrodes, when very small quantities of electricity were passed. They found that the relation between the quantity $\Delta\Gamma$ of the deposited hydrogen and the increase in electrode potential E was

$$-\frac{\Delta E}{\Delta\Gamma}=K$$

for liquid mercury, where K was independent of the area of the cathode, current density, time of electrolysis, and strength of solution. With platinised mercury, and silver amalgam, they found K suffered little change, and generalised that if the surface were plane, K was independent of the chemical nature of the underlying metal. With etched or polished metals a considerable decrease in the factor K occurred. They then state that if A is the factor by which the plane area must be multiplied to give the irregular area accessible to hydrogen ions, the new relation applying to this case is (loc. cit. p. 72)

$$-E=\frac{K\Gamma}{A}+\text{const.}$$

or

$$-E=\beta\Gamma+\text{constant},$$

where $\beta=K/A$ and is a constant, and is the same for all metals, and Γ is called by Rideal and Bowden the 'true' surface concentration of the added hydrogen.

The direct assumption is thus made that the quantity β is independent of both (*a*) the chemical nature, and (*b*) the physical state of the minute structure of the surface. The latter assumption, which is fundamental, is very difficult of experimental proof, and is contained in all calculations of area by this method. The method is therefore empirical. The standard value of $\beta=\frac{K}{A}$ was obtained from a mercury surface, assuming $A=1$.

I think it probable that the method of Bowden and Rideal (assuming the truth of the fundamental assumption) would give results less than the maximum area as here defined, owing to the sparseness of the atomic layer of hydrogen used.

The interference method that I have been using disregards inequalities in the surface of magnitude smaller than 10^{-5} cm., and so gives results less than the 'maximum' area, and also less than Bowden and Rideal's results.

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The Estimation of Bacterial Numbers in Soil by Direct Counts from Stained Films.

THE method now in common use for determining the number of bacteria in soil by colony counts admittedly provides an estimate of only a small fraction of the total numbers in the soil, since any one medium will enable only a few of the physiological groups of the bacterial population to develop. The method of direct counts of bacteria in films of the actual soil was rendered possible by the development of a suitable staining technique by H. J. Conn and by S. Winogradsky. Both these workers have suggested methods by which estimates of the bacterial numbers in a soil sample can be made.

The method of H. J. Conn consists in diluting a given mass of soil to a known degree and spreading 0·01 c.c. of this suspension on a slide over an area of 1 sq. cm. The film is then stained and, from counts made from a number of microscope fields, the bacterial numbers are estimated. An important factor limiting the accuracy of such determinations would appear to be the difficulty in obtaining an accurate sample of a suspension of soil particles only 0·01 c.c. in volume. S. Winogradsky estimates the mass of soil in his films by weighing. Here the difficulty in obtaining accurate weighings of such small masses of soil would seem to limit the accuracy of the method. In both methods the bacterial numbers are actually based on counts from random microscope fields.

G. Kühlmorgen-Hille found that these two methods gave widely different results. The main sources of error would appear to be, first, that of determining accurately the mass of soil in the film examined, and secondly, the implied assumption that the bacteria are distributed at random over the film from which sample fields are taken. Kühlmorgen-Hille's data, when tested by the χ^2 index of dispersion, show that the distribution of the bacteria is not random.

We have tested a method in which both of these

difficulties are avoided, by determining, in random microscope fields from a parallel series of stained films, the ratio between the number of bacteria and the number of particles of indigotin, a counted suspension of which has previously been added to a given mass of the soil. The ratios thus obtained from parallel fields are found to be distributed at random, and the bacterial numbers calculated therefrom are of course independent of the amount of soil in the film.

The following is a description of the method tested by us. A suspension of indigotin in distilled water is sterilised and the number of particles per c.c. counted on a hæmocytometer by means of a high-power water-immersion objective. 5 grams of the soil are shaken for three minutes in 25 c.c. of this standard indigotin, and further shaken for one minute after the addition of an equal volume of sterile 0·01 per cent agar. From each soil to be examined three or four parallel slides are made, each having four or five small drops of soil-indigotin-agar suspension, applied by means of a mapping pen. The suspension is shaken between the application of successive drops and the slides placed immediately under a damp cover for a few minutes. The films are dried and placed for 10 minutes in a bath of carbol-erythrosin (1·5 gm. erythrosin; 5 gm. phenol; 100 c.c. water; filtered before use); washed in a bath of distilled water; stained for 10 minutes in 2·5 per cent aqueous erythrosin; washed in distilled water, and dried. Bacteria and indigo particles in four to eight random fields from each drop are counted. The ratio of bacteria to indigo is thus obtained, and since the absolute number of indigo particles is known, the number of bacteria per gram of soil can be calculated.

The accuracy of the method has been tested in the following experiments:

(i) A known number of cells of an organism were added to sterilised soil and estimated to within 1 per cent.

(ii) The bacterial numbers in four portions of the same soil sample agreed within a standard error of 5 per cent.

(iii) In all tests the deviations observed between parallel drops were within expectation based on random sampling, and can be brought down to a standard error of 2·5 per cent by counting sufficient fields.

(iv) The numbers found by two workers counting independently in test (ii), and

(v) The numbers found in films prepared by three workers from the same soil sample, showed no significant differences.

A full description of the method and the results obtained will be published elsewhere.

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Cress Grown on Adrenaline.

A FEW preliminary experiments relating to the action of the internal secretions of animal glands upon vegetable life have yielded a somewhat extraordinary result with adrenaline. Cress seeds grown on pads of cotton wool soaked in 1 in 10,000 solution of adrenaline showed the following marked differences from control crops grown on distilled water.

(1) The seeds germinated later, and there was a retardation of approximately twenty-four hours.

(2) After the preliminary retardation, growth advanced at a rapid rate, and within three days the plants were considerably taller than the controls.

(3) When maturity of growth was reached the plants were much taller, and the leaves larger than the controls. Also, the plants were a paler shade of green.

(4) The most striking feature was the presence of adrenaline, or adrenaline-like compounds, in the 'heads' of the cress. It is important to note that no adrenaline was added after the initial dose, and the wool pad kept moist with distilled water. The plants were continuously exposed to the air and light.

After carefully washing the cut 'heads' of the plants they were reduced to a paste with distilled water, and the fluid filtered and tested for adrenaline. A deep rose pink colour was obtained with the iodine test and other oxidising tests for adrenaline. The control cress entirely failed to show any of these reactions.

Some of the cress was extracted with normal saline and injected into decerebrate cats. Typical adrenaline curves were obtained, and it has been possible to demonstrate all the pharmacodynamical reactions of adrenaline in the cress.

(5) The cut ends of the stalks show a distinct tendency to bud.

Tests of the cotton wool pads at the time of mature growth failed to reveal the presence of adrenaline even in minute amounts. It therefore is suggested that the cress in some manner either produces a stable form of adrenaline, or manufactures an adrenaline-like compound which is stable.

Moreover, it appears to be probable that the cress synthesises adrenaline, or a similar compound, from the products of the oxidation of adrenaline.

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The Crystalline Structure of Benzene.

BY means of X-ray measurements upon single crystals, using the rotation method, I have been able to determine the unit cell of benzene. The cell is simple orthorhombic, of dimensions $a = 7{\cdot}44$ A., $b = 9{\cdot}65$ A., and $c = 6{\cdot}81$ A. at $-22°$ C., and contains four molecules. As a result of the examination of about one hundred crystal planes, the space group was found to be Q^{15}_h (orthorhombic bipyramidal). From this it can be shown that *in the crystal* the molecule has a centre but no planes of symmetry. Taking a standard molecule at a corner of the cell, the three derived molecules are situated at the centres of the cell faces. This pseudo-face-centred arrangement accounts both for the fact that the plane (111) gives the strongest X-ray reflections, and also for the bipyramidal habit of benzene crystals.

The cell now determined has axial ratios 0·771 : 1 : 0·704. Using the powder method, Eastman (*J.A.C.S.*, **46**, 917; 1924) obtained the values 0·775 : 1 : 0·725, while Broome (*Phys. Zeit.*, **24**, 124; 1923) found the ratios 0·763 : 1 : 0·700. Mark (*Ber.*, **57**, 826; 1924) measured the c-axis, and obtained a value between 6·8 and 6·9. He inferred from his measurements that the space group was either Q^{11}_h, Q^{15}_h, or Q^{16}_h.

Further work is in progress with the view of determining the remaining variables in the structure.

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The Archæology of Scotland.[1]

By Sir GEORGE MACDONALD, K.C.B.

THE first movement towards an organised study of Scottish antiquities dates from the last quarter of the eighteenth century. The Society of Antiquaries of Scotland was founded in 1780, and with it there came into existence what is now the National Museum. The leading spirit in the enterprise was David Erskine, eleventh Earl of Buchan. If we may trust Sir Walter Scott, who characterised him as "a person whose immense vanity, bordering on insanity, obscured, or rather eclipsed, very considerable talents," Lord Buchan was not altogether a promising sponsor for the infant science. But at this distance of time we may forgive his eccentricities and honour his memory for the substantial service which he rendered to our common cause.

In point of fact, it was probably the first president's very vanity, so severely stigmatised by Scott, that inspired William Smellie to produce his full contemporary 'Account' of the origin of the Society and its Museum with a list, or rather lists, of acquisitions. Lord Buchan's speeches and letters, which are there to be found verbatim, show plainly how limited was the archæological horizon of the age. Thus in his inaugural address, which maps out the field of the new Society's activities, he states explicity that the starting-point must be "the period of the Roman attempts to subjugate the northern parts of Britain." The monuments which we call prehistoric, but which in those days were called Druidical, "the Cairn, the Mount of Earth, Four Gray Stones covered with Moss"—I am quoting his own words—he attributes to the time of Ossian, and Ossian and his heroes he supposes to have lived in the reign of Caracalla. It is quite consistent with such a perspective that, after a gift of twenty pounds in cash, the first recorded donation to the Museum should have been "a quantity of Roman arms, consisting of twenty-three pieces of the heads of hasta and jaculum, twenty pieces of the blades, and nine of the handles of the gladius and pugio; a ring, three inches in diameter, fastened to the end of a staple; and a mass of different pieces of these arms, run together by fire, all of brass." It is not easy to realise that the objects masquerading in this classical garb are the contents of the well-known Bronze Age hoard which was dredged from the marl at the bottom of Duddingston Loch. Bronze Age weapons, indeed, are systematically labelled 'Roman' in the official record. Nor was it only to weapons that the epithet was applied. The relics of a Bronze Age interment figure as "an antient sacrificing ax of Roman brass . . . antient Roman cinereal urns . . . and pieces of burnt Roman bones." That is typical. The men of the Stone Age fare even worse. One or two perforated axe-heads of stone do appear in the catalogue, but they stand cheek by jowl with *lusus naturæ* like "a chicken preserved in spirits, having two heads conjoined laterally at the back of the skull." They are entered, too, under the old-fashioned name of "purgatory hammer," an echo of the popular belief that the purpose of placing such objects in graves was to equip the spirit of the dead with an instrument which should be sufficiently heavy to ensure a prompt response to his knocking at the gate of the after-world. Yet, despite the quaintness of these first beginnings, the institution thus cradled has developed, within a century and a half, into one of the finest archæological collections in Europe. The Earl of Buchan and his friends had builded better than they knew.

The story of our National Museum of Antiquities is a parable. It reflects the process by which, in every European country, the dilettante was transformed into the scholar, the antiquary into the archæologist. There are no general features which can be said to be peculiar to Scotland. *Honoris et pietatis causa*, however, mention must be made of one conspicuous figure. In retrospect, Dr. Joseph Anderson towers head and shoulders above the whole of his contemporaries. He was in charge of the National Museum for the long period of forty-three years, and the present collections are, in large measure, the fruit of his energy and discriminating zeal. But he did much more than merely stimulate their growth. He used them as material for that invaluable compendium of Scottish archæology which he embodied in his successive series of Rhind Lectures, the first of which was delivered so long ago as 1879. The intervening period has added much to our knowledge, so that, in the light of the fresh information now available, the details require to be corrected here and there. More frequently they merely require to be supplemented.

The pre-history of Scotland has much in common with the pre-history of other areas; but the country also contains groups of monuments and classes of archæological objects to which no parallel can be adduced from any other part of the world. Scotland, in a word, has an archæology of its own. The Scottish brochs, for example—those strange towers of dry-built stone with chambers in the thickness of the wall and no opening towards the outside save a very narrow doorway—are peculiar to the area. Scarcely less characteristic is one of the principal varieties of Scottish earth-house. Similarly the so-called 'Pictish' symbols on the sculptured stones stand quite alone, as do the heavy silver chains on which they occasionally appear, and the massive bronze armlets and carved stone balls of a somewhat earlier age.

Finally, as regards the archæological material generally, Scotland enjoys in one important respect a distinct advantage over her southern neighbour. Her medieval monuments may always have been relatively few and inconspicuous. Certainly her castles and her abbeys and her cathedrals have too often suffered grievously from hands that were

[1] From the presidential address to Section H (Anthropology) of the British Association, delivered at Glasgow on Sept. 10.

bent on malicious and wilful destruction. But her prehistoric remains are extraordinarily numerous and, ruinous as the condition of many of them is, they are not seldom sufficiently well preserved to offer a rich field for scientific investigation.

The first thing needful is a proper survey of the ground. That is being carefully, if slowly, carried out by the Ancient Monuments Commission, which has already dealt with several of the districts that are of most interest to the student from the prehistoric point of view. The reports on Sutherland, Caithness, Galloway, Skye, and the Outer Isles have all been published. Orkney and Shetland are under examination now. Argyll and Bute, Aberdeen and Kincardine, Peebles and Roxburgh will follow in due course. When these have been completed, a long step forward will have been taken. But something more than a proper survey is required; it should be accompanied by systematic and well-directed excavation.

It has been calculated that in Aberdeen and Kincardine alone there are some 200 stone circles. These, of course, are of the Bronze Age. Equally worthy of note is the abundance of remains belonging to the Early Iron Age. Thus the Inventories of the Royal Commission actually register as many as 67 brochs in Sutherland and no fewer than 145 in Caithness. If the pottery and chambered cairns of the Neolithic Period are less spectacular, they are scarcely less remarkable. In a word, it is not open to doubt that, in the days before history began, the north of Scotland and the Western and Northern Islands carried a population that was relatively very numerous. The contrast with the scene of desolation which they now present is often very striking.

The solitude of to-day is easy enough to understand. It is the density of population in prehistoric times that calls for explanation. I believe that the key will be provided by geography. That means distribution-maps. As yet our supply of these is far from adequate. Imperfect as it is, however, it may prove sufficient for our present purpose, more especially as we can fortify ourselves by an appeal to the sister-science of history.

Nowadays the vast majority of those who invade the Highlands and Islands approach them by way of southern and central Scotland. In prehistoric times that avenue was barred. The Caledonian Forest, which spread far southwards into what we regard as the Lowlands, must have been an impenetrable obstacle. The early immigrants arrived by sea and reached the mainland via the Western Islands. This implies that they came from Ireland, and that it is in Ireland that the roots of Scottish prehistoric civilisation must be studied. At the moment, however, we are concerned not with studying the roots, but merely with establishing a connexion between them and the full-grown plant. In other words, all that is necessary is to satisfy ourselves as to the set of the current of migration. It is significant that so late as the dawn of the historic period it was flowing strongly towards the north and east. The Scots themselves were, of course, incomers from Ireland and, if we can trust Continental analogies regarding the movement of peoples, we may assume that the foundation of the kingdom of Dalriada was preceded by a prolonged process of gradual infiltration. I have more than a suspicion that the troubles which the Romans experienced, and in particular the restlessness which compelled them to abandon the Forth and Clyde wall, were in no small measure due to the encouragement which the turbulent natives received from the passage of a steady stream of reinforcements across the narrows of Stranraer.

The case for migration from Ireland in prehistoric times rests upon a basis more stable than analogy. Further excavation and an ampler supply of distribution-maps are needed to make it complete, particularly for the Neolithic Period. The evidence however, is already considerable enough to furnish what may perhaps be accepted as convincing proof. Some years ago Mr. A. O. Curle, in his Rhind Lectures, directed attention to the testimony supplied by cup-and-ring markings. Such markings are recorded as occurring in twenty counties—Wigtown, Kirkcudbright, Roxburgh, Berwick, Ayr, Bute, Argyll, Dumbarton, Lanark, Mid and West Lothian, Peebles, Fife, Clackmannan, Perth, Forfar, Ross, Aberdeen, Sutherland, and Caithness. The Royal Commission's survey of North Uist and Benbecula enables us to add Inverness to the list. But, for the proper interpretation of the record, Mr. Curle went on to say, we must have regard to the number of examples that have been noted in each of the various countries. The poverty of the three shires that march with England—Berwick a single example, Roxburgh two, Dumfries none at all—precludes the idea that the folk responsible for these mysterious sculpturings entered Scotland by crossing the border. On the other hand, the area in which the markings are found in greatest number and with the greatest variation of device and complexity of design, is exactly the region that lies over against Ireland—the coastal districts of west and south-west Scotland. They abound in Wigtown and Kirkcudbright, and are still more common in Argyll. As they are also frequent in Ireland, the inference seems plain.

Cup-and-ring markings, in Scotland at least, must be associated with the phase of culture that was distinguished by the use of bronze. To discover what happened during the phase that succeeded it, we may turn to the brochs. At the outset it has to be admitted that the broch was not imported from Ireland. There are no brochs in Ireland. The broch is a purely Scottish creation, evolved on Scottish soil. Nevertheless, it is scarcely possible to doubt that it was from the shores of Ireland that the ancestors of the broch-builders originally came. They certainly did not make their way into Scotland across the border, any more than did the men who carved upon the rocks those mysterious cups and rings. There are no brochs at all in Dumfries or in Roxburgh. It is true that Berwick, Selkirk, and Midlothian can boast of one apiece. But that is a paltry display compared with Orkney's 70 and Shetland's 75. Nor is it only their rarity in the south that is

significant. The three sporadic examples I have named seemed to show the characteristic features of this type of structure already fully developed. The broch did not spring full-grown from the brain of some architectural genius of the prehistoric period; it was the outcome of a slow process of evolution. The southern brochs can only have been built by intruders from the north.

We may go further. Seventeen or eighteen years ago, in surveying Sutherland and Caithness for the Royal Commission, Mr. Curle noted certain points which seemed to him to indicate a gradual improvement in the type as one moved inland from the western coast, and he saw in this—rightly, as I think—a clue to the drift of the population. His deduction has received remarkable confirmation from the Commission's recently published survey of Skye and the Outer Isles, as well as from the late Dr. Erskine Beveridge's investigations in Tiree. In the insular region we find brochs in reasonable abundance—44 are recorded there by the Royal Commission—but we also find numerous specimens of what can best be described as the broch in the making. The so-called 'semi-brochs' of Tiree, the 'galleried duns' of the Hebrides and Skye, all alike appear to represent experiments in the architectural form which was destined to have its fullest expression on the mainland. As the broch-builders moved farther north and then farther east, they carried with them the fruits of their ripening experience.

The facts of early Scottish history and the inferences as to the Bronze Age and the Early Iron Age are thus in complete accord. They bear out the view—in itself *a priori* probable—that for uncounted generations the trend of migration was from the direction of Ireland through the islands of the west coast to the north of Scotland. We may reasonably assume that an exhaustive examination of the chambered cairns, in continuance of the work carried out with such marked success by Prof. Bryce, would give a similar result for the Neolithic Period.

Once the set of the current has been determined, it is not difficult to understand why regions, where the sheep and the deer now wander at will, should have been thickly populated in prehistoric times. Although the causes that prompted the movements of peoples in those far-off days are obscure, one of the most potent was certainly the demand that would be created for fresh means of subsistence when the mouths to be fed were multiplied. At intervals a surplus of humanity would be spilled from Ireland. In front there stretched but one open road, and that was a *cul de sac*. For, to those who followed this route, northern Scotland was literally the end of the world.

Long afterwards, under the pressure of a similar urge, a similar stream descended from Scandinavia. But the later immigrants came in stout ships, and could at need deflect their course, as they did, to the Faroes, to Iceland, even to Greenland. With the earlier wanderers it was different. When they had reached Unst, they would scan the horizon in vain for any sign of land to tempt their frail craft further. The ocean was an insurmountable barrier. The flow from the south would be brought to a standstill on its shore, and the more nearly that limit was approached, the greater would the congestion of population tend to become. This, I think, is the real secret of the abundance of Scotland's prehistoric remains.

Active Nitrogen.

By C. N. HINSHELWOOD.

IN 1900, E. P. Lewis observed that nitrogen could be stimulated by an electric discharge to emit a bright yellow glow, which continued for some time after the discharge had ceased; he made a number of spectroscopic observations on the glowing nitrogen. The present Lord Rayleigh investigated the phenomenon in a more general and systematic manner, discovered that the glowing gas had remarkable chemical properties, and named it 'active nitrogen.'

Certain important conditions must be observed for its production. The pressure of nitrogen should be a few millimetres of mercury: at higher pressures collisions with ordinary nitrogen molecules apparently destroy the glowing substance. The best procedure is to draw a stream of rarefied nitrogen through the discharge tube by means of a pump. The persistence and gradual decay of the glow in the gas which has left the region of the discharge can then be easily observed. When the discharge is from an induction coil, it should be a 'condensed' discharge, the use of the condenser giving a sudden intense current. The importance of this condition can be seen from the fact that if an uncondensed discharge is passed through the gas rendered luminous by passage through a condensed discharge, the glow is actually destroyed. Finally, the presence of a small proportion of some other gas in the nitrogen is necessary for the production of the luminescence.

At first it was thought that a little oxygen must be present, but methane, hydrogen sulphide, ethylene, and various other substances are equally efficacious. It seems to be generally agreed that a trace of some 'electronegative' gas, that is, a gas which readily takes up electrons to give negative ions, is the essential thing. A few parts per thousand of the foreign gas produce the most intense glow: larger amounts destroy it. In the presence of more than about 2 per cent oxygen, the nitrogen does not glow at all. Rayleigh thought that pure nitrogen still could be made to emit a faint glow, but Bonhoeffer and Kaminsky have shown that it emits none at all.

The glowing nitrogen was shown by Rayleigh to have great chemical reactivity, and also to excite many substances to luminescence. It reacts with acetylene to give hydrogen cyanide, and with mercury to give a nitride. Mixed with iodine vapour, it produces a brilliant blue light. Hydrogen

and the inert gases merely dilute the glow, but oxygen extinguishes it altogether. The reaction with nitric oxide is important: the gases interact with the production of a greenish flame, the evolution of heat, and the formation of nitrogen peroxide and nitrogen. Rayleigh and, later, Willey and Rideal have used this reaction as a means of estimating the concentration of the active body in a gas stream.

The nature of active nitrogen and the mechanism of its formation and decay have been the subjects of much research and speculation. The problem is not yet completely solved, but the range of possibilities has been very much narrowed down.

In the first place, although the production of the glow is determined by the presence of other gases, the actual emission process is one, apparently, in which nitrogen alone is concerned, for the spectrum is identical whether the impurity is oxygen, methane, or hydrogen sulphide. Moreover, the most important group of bands, the 'α-group,' which are three conspicuous bands in the red, yellow, and green, are simply part of the well-known 'first positive' bands in the ordinary nitrogen spectrum. (The intensity relationships are, however, quite different, a few of the bands being specially prominent in the glow and the rest entirely absent.) The 'β'- and 'γ'-groups of Fowler and Rayleigh have by many been attributed to nitric oxide, but these are not so characteristic, and are of less importance.

The glow is not associated with any ionic form of nitrogen: it is unaffected by the removal of ions from the gas which has passed through the discharge. Moreover, the spectroscopic evidence goes to show that the first positive bands of nitrogen are emitted by the neutral molecule itself.

In order to be clear about the value of the spectroscopic evidence, we must consider for a moment the nature of band spectra. In a given spectrum there may be several systems of bands in regions quite far removed from one another; each system has a number of more or less evenly spaced bands, the frequency differences between the centre of one band and the next being much smaller than those between corresponding bands of different systems. Finally, each band is composed of a number of lines which crowd together at one side or the other, producing a fluted appearance, the frequency differences here being on a still smaller scale. Now, according to the Bohr principle of energy levels, the frequency of the light emitted by an atom or molecule is equal to the difference between the energies of the initial state and the final state, divided by Planck's constant h. The energy of an atom, for this purpose, is determined by the quantum state of its electrons; changes in this correspond to the different lines in the *line* spectrum of the atom. The same applies to a molecule, but for each electronic energy level there are various degrees of vibrational energy possible; hence each line is multiplied into a system of lines. For each electronic and vibrational state various amounts of rotational energy may be possessed by the molecule; hence the system of lines becomes a system of bands.

The quantitative differences between the different kinds of energy fit in exactly with what is required to account for the relative frequency differences of system, band and component lines, so that there can be very little doubt that the nature of the spectrum proves the glowing of active nitrogen to be due to a molecule. It may also be mentioned that a line spectrum due to the nitrogen atom is known, but is not shown by active nitrogen; that Wien, by his canal-ray method, showed the emitting system of the nitrogen first positive bands to be uncharged, and that Rayleigh was unable to condense out anything which might indicate the existence of a body such as N_3. It seems fairly certain, therefore, that the characteristic luminescence is emitted by simple diatomic nitrogen in some unusual state.

The spectroscopic investigation carries us still a little further. From the frequency of the lines and from the Bohr principle, combined with measurements of the energy of the electrons necessary to stimulate the emission of various bands in the spectrum, an idea can be obtained of the actual energy levels from which any given line or band is emitted. In this way Birge, Sponer, and others arrive at the conclusion that the strongest bands in the afterglow correspond to transitions from a state where the nitrogen molecule possesses 9·3 volts of electronic energy,[1] with about 11 quanta of vibrational energy, which are equivalent to 2·1 volts. After these particular bands are emitted, the molecule still appears to have about 8·0 volts. Before emission it possesses 11·4 volts, or about 260,000 calories, which must be approaching the heat of dissociation of nitrogen. Saha and Sur conclude that the energy corresponding to the maximum frequency of the lines emitted when active nitrogen reacts with metals is 8·2 – 8·5 volts: but this is inconclusive, since chemical reactions are involved here, and it is well known that chemical energy may appear as light (chemiluminescence).

Willey and Rideal made a direct measurement of the heat liberated when active nitrogen reacts with nitric oxide, and found that 42,500 calories were contributed by the nitrogen for each molecule of nitric oxide which reacted. They assumed that each molecule of nitrogen accounted for one molecule of nitric oxide. This gave 42,500 calories (2 volts approximately) as the energy of the active nitrogen, in conflict with the spectroscopic evidence. The doubtful part of this procedure is simply the assumption of equimolecular equivalence: Rayleigh, for example, had assumed the reaction $2NO + N = NO_2 + N_2$, which would involve four molecules of nitric oxide to one of nitrogen. But this question may be left, since the conflict is resolved in another way. It has often been pointed out that active nitrogen may be complex, and contain different products in different states of excitation. Willey

[1] An energy of 1 volt means an energy equal to the kinetic energy which an electron would acquire in falling under a potential difference of one volt. 1 volt corresponds to about 23,000 calories per gram molecule.

has recently confirmed the fact that the glow and the chemical activity are independent: the glow may be destroyed, by Rayleigh's method of passing the gas through a weak subsequent discharge, without destroying the chemical activity. Hence it is clear that the average energy of nitrogen which is chemically active may be much smaller than that of the light-emitting molecules. Indeed, the balance of evidence seems to be that the chemical activity of the nitrogen is much smaller than it would be if all the molecules which are 'active' at all possessed energy equivalent to the spectroscopic 11·4 volts. For example, it does not excite molecules of hydrogen in any way, nor does it stimulate the combination of hydrogen and oxygen. Energy exchanges tend to be so specific that these arguments must not be pushed too far; but the evidence at present available seems to show that the glowing nitrogen is only a fraction of the total chemically active nitrogen, and in a considerably more excited state than the average.

We now come to the question of the mechanism by which these active molecules are produced and decay. In this connexion it must be remembered that most of the quantitative work on the subject refers to the glowing nitrogen, and not to other forms which are produced simultaneously, or in the course of the decay, which may still possess chemical activity although they are non-luminous.

It has been suggested that, in the discharge, free atoms of nitrogen are produced, in a manner analogous to that in which Wood's atomic hydrogen is formed. These have to give rise to a molecular spectrum, which they can do in two ways, either by simple recombination, or by communication of the energy of recombination to a normal nitrogen molecule which collides with two atoms at the moment of their union. It must be remembered, however, that the analogy between active nitrogen and active hydrogen is a very imperfect one. There is a marked correlation between the occurrence of active hydrogen and the appearance of the Balmer series, which is known to be emitted by the hydrogen atom, whereas the active nitrogen spectrum, as we have seen, is definitely molecular.

We thus have three possible views: (*a*) molecules of nitrogen excited in the discharge to a high energy level are 'metastable,' that is, they have a considerable life and can continue to exist for some time after leaving the discharge, when they slowly revert with emission of light; (*b*) atomic nitrogen emerges from the discharge, and then recombination takes place to give the molecules which are at a high enough energy level to emit the spectrum; (*c*) nitrogen atoms emerge from the discharge and cause excitation of normal molecules in a ternary collision ($2N + N_2$).

Of (*a*), all that can be said is that ordinarily an excited molecule loses its energy after about 10^{-7} seconds, but that 'metastable' states occasionally have to be assumed in spectroscopy. With nitrogen it would be an assumption made directly for the purpose of explaining the facts, and without independent evidence. The arguments against (*a*) are, however, principally the arguments for (*b*) or (*c*).

The rate of decay of the glow, for a constant total pressure, shows that the process is a bimolecular one (Rayleigh, Angerer, Bonhoeffer and Kaminsky, Willey). The simplest, though not the only possible, interpretation of this is that recombination of two nitrogen atoms takes place. This interpretation is also consistent with the fact that the estimated energy of the initial state from which the α-bands are emitted approaches the heat of dissociation of the nitrogen molecule. If we now assume (*b*) to be the mechanism, a spectroscopic difficulty arises, in that we should expect a certain amount of continuous spectrum from the recombination of free atoms. This difficulty possibly may not be a very serious one. However that may be, there is some theoretical reason for believing that free atoms cannot combine, unless they suffer a collision with a third molecule which can remove the excess energy liberated in their union. Otherwise, according to Herzfeld, they would fall apart again immediately. Thus (*c*) becomes a natural hypothesis to make, the third body being a nitrogen molecule which is excited to luminescence in the process.

Rayleigh found that the active nitrogen decayed more rapidly at low temperatures than at high temperatures. If the decay depends upon a ternary collision, this is natural, since the chance of such encounters decreases with increasing speed of the molecules.

If this hypothesis is true, the rate of decay should be directly proportional to the total pressure of the ordinary nitrogen. Opinion on this point is somewhat divided. It seems to be clearly shown that the glow decays more rapidly when the pressure of nitrogen is increased (Rudy, Bonhoeffer and Kaminsky, Willey), but Bonhoeffer and Kaminsky find that if more nitrogen is added to the glowing gas, it weakens instead of brightening the glow as might be expected. They consider this to disprove the suggestion that the decay is accelerated. The fact remains, however, that the weakened glow persists for a shorter time. Further investigation therefore seems to be needed.

It remains now to consider the part played by the small proportion of foreign electronegative gases in the production of active nitrogen. It must suffice to mention the possible explanations, without, at the moment, attempting to decide between them. We have seen that the impurities play no part in the actual light emission process. Their function must therefore be in some way to catalyse the formation of the atoms on the excited molecules in the discharge,—which is very unlikely,—or to retard the spontaneous reversion of the active nitrogen, which in their absence may be very rapid indeed, or take place by some process not attended with luminescence. Birge, from the point of view of the theory that the glow is emitted by metastable nitrogen molecules, suggested that these could only remain in their metastable state in the absence of a disturbing field, and that free electrons from the discharge would therefore cause a rapid reversion: a small amount of electronegative gas would 'clean up' these free electrons, while too

much would begin to exert a disturbing effect itself.

The alternative explanation is based upon analogy with atomic hydrogen, which can be definitely proved to recombine catalytically with great rapidity on clean glass walls of containing tubes: impurities such as water are shown to poison the walls and stabilise the atomic hydrogen. The impurities could have an exactly similar effect in preventing the destruction of the atomic nitrogen in a 'useless' wall reaction. In this connexion it is significant that Rayleigh found the decay to be much influenced by the walls of the vessel, while Bonhoeffer and Kaminsky showed that the effect of the different foreign gases was particularly a function of the walls.

The British Association at Glasgow.

THE 1928 meeting of the British Association will linger in the memory as a delightful reunion, at which, without the announcement of any sensational discovery, much useful and important work was accomplished. Centred in the midst of one of our greatest industrial and commercial communities, it has accomplished valuable propaganda work for science, driving home into the mind of the ordinary citizen some appreciation of the fact that not merely his material prosperity and comfort, but also a large proportion of all that renders civilised existence possible, is dependent upon science and its advancement.

The formal proceedings commenced upon the evening of Sept. 5, when Sir William Bragg took over the presidential chair in succession to Sir Arthur Keith. Between seven and eight o'clock the St. Andrew's Hall began to fill with an immense audience, who whiled away the time listening to an excellent organ recital and watching the platform fill with well-known figures of the worlds of science and citizenship. At 8.30 precisely, Sir Arthur Keith appeared, followed by the president-elect, the Lord Provost, and the Principal of the University. The proceedings opened with short speeches from the two last-mentioned, who with kindly warmth and facile wit bade the Association welcome to Glasgow. Incidentally, it may be mentioned that an outstanding feature of the Glasgow arrangements was the cordial and smoothly working co-operation of all concerned in making the meeting a success. In his presidential address, so admirably conceived to fit a great centre of art and craftsmanship and applied science, Sir William Bragg held his vast audience throughout with that success to which auditors of his lectures at the Royal Institution and elsewhere are accustomed.

On Thursday, Sept. 6, the various sections settled down to work, and those members of the Association more particularly who flit from section to section, whither for the moment their fancy leads, appreciated to the full the advantage of having the various sections housed, each in its own appropriate department, within the one ring fence of the University.

The sectional proceedings themselves have proved of great and varied interest and have aroused much appreciative comment. Here and there, glints of the sunshine of humour have illuminated the sombreness of scientific exposition and debate, as for example the comment that was heard after a paper by one of our brilliant marine zoologists upon a method which he had devised for collecting and recording upon a continuous band of silk gauze the minute forms of life constituting the plankton along the track of his ship. "What a wonderful young man!" the commentator said, "just fancy catching *whales* in a machine like that!"

As usual, during the week the centre of organisation has been the Reception Room in the Bute Hall of the University, the normally somewhat austere and cheerless interior of which, brightened up by the presidential banners hung round the gallery, has been from morning to night a scene of cheerful activity and bustle.

On Saturday, Sept. 8, the members for the most part forsook town for country—many accompanying one or other of the numerous excursions which had been arranged beforehand, others going off by motor-car on unofficial expeditions of their own. The good fortune of the Glasgow meeting did not fail it, for the gloom and rain of preceding days cleared away entirely and a pleasant south-westerly breeze with blue sky and heavy clouds gave to the full these light and shade effects which show western Scottish scenery to its greatest advantage. On Sunday again the same conditions held, and there were many who sought their sermons not in cathedral or church, but in the stones and running brooks of the Highland glens.

As was to be expected, social activities were a conspicuous feature of the Glasgow meeting: in fact, its activities may be said to have been inaugurated by a luncheon given on the opening day by the Glasgow Chamber of Commerce—the oldest of such chambers—to a number of the chief officials of the Association, while almost at its close came the annual dinner of the Clyde Navigation Trust, to which again were invited representative members of the Association's organisation. Both the usual evening parties were well attended. The first of these, on the evening of Thursday, Sept. 6, was given by the Lord Provost and Corporation in the magnificent City Chambers, and the invited guests had a delightful time—conversing with their friends, listening to an admirable programme of music, dancing, or looking on—and listening—during the—to many—unfamiliar evolutions of the Scotch reels. The second party, still larger though less crowded, was held in the spacious galleries of Kelvingrove, where the artistic and other treasures provided an endless source of interest.

On Monday, Sept. 10, a special honorary graduation ceremonial was held, in the presence of a somewhat restricted company owing to the Bute

Hall, in which graduation ceremonials normally take place, being in use as the Reception Room. The short list of graduands was restricted to the president and president-elect of the Association and foreign representatives, and consisted of Sir William Bragg, Sir Thomas Holland, Dr. Adrien Loir, representing the Association française pour l'Avancement des Sciences, Dr. F. L. Stevens, representing the American Association for the Advancement of Science, Prof. E. Suess, Prof. P. Zeeman, Prof. Shailer Mathews, and Prof. E. A. Westermarck. By a particularly happy arrangement the Frazer Lecture—founded in honour of Glasgow's greatest living representative in the world of scholarship, Sir James G. Frazer, author of "The Golden Bough"—had been made to coincide with the first evening discourse, and Prof. Westermarck in his dual capacity delivered on Friday evening a fascinating discourse upon "The Study of Popular Sayings"—remarkable alike for its subject matter, its admirable English, and the thread of humour which ran through it.

As usual at British Association meetings, a centre of particular activity was the Conference of Delegates. Perhaps the chief item of business there decided was the unanimous adoption of a resolution proposed by Dr. Charles R. Gibson urging upon the Government "to stimulate the employment by local authorities of the powers already conferred upon them by Parliament for the preservation of scenic amenity in town and country." This resolution followed a powerful address by Dr. Vaughan Cornish, and was strongly supported by other speakers, including Lord Crawford and Sir John Stirling-Maxwell. An interesting announcement was made by Dr. Hamshaw Thomas that a conference summoned by Government had approved of a by-law prohibiting the public from uprooting ferns or other plants in places to which they had access.

It is not possible here to do more than merely mention one or two of the more important items of administrative business passed by the General Committee of the Association. Chief amongst these is the appointment of Sir Josiah Stamp as general treasurer in succession to Dr. E. H. Griffiths, whose retirement—forced by ill-health—was referred to in feeling and grateful terms by the president.

An invitation to meet in Bristol in 1930 was gratefully accepted, as well as a similar invitation from Leicester, the precise year being in this case left undetermined in the meantime. An invitation from Aberdeen was cordially appreciated, and a meeting there also foreshadowed in the near future.

Dr. Adrien Loir attended the Glasgow meeting and, announcing that the French Association would meet at Havre next year, extended a cordial invitation to such members of the British Association as do not go to South Africa to attend the meeting of the French Association. This invitation was, on their behalf, gratefully accepted by the General Committee.

The number of members registered was more than three thousand, as compared with 1912 at the last Glasgow meeting.

Obituary.

Viscount Haldane of Cloan, K.T., O.M., F.R.S.

THE death of Lord Haldane on Aug. 19 has removed from our midst not only a distinguished lawyer and statesman, but also a man of wide learning and a thinker of much ability and acuteness. I have been asked to give some account in these pages of his philosophical and scientific work, and of his labours in the cause of education. It is not a task easy to accomplish within the compass of a short article.

Richard Burton Haldane was born in 1856. His father, Robert Haldane, belonged to an old Scottish family, and was a Writer to the Signet in Edinburgh. His mother, who died in 1925, at the advanced age of over a hundred years, was a daughter of Richard Burdon-Sanderson, a Northumberland landowner. He went in 1873 to the University of Edinburgh and studied under Campbell Fraser. In due course he graduated with first class honours in philosophy, obtaining the Bruce of Grangehill Medal in metaphysics, and three years later the Ferguson Scholarship of the four Scottish Universities. Part of his student life was spent in Göttingen, where he worked under Lotze, for whom he always expressed profound admiration. In conjunction with his friend, Mr. J. Kemp, he translated Schopenhauer's chief work into English, the first of the three volumes appearing in 1883. He was Gifford Lecturer in St. Andrews in 1902–4, and his lectures, entitled "The Pathway to Reality," were published in two volumes in 1903 and 1904. His next considerable work, "The Reign of Relativity," did not see the light until 1921, although he tells us it was projected on the day of his release from office as Lord Chancellor in 1915. There followed in 1922 "The Philosophy of Humanism," and, in 1926, "Human Experience: A Study of its Structure." Haldane was raised to the peerage in 1911; and received the Order of Merit in 1915. He was elected fellow of the Royal Society in 1906; and, in 1914, fellow of the British Academy. In 1907–8 he was president of the Aristotelian Society, and he contributed many papers both to its *Proceedings* and also to *Mind*.

Lord Haldane's first published article, written in collaboration with his brother, Dr. J. S. Haldane, on "The Relation of Philosophy to Science," appeared in 1883 in the volume of "Essays in Philosophical Criticism," dedicated to the memory of T. H. Green,—a volume which also contains contributions from several other men who afterwards became well known, such as Andrew Seth, Bosanquet, Sorley, Henry Jones, and W. P. Ker. In this essay the Hegelian position, to which throughout his life Haldane steadily adhered, is concisely and lucidly set forth. The term 'mind' has, he insisted, a twofold significance. It may

mean the ultimate reality to which all existence is referable; and then it indicates not a substance or individual object of experience, but the creative synthesis of thought which, precisely because it is that which constitutes experience, cannot as such be made an object of experience. Or it may mean the individual conscious life, mind conceived as it appears, as its own object—having transformed its nature and become a definite part of experience—the subject matter, namely, of psychology. Thus mind may be regarded as at the same time creator and created, as at once infinite and yet a finite self.

Assuming, then, that the ultimate ground, the essence of reality, is mind or thought or self-consciousness, Haldane tried to show that notions such as those of causation and substance are but abstract categories, limited ways of thinking of things in knowledge, and that they do not indicate independent ways of existence in Nature. When the attempt is made to explain by their means the phenomena of life and psychical being they become, he argued, wholly inadequate. The properties of a body *qua* organised can no more be expressed in terms of these mechanical categories than the properties of a stone can be expressed in terms of moral judgment. He insisted that, if science is to do more than merely observe and record facts, it must recognise the necessity of a department of inquiry that shall deal critically with the categories it employs, assign to them their true position, and make clear the real nature of scientific method.

In the Gifford Lectures the line of reflection that had been thus adumbrated was elaborated in detail. In these lectures Haldane espoused Hegelianism with all the fervour of a prophet; he presented it as almost an inspired revelation which, when its meaning was grasped, would be seen to dispose of the enigmas that have long perplexed human reason. Once recognise the implications of the principle that the objective world, and the system of universals which it exemplifies, are but the workings of a mind which is not another than ours, but the mind in which all reality, our minds included, has its place, and one by one the problems of philosophy would be found capable of solution.

It seemed to many of us then, as it seems still, that Haldane took the 'pathway to reality,' even though entered upon under Hegelian auspices, to be a much shorter cut to that destination than we are entitled to suppose it is; but no one could doubt the sincerity of his assurance, or help admiring the pertinacity with which he sought to explain and defend the leading ideas of his idealistic system. Probably the most permanently valuable and original part of the work is that which is concerned with the method of scientific investigation and the relation to it of a criticism of categories. He submitted to scrutiny some of the main concepts of mathematics, physics, chemistry, biology, and psychology, for the purpose of showing that the categories of physics are less abstract and consequently nearer reality and truth than those of mere number, those of chemistry than those of physics, those again of life than those of chemistry, and those of mind than those of life. Particularly suggestive was his exposure of the notion of a special 'vital force' as the re-introduction, under another name, of the old mechanical theory; and, again, of the delusion of imagining that, because no specific 'vital force' can be detected, life must be simply a complicated mechanism.

After the publication of the Gifford Lectures, Haldane appears to have devoted a great deal of attention to the philosophy of mathematics, and especially to the mathematical conception of infinity. In his presidential address to the Aristotelian Society in 1907, he endeavoured to show that recent developments in logical theory, particularly those relating to the meaning of the notion of quantity, had a close bearing on the principles of the calculus. He pointed out, truly enough, the confusion into which Leibniz and some of Leibniz's contemporaries had fallen in speaking of infinitesimals as minute discrete quanta, the magnitude of which might be disregarded, just as the magnitude of a grain of sand might be disregarded when compared with the size of the ocean. A procedure of that sort would rob the calculus of any claim to exactness. The source of the confusion lay, he contended, in neglecting the consideration that quantity has two aspects, each implying and inseparable from the other, continuity and discreteness. If quantity be thought of in the latter aspect alone, the only 'infinite' conceivable will be, he argued, the 'false' infinite of mere unendingness in increase or decrease of finite quanta. On the other hand, the infinity which belongs to the continuous aspect of quantity cannot be reached by addition or subtraction; and, this being realised, the so-called infinitesimal calculus may be consistently treated as a science not of infinitesimals, but of 'rates,' its peculiar province being quantity regarded as a state of continuous change. Thus we may arrive at the notion of infinity in the sense of what is self-contained. But still the relations so treated would be abstract; what is abstract has been wrenched from a context, and has, therefore, something outside itself. The 'true' infinite must be both concrete and completely self-contained; and only the Absolute can be that.

It must, I think, be admitted that, although his criticisms of Leibniz were perfectly justifiable, Haldane was, in this context, flogging a dead horse. In working out a theory of the calculus, the modern mathematician no longer assumes either infinitely small quantities or infinitely small numbers. He proceeds from the fundamental concept of a *limit*,—a purely ordinal notion, which involves no reference to quantity at all, and no such entities as 'infinitesimals' or 'negligible differences.' The modern mathematical conception of the infinite may not be free from logical difficulties, but it would seem to be as remote from what Hegel called the 'false' infinite as it is from what he called the 'true' one.

It is worth noting that in the early essay, to which I have alluded, of 1883, Haldane had already laid stress upon the consideration that space and time are not separable from, or independent of, one another, that they exist only in co-ordination as contributing to the constitution of a highly

concrete reality which they do not exhaust. He was thus to some extent anticipating the merging of space and time into space-time, which is probably the most radical innovation introduced by the theory of relativity, and that aspect of it which is of chief philosophical importance. Of course, in the large volume published in 1921, Lord Haldane reasserted the same contention, here, however, as an outcome of the scientific investigation of the twentieth century. But he went now much further, and maintained that the theory of relativity is, in truth, simply an illustration of the application of what he called the philosophical principle of relativity to a special domain. By the term 'relativity' in the philosophical sense he understood the doctrine that Nature is unintelligible apart from its relation to knowledge, and indeed that individual knowledge is unintelligible apart from a structure which is 'foundational' in the knowledge of every individual knower. Einstein, he insisted, was concerned with a series of meanings which possess veracity only relatively to knowledge.

Notwithstanding the ingenuity with which this thesis was enforced, it has failed, I think it must be confessed, to produce conviction. So far as I can see, the physics of Einstein takes no more account of the relativity of Nature to knowledge than did the physics of Newton. It is true that in popular expositions of the theory reference is frequently made to the 'observer.' Yet that surely is merely an expository device for indicating that the relations observed are in each case dependent upon the space-time framework to which the *body* of the observer belongs. The 'observer' might be replaced by a photographic plate, and the facts with which the scientific theory of relativity is concerned would remain unaffected.

The interest of the book lay, however, not in its handling of the scientific theory of relativity, but in its comprehensive presentation of that form of idealism upon the elaboration of which Lord Haldane had spent so many years of patient thinking and reflection. This was far from being a mere re-statement of what he had said before; it was the result of a careful working over again of the old material, in the light of maturer insight and wider experience. He had not been uninfluenced by the movements of speculation since the days of his Gifford Lectures. It now seemed to him advisable to name the essence or *prius* of reality not as thought or experience, but as knowledge,—knowledge in the fullest sense, including within it both feeling and conation. By 'knowledge' he evidently meant that which must in some way be conceived as a synthesis of both knowing and the known. Human experience was undoubtedly a type of knowledge; but it implied, as the ground of its possibility, knowledge that is final and ultimate. The world confronting us is, indeed, actual, and independent of us, its observers. Yet that is not the last word about either it or ourselves. Both belong to a greater entirety; and only in so far as they fall within the sphere of knowledge have they either being or meaning.

I have but little space left in which to refer to Lord Haldane's activities as an educationist. No politician of his time was more alive than he to the necessity of a thoroughly efficient educational system for a democratic State. He saw clearly that no system of elementary education ever can be efficient unless it form part of one comprehensive scheme in which the universities are given the lead. Frequently he laid before large assemblies, sometimes of students and sometimes of business men and manual workers, his conception of the ideal of intellectual culture, and of what the effort to realise it would mean for the welfare of the whole community. He was an ardent supporter of the Workers' Educational Organisation and of the Institute of Adult Education. The younger civic universities found in him a staunch friend; and, in the address which he gave on being installed as Chancellor of the University of Bristol in 1912, he spoke with enthusiasm of their manifold opportunities. But he was not less attached to the university system of his native Scotland. He was Chancellor of St. Andrews as well as of Bristol. "The corporate spirit of University life," he told the students of Edinburgh as their Rector in 1907, "needs but little surrounding for its development, and that little it finds as readily in the solitude of the Braid Hills as on the banks of the Isis or the Cam, in the walks round Arthur's Seat as in the gardens of Magdalen or Trinity." Nor ought one to omit to mention the signal services he rendered as chairman of the Royal Commission on University Education in London, appointed in 1909. The Report of that Commission, a remarkably lucid and exhaustive document, was issued in 1913; and put forward recommendations of far-reaching import, the adoption of which would have meant the establishment of an adequate and worthy university for the metropolis. If it be permissible to note small things along with great, I should also like to place on record that one of the last acts of Lord Haldane was to preside, in July last, over a gathering of friends met to do honour to Prof. John Dewey, of Columbia, the distinguished American educationist, on the occasion of a brief visit of his to Great Britain.

English public life can ill afford to lose a man of the uniqueness of Lord Haldane. If he had devoted himself wholly to philosophy, he would probably have left behind him scientific work of greater originality. But if he had devoted himself wholly to politics, it is certain that he would have influenced the world far less than he did and would not have been the striking personality he was.

G. DAWES HICKS.

IN Viscount Haldane the Empire has lost one of its foremost citizens, a man to whose abilities and devotion it owes an incalculable debt. The work for which history will chiefly remember him was done in fields that seem to occupy opposite poles of practical activity—war and law. Yet the greatness of his achievements in regions so diverse is not to be taken merely as a proof of versatility—which is often shallow as well as brilliant—or of restless energies ever seeking new

worlds to conquer. It was due rather to qualities central and typical in him : namely, his power to see the vital needs of the community steadily and as a whole, his profound conviction that those needs can be met only by unremitting intellectual labour, and his extraordinary capacity for getting broad ideas translated into administrative detail. The immense value of his services at the War Office during the critically important period from 1906 to 1912 is now universally recognised, and is his most obvious claim upon the gratitude of posterity. But his work, since 1918, as a member of the Judicial Committee of the Privy Council may prove, in the end, to have scarcely less importance. For the War, which left nothing unchanged, has transformed the British Empire we know into a Commonwealth of Sovereign Nations, and so created problems, legal and constitutional, of the utmost gravity and delicacy. It is characteristic of Lord Haldane's profound practical intelligence that he appreciated at once the emergence and significance of the new order, and of his patriotism that, ignoring medical warnings, he spent the whole reserve of his physical strength in seeking to guide upon sound lines the most amazing and possibly the most hopeful political experiment the world has seen.

When we consider what the country owes to this great public servant and how inadequately the debt was acknowledged, one is tempted to think that it scarcely deserved him. It is true that the ignorant and almost insane detraction which drove him out of the Cabinet early in the War is now silent, and that during the last years of his life he enjoyed increasingly general respect. Yet the respect was undoubtedly cool—even, one must admit, a little grudging. This is explicable in part by his lack of certain personal and temperamental gifts that make an easy popular appeal ; but the fundamental cause lies in a defect of the public mind which has again and again been deplored in the pages of NATURE. We do not mind a minister's having a little learning, provided that he wears it solely as a flourish upon his more solid qualities ; but we are incurably suspicious of one who attempts to bring theoretical ideas to bear upon important public business.

Now Lord Haldane was guilty of this fault in its worst form. It would not have mattered that, bred a student of philosophy, he remained one to the end. The serious thing was that his philosophy was the mainspring of his life, and that he sought deliberately to bring his immense practical capacity under its control. His mind was formed, at Edinburgh and Göttingen, under Hegelian influences, and these remained strong with him throughout life. (A month before his death he told the present writer that he had returned to the great works of Hegel and was pondering them nightly, sentence by sentence, in bed ; and added, with pathetic humour, that he deemed himself to be the last Hegelian left in Britain.) The value of his contribution to the Hegelian tradition is considered in another article, but it is essential to note here that for him its central doctrine took the form of a conviction that reality is to be identified with knowledge ; for that conviction gave unity and force to the whole of his life, and is the key to an understanding both of his achievements and of his limitations. From it was derived the profound appreciation of the value of science—rare both in a philosopher and in a minister of the Crown—which was expressed in his cultivation of personal relations with his great scientific contemporaries, in the eagerness with which he sought to grasp the significance of modern developments in biology and physics, and his ability to understand and utilise fully the services of expert advisers of the Government in matters of great national moment.

From it above all sprang his passionate belief in education. What Lord Haldane did in this field is not likely to be fully revealed, for so much was done behind the scenes and incidentally. But the cause of national education in all its grades had no more powerful friend ; and the immense progress that has been made in recent years owes a great deal to his wide vision, to his warm and watchful sympathy, and to the power of his persuasive advocacy exerted in quiet corners and at critical moments. University education, both in England and in Ireland, is particularly indebted to him ; and it was, perhaps, fortunate that the great friend of the new universities was one who had not been hypnotised by the traditions of Oxford and Cambridge. From Haldane's philosophical point of view, nothing was more essential to national wellbeing than a strong and comprehensive university system. The universities were, in his view, centres of consciousness where cultural and practical experience, in its chief modes, was to be worked up into that exact knowledge which would raise the level of reality of the nation's life. Thus is to be explained, for example, his enthusiastic co-operation in the founding of the London School of Economics and his general interest in enlightened professional education. From the same source sprang his invaluable faith in the destiny of such organs of general education as the Birkbeck College and the British Institute of Adult Education.

It was an unseemly jest of fortune that, in the public mind, Lord Haldane should be connected with the University of London mainly through his chairmanship of an unpopular Commission. The Report of that Commission was undoubtedly an extremely able document, full of interesting ideas courageously set forth, and inspired by a wide and lofty vision of the possibilities of the metropolitan University. The constitutional architecture it planned was, however, too formal, narrow, and precise, and it is unlikely that the untidy soul of the University could have inhabited it and grown in it happily. On the whole, it is lucky that events cut short a somewhat heated debate about its merits and demerits, and that the Departmental Committee, returning in 1925 to the insistent problem of the reorganisation of the University, could reconsider it in an atmosphere cleared by the storms of war. It would, however, be unjust not to recognise that the scheme of the Departmental

Committee embodied in the Statutes now awaiting confirmation, though it makes important concessions to historical features in the University which the Haldane Report treated rather shortly, yet draws from that Report most of its vital ideas. It must also be acknowledged that since 1913 feeling and opinion within the University have moved perceptibly and even strikingly towards a unity that makes those ideas more acceptable than they formerly were. It is too soon to prophesy about the University of London; but it may yet become a monument to the wisdom and imagination of those who saw in it possibilities of immense usefulness, and laboured to set it upon the path of realisation. Among these Viscount Haldane will certainly hold a very high place.

Lord Haldane was so accessible and so widely known that it would be impertinent for one who cannot claim exceptional intimacy to attempt a sketch of his personality. Such a one may, however, be permitted to record that in prolonged conversations in recent years, during which the great statesman, student, and man of affairs talked freely about many phases of his wonderful experience, he never uttered a word of bitterness, and that one caught glimpses of a faith, a courage, and a spiritual nobility that could not but evoke reverential esteem. T. P. NUNN.

News and Views.

THE members of the Council of the British Association elected at the Glasgow meeting are as follows (the names of new members are in italics): Prof. J. H. Ashworth; *Dr. F. A. Bather*; Rt. Hon. Lord Bledisloe; Prof. A. L. Bowley; *Prof. C. Burt*; Prof. E. G. Coker; Prof. W. Dalby; Dr. H. H. Dale; *Prof. C. Lovatt Evans*; Sir J. S. Flett; Sir Henry Fowler; Sir Richard Gregory; *Dame Helen Gwynne-Vaughan*; Mr. C. T. Heycock; Mr. A. R. Hinks; Sir Henry Lyons; *Mr. C. G. T. Morison*; Dr. C. S. Myers; Prof. T. P. Nunn; Prof. A. O. Rankine; Mr. C. Tate Regan; Prof. A. C. Seward; Dr. F. C. Shrubsall; Dr. N. V. Sidgwick; Dr. G. C. Simpson. Prof. J. L. Myres and Dr. F. E. Smith have been re-elected general secretaries. During the past year the Council was again deprived of the presence of Dr. E. H. Griffiths, general treasurer, owing to ill-health, but it is gratefully recorded in the Council's report that he did not allow this to deprive the Council of his valuable advice and reports on the finances of the Association. Nevertheless, Dr. Griffiths again tendered his resignation, and the Council, with the deepest regret, felt that he should not again be pressed to withdraw it. In accordance with precedent, the Council consulted a committee consisting of the president, general officers, and ex-presidents, in considering the nomination to be made in the room of Dr. Griffiths, as a result of which Sir Josiah Stamp has now been appointed to the office of general treasurer of the Association.

AN afternoon meeting at Glasgow of Section D (Zoology) of the British Association was devoted to a discussion of the work of the *Discovery* expedition. Dr. S. C. Kemp opened with a general account of the expedition; readers of NATURE will remember that Dr. Kemp has contributed articles dealing with the expedition to our columns (Oct. 30, 1926, and May 19, 1928). Mr. E. R. Gunther then described the distribution of the plankton on the whaling-ground, and Prof. A. C. Hardy showed its curiously discontinuous character. Unevenness was first revealed by his ingenious 'continuous plankton recorder,' but systematic netting during long runs indicated that the particular plankton (*Euphausia*) which is the food of the whale exists in dense patches a hundred metres or so in diameter and a kilometre or so apart. Mr. N. A. Mackintosh gave many interesting facts resulting from the examination of the carcases of 1683 whales. The growth was traced from the earliest embryo $\frac{1}{12}$ in. in diameter, through the recognisable fœtal whale of 6 in. long to the new-born 'baby' of 21 feet; then through lactation to weaning, and through adolescence to the astonishingly early maturity. The papers were discussed by Prof. Garstang, Dr. Chalmers Mitchell, Prof. Peacock, Mr. Heron-Allen, Dr. Cunningham, Mr. Arthur Earland, Dr. Bidder, Mr. Elmhirst, and others.

THE president of Section D, Prof. W. Garstang, in thanking the director and zoologists of the *Discovery* expedition for their communications, said that members of the Section had now heard preliminary accounts of all the *Discovery* researches. They had judged thereon that the scientific investigation had been well planned and well executed, and the interim reports alone were very valuable. In the name of Section D he assured Dr. Kemp and his colleagues that zoologists admire these achievements and the work which has led to them, and have full confidence that the further progress of the expedition will be marked by the successive attainment of valuable and well-founded results.

OWING to the regulations governing the introduction of scientific films into Great Britain, the paper by Prof. Rathjens on his explorations in Arabia had to be withdrawn from the programme of the recent International Congress of Orientalists at Oxford. It will be remembered that the Chancellor of the Exchequer has conceded that scientific films may be brought into England free of duty on a certificate from the Royal Society to the customs authorities that the film illustrates a scientific investigation (see NATURE, July 28, p. 138). Notwithstanding the fact that Prof. Rathjens on Aug. 9, and the secretary of the Congress on Aug. 10, had made application to the Commissioners of Customs for the admission of the film, and application was addressed to the Royal Society for the desired certificate, the customs authorities were prepared to admit the film only on a deposit of the duty, £31, 10*s*., "to be refunded in the event of the film being certified by the Royal Society." The ground for this decision was that the Royal Society being in vacation, it was difficult "to

make contact with officers of the Society qualified to give decisions in these matters." In the circumstances there was no alternative but for the paper to be withdrawn. A concession which functions only when the certifying body is not in vacation and its officers are accessible evidently scarcely meets the needs of the case.

THE justification for international congresses is, as Sir Charles Close states ("International Geographical Congresses," R. G. S.; 1928), that science is essentially international, and every worker finds, from time to time, the need of freeing himself from the intellectual preoccupations of his fellow-countrymen. This is especially the case with geography, which of all branches of knowledge requires most to be studied from the point of view of a citizen of the world. The first International Geographical Congress was held at Antwerp in 1871; the twelfth, in Cambridge in July last. The history and proceedings of these congresses reveal in some measure the progress of an old study under the precision imposed by modern science and modern needs. The record of the many resolutions dealing with cartography gives a strong impression that the map is the essential foundation upon which geography is built. It is therefore significant and interesting to note that the International Map of the World owes its inception to a suggestion made by Dr. Penck at Berne in 1891. The congress at Geneva in 1908 unanimously accepted various principles for its construction and prepared the way for the International Conference on the Map of the World which met in London in 1909; followed, after the Rome Congress in 1913, by a further Conference in Paris, when the Map was definitely standardised.

THE various sections into which each geographical congress has divided its proceedings reveal the width no less than the depth of geographical study. Nevertheless, the great guiding principle has been repeatedly enunciated. Fr. Alexis defined it at Paris in 1875 thus: "L'objet de la géographie est double: en premier lieu, la connaissance de la configuration naturelle de la surface terrestre, considérée en elle-même (géographie physique); en second lieu, l'étude du rapport de la Terre avec ses habitants (géographie politique, ethnographique, économique, etc.)." Sir Charles Close, in concluding his survey of the congresses, states: "The general aim is clear; by travel, by exploration, by the apparatus of maps, by detailed investigations, by the study of historical records, to learn all we can about the Earth, considered especially in its aspect as the home of man."

THE problem of crime is of more than biological interest, but it has its biological side, and Dr. Charles B. Davenport discusses this in the *Journal of Heredity* (vol. 19, No. 7, 1928), under the title "Crime, Heredity, and Environment." From the biological point of view, the important element in criminal behaviour is the failure of the individual to meet the requirements of the mores, that is, the conventional rules of behaviour, which differ in different countries. Such failure is due neither wholly to lack of suitable training nor wholly to heredity, but nevertheless behaviour depends upon the constitution of the individual criminal, and training, in order to be effective, must not be of a general miscellaneous kind, but must take cognisance of the special make-up of the individual. Dr. Davenport's first step in combating crime would be the prompt and painful punishment of the criminal, for this is not only a physical deterrent, but also, from the obvious sequence of cause and effect, it strengthens the weak inhibitions characteristic of most criminals. As a second step our author would study the individual to find out the particular trait of his character that has made the particular criminal act possible, in order to see whether anything can be done to correct that condition.

WE are of opinion, however, that Dr. Davenport has overlooked the very first necessity in combating crime, and that is the certainty of detection: first catch your criminal. On one occasion we discussed the problem with one of the best known of Scottish judges, who has studied the problem in America as well as from the Scottish bench, and his reasoned conclusion was that the amount of serious crime increases in proportion with the probability of eluding detection and escaping the consequences. The extraordinary number of serious crimes in proportion to the population of the United States as compared with those in Great Britain has to be read, he held, in the light of the high percentage of detection and subsequent punishment in the latter, in contrast with the high percentage of total escape, or escape from adequate punishment, in the United States.

THE Forest Products Research Laboratory, instituted at Princes Risborough under the auspices of the Department of Scientific and Industrial Research, has already been alluded to in NATURE. The investigations now being carried on are an outcome of the wholesale felling of woods in Britain during the War, the threatened shortage of supplies, and the waste in utilisation. The primary purpose of the laboratory is therefore to promote the more economical use of timbers by the wood-using industries of the country. This object can be attained through a knowledge of the strength factors of various timbers and grades of timber, by better seasoning, and so forth. A small pamphlet has recently been issued from the Laboratory on "The Uses of Home-Grown Timbers." This brochure has been compiled by a Committee representative of the Land Agents' Society, the Federated Home-Grown Timber Merchants Association, the Royal Institute of British Architects, and the Forest Products Research Laboratory. The investigations of the committee are of interest since they revealed three facts: (1) that architects in Great Britain usually specified for foreign timber owing to the variety of choice and the certainty of supplies; (2) apart from building operations, there were a great many outlets for home-grown timbers: with a closer knowledge of their properties a larger demand might be expected; (3) that this demand will be increased by the more careful seasoning and grading of the home-grown product. It is recognised that more scientific forestry methods are necessary for the production of straight clean timber free from knots, and that better facilities

for marketing would be obtained by the concentration of woods in large compact blocks. The greater part of the pamphlet is devoted to a schedule dealing with the most important of the home-grown timbers. Each timber dealt with is briefly described, and the demands for it are classified under the following five heads: (*a*) When the British timber is more often used; (*b*) when the foreign timber is more often used; (*c*) when both are more or less equally used; (*d*) when the British timber is more suitable; (*e*) when the foreign timber is more suitable.

PERHAPS one of the most important items in the programme of work which is being undertaken by the Forest Products Research Laboratory is a comprehensive study of the mechanical and physical properties of home-grown and imported timber. It is proposed to publish the results of these investigations as data become available and the lines of work are based on those already established and in use in similar laboratories in India, Canada, and the United States. In a recently published pamphlet entitled "Project 1, Mechanical and Physical Properties of Timbers—Tests on Small Clear Specimens," a detailed account of the methods employed in such investigations is given, together with a definition of the principal technical terms. The compilers of the pamphlet correctly say that much of this will be known to fellow investigators, especially in connexion with the standardised tests on small clear specimens. The main principle, which is clearly indicated in the pamphlet, is that a common standardisation of tests and standardised specifications have been adopted by India, Canada, and the United States; and the laboratory at Princes Risborough in England has fallen into line with the similar laboratories in the other three countries.

THE eighth annual report of the Council of the Research Association of British Motor and Allied Manufacturers is now available, and contains notes on many valuable papers which have been circulated among its members. Fundamental work on problems relating to springs and ferrous metallurgy in general has been attempted, and large numbers of air filters, manifolds, silencers, brake fabrics, and other motor components have been examined with the view of effecting improvements in design or to increase resistance to wear. It is to be regretted that the activities of the Association are hampered by lack of support of the industry, which by a voluntary levy of 6*d.* per motor vehicle could produce annually a sum much in excess of the subscription income of £4200 which was necessary under the conditions recommended by the Department of Scientific and Industrial Research to make the Association eligible for a grant.

IN celebration of the tenth year of the existence of Czechoslovakia, an exhibition of contemporary culture and scientific achievement has been arranged at Brno, in Moravia, and will remain open until the end of October. The exhibition is designed to show the progress made during the country's brief existence. The scientific and general studies conducted in different types of schools, institutes, and colleges are portrayed, culminating in the research exhibits from the science faculties of the universities and from special research associations. The great increase in the number and circulation of cultural periodicals, the production of books, and the number of libraries opened, afford a striking testimony to the progress made. The undertakings of governmental ministries and transport developments are also intimately connected with this cultural progress, and whilst new railways have been laid, air services opened, postal, telegraphic, and telephonic communications improved and extended in remote areas, much still remains to be completed, and such work already in hand is depicted as though it stood, like an artist's unfinished picture, upon an easel.

The Brno exhibition is arranged to show the close interrelationship between the State, the sciences, and general culture. The spread of ideas through the receipt of foreign journals and news is expressed by a long aisle, the white walls of which have dark lines to represent railway tracks. The engineering difficulties encountered in duplicating lines in poorly served areas have brought together specialists in different branches of pure and applied science, and such connexions are cleverly indicated. Other links, such as that of the Ministry of Health with the radium exhibit from Jáchymov and the products from other curative spas, are emphasised. The recent growth of towns, urbanism, is depicted by statistical designs among small-scale apparatus illustrating the latest methods in purifying water supplies, generating electricity, etc. Sciences concerned with inanimate matter and those which are observational and descriptive occupy the ground floor; the mathematical sciences are above, whilst the philosophical studies are placed still higher. Architecturally the main hall is a surprise of impressive spaciousness. The graceful parabolas of concrete admit a maximum of light; smaller surrounding pavilions contain exhibits of the public works of important towns and the arts sections of culture.

THE reports of the council and director of the Norman Lockyer Observatory for the year ended Mar. 31, 1928, show that, in spite of exceptionally unfavourable weather, the useful work which this institution has been carrying on for several years past has been well maintained. With the exception of an expedition (ruined by clouds) to Richmond, Yorkshire, to observe the total eclipse of the sun in June 1927, there has been little variation in the former programme of work, the main features of which are the classification of stellar spectra from original observations, the determination of spectroscopic parallaxes, particularly of early-type stars, and the special study of certain bright-line hydrogen stars. Considerable repairs to the observatory buildings have been carried out, and the equipment has been increased by the addition of some good lenses, which have been purchased at a low figure. Unfortunately the financial position of the observatory is not so favourable as might be desired, the

accounts for the year showing a deficit of £55 2*s.* 9*d.* It has been necessary to reduce the scholarship grant from £150 to £100 per annum. The income is still largely dependent on special donations and subscriptions, and it is greatly to be hoped that increased help will shortly be forthcoming so that the very valuable work which the observatory performs may be carried on without the embarrassment of inadequate financial means.

MR. L. A. REDMAN, the author of "The Einstein Delusion and other Essays," in a communication to the editor, objects to two passages in the short notice of his book in NATURE of June 23 (vol. 121, p. 979), namely, (1) "scarcely any reference is made to the original publications of Einstein and his successors," and (2) "other topics, mainly mechanical." The second objection is due to a misunderstanding of the term 'mechanical,' which in the notice is used in the wider sense 'pertaining to mechanics' (cf. "Chambers's Dictionary"); 18 of the 24 "other topics" can be included under this head. As regards the first objection, the title chosen by Mr. Redman for his book clearly points to the first essay as by far the most important in his own estimation; in fact, most of the others deal with problems familiar to students of mechanics and call for no special mention. The first essay contains 43 references of all degrees of importance, including a score or more to popular books, 8 to Einstein's popular (gemeinverständlich) tract on "Relativity," 4 to Eddington's "Space, Time, and Gravitation," 5 to various experimental papers, and 4 to the writings of Prof. Poor. There is no reference whatever to the *original papers* of Einstein himself, nor of Poincaré, Minkowski, Weyl, Levi-Cività, to mention only a few of his successors, and none to any authoritative treatise later than Eddington's "Space, Time, and Gravitation," not even to his "Mathematical Theory of Relativity."

THE International Federation of Intellectual Unions (Internationaler Verband für kulturelle Zusammenarbeit) announces a fifth congress to be held in Prague on Oct. 1–3. Lectures and discussions will centre round the theme "The Elements of Modern Civilisation." Among expected speakers are A. Fontaine of the Bureau International de Travail, Geneva, the architect le Corbusier, the psychoanalyst Jung, and the sociologist De Man. The first congress was at Paris under the presidency of Borel; since then the Federation has met in Milan, Vienna, Heidelberg, and Frankfurt. As now organised, the Federation is based on unions in Germany, Austria, Belgium, Spain, Esthonia, France, Hungary, Italy, Poland, Roumania, and Czecho-Slovakia. It is officially registered with the International Institute of Intellectual Co-operation in Paris. There is still no formally affiliated British union, but contact has been made with the Information Service on International Affairs, 10 St. James's Square, London, S.W.1, and Mr. Denis Buxton, of 43 Campden Hill Square, London, W.8, is one of the five members of the permanent committee. Applications for membership and for more detailed programmes should be made to the secretary of the Federation, Prince Charles de Rohan, Wien IV., 18 Rainergasse, Austria. The objects of the Federation include the fostering of personal relationships among the 'intelligenza' of Europe by opening correspondence with distinguished foreigners, by personal introductions, and by hospitality to strangers, especially those on professional errands. Any efforts to reconstruct European society may be welcomed. The history of international societies indicates that a definite aim and open adhesion have been conditions of lasting success.

LIEUT.-COLONEL J. T. C. MOORE-BRABAZON has accepted the invitation of the Council to become president of the Junior Institution of Engineers in succession to Sir Murdoch MacDonald. His induction will take place at a meeting to be held at the Royal Society of Arts on Friday, Dec. 7, when he will deliver his address.

WITH reference to the academic and other honours which distinguished the career of the late Viscount Haldane, it is noteworthy that he was elected to the fellowship of the Royal Society in November 1906, and thus whilst a commoner. Also, the date coincides with the election of the late Edward Cecil Guinness, Earl of Iveagh, both being specially selected for inclusion in the Society's ranks on the ground of services to the cause of science. It is of interest to recall that the above nominations were made during the presidency of Lord Rayleigh (1905–1908).

IN connexion with the forthcoming British Industries Fair (1929), we are informed that the space already taken in the Scientific Instrument Section is 6520 square feet, and 56 firms are participating. Thus the figures for the 1928 Fair, namely, 5990 square feet and 52 firms, have already been exceeded. The total space for the whole of the British Industries Fair at present allotted is 211,000 square feet, and 781 firms are taking part.

As in previous years, during the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff, will be able to give a few lectures to Chambers of Agriculture and Horticulture, Farmers' Clubs, Farm Workers' Associations, Agricultural Societies, etc., on the Rothamsted experiments. No fee will be charged for the lecturers' services, but any association engaging them would be expected to defray their travelling and hotel expenses and to make such arrangements for the lectures as may be necessary. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

THE Palæontologische Gesellschaft is to meet this year in Budapest on Sept. 26–29, and the meeting will be followed by excursions lasting until Oct. 5. The complete cost is estimated at 12 shillings a day. Communications are promised by K. Beurlen, T. Edinger, K. Ehrenberg, K. Lambrecht, A. Liebus, R. Richter, and O. H. Schindewolf. Details can be

obtained from "Direktion der Kgl. Ung. Geologischen Anstalt, Budapest VII, Stefánia-út 14."

IT was reported recently in the daily press that the late Count Vigyazo had bequeathed his estate, valued at more than two million pounds, to the Academy of Sciences at Budapest. The secretary of the Academy, in reply to an inquiry, informs us that the value of the bequest has not as yet been fully assessed, and that it is uncertain when the Academy will be able to enter into possession in view of the fact that several legal actions are still undecided, and the Count's title to certain parts of his possessions is being contested. The revenue of the estate would be used by the Academy exclusively for scientific and national purposes.

THE entire issue of *Die Naturwissenschaften* for June 1 is devoted to a summary of the results of a dozen recent researches carried out in the Kaiser Wilhelm Institute—in experimental embryology, on the cerebral cortex, and on various physical and chemical problems—and to records of the principal activities of the Kaiser Wilhelm Gesellschaft from April 1927 to March 1928, including the reports of the various Institutes. The reports afford striking evidence of the scientific energy and enterprise of the Institutes.

VOLUME 20 of the Collected Researches of the National Physical Laboratory has 444 pages, and includes 30 memoirs published in the years 1920–1927 dealing with questions of an optical character. Of these memoirs, Mr. T. Smith, the head of the Optical Division, is responsible for 13, which deal with the properties and defects of the component parts of optical instruments. Mr. Guild is responsible for 8, mainly concerned with colour measurement, and Dr. Walsh for 4 dealing with problems of photometry. A short abstract precedes each memoir, so that the reader may quickly make himself acquainted with its object and results. Any reader who does so must be impressed with the great value to the various branches of the optical industry of the work which has been done at the Laboratory during the period covered by the volume.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant bacteriologist at the University of Durham College of Medicine, Newcastle-upon-Tyne—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne (Sept. 22). An agricultural economist at the North of Scotland College of Agriculture—The Secretary, North of Scotland College of Agriculture, 41½ Union Street, Aberdeen (Sept. 22). A part-time woman demonstrator in chemistry in the Household and Social Science Department of King's College for Women—The Secretary, King's College for Women, Campden Hill Road, W.8 (Sept. 25). An assistant conservator of forests under the Department of Agriculture and Forests of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (Oct. 6). Male assistant superintendent of traffic (Class II.) in the London Telephone Service, and male assistant traffic superintendent in the Provinces, G.P.O.—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (Oct. 25). A head mastership of the King Edward the Sixth High School for Boys, Birmingham—The Secretary, King Edward's School, Birmingham. Evening lecturers in structural engineering and graphics, structural steelwork design, and reinforced concrete design, respectively, at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. An assistant wireless engineer for the Public Works Department of the Government of Hong-Kong—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/943).

Our Astronomical Column.

METEORS AND METEORITES.—The *Nineteenth Century* for September contains an interesting article by Mr. A. R. Hinks on meteors and meteorites, suggested, as he says, by Prof. Olivier's recent book on the subject. The book regards large and small meteors as members of the same class, but Mr. Hinks gives reasons for his dissent from this view. He recalls with approval Sir Robert Ball's suggestion that the larger meteors may have been expelled from terrestrial volcanoes in long past ages. Their orbits would continue to lie near that of the earth, so that an eventual return to it would not be improbable. He also regards as inconceivable the idea that meteors of the complicated 'plum-pudding' structure could have originated either in the sun or in interplanetary space; they must have been formed on some planetary body, and the earth is the most obvious suggestion. His argument might also be used to support Proctor's view that the comets of short period had been expelled from Jupiter and the other giant planets.

Mr. Hinks turns to the masses of iron which are classed as meteoric but were not seen to fall; he notes that five-sixths of them were found in America and Australia, whereas the recorded falls are in a majority in the old world. He explains this by supposing that most of these masses have never left the earth, but were, like the others, the products of volcanic activity. Their distribution may either indicate greater volcanic activity in certain regions in early times, or climatic conditions more suitable for the preservation of the meteors. The article also deals with cometary physics, and points out the inadequacy of mutual friction of particles to supply the violent expulsive force that was demonstrated to exist in the envelopes of Morehouse's comet; no solution of the difficulty is arrived at.

THE ORBIT OF ZETA HERCULIS.—This star has been a favourite object for double star observers owing to its short period and the brightness of both components. It has now completed three revolutions since discovery, and materials exist for a very accurate orbit. It is discussed very fully by E. Silbernagel in *Astr. Nach.* 5578. He studies the systematic errors of the observers. His final period is 34·417 years, the eccentricity being 0·455 and the semi-major axis 1·349″. There is some evidence of a progressive movement of the node of 1° in 10 years. Adopting a parallax of 0·100″, the masses of the components are 1·35 and 0·73 of the sun's mass. The diameter of the principal star is given as 2½ times the sun's, its density one-tenth of the sun's. Some people have suspected an invisible companion from supposed irregularities in the motion; the author does not think that the evidence requires this.

Research Items.

MUMMIFICATION IN AUSTRALIA AND AMERICA.—Mr. Warren K. Dawson has published in the *Journal of the Royal Anthropological Institute*, Vol. 58, Pt. 1, a study of the characteristic features of mummification as practised in Australia and America, based partly upon the published evidence, and partly upon a personal examination of such of the actual mummies or their photographs as are available—the latter a point of importance, as it has enabled the author to meet the contention, maintained by many writers, that mummification in South America is a result of natural causes, as it undoubtedly was in the early period in Egypt. In Australia the object of mummification was to secure the preservation of the body until the prolonged ceremonies after death had been completed. Hence it was necessary that the body should be portable owing to the frequent moving of the camp. The body was, therefore, preserved in a position which was often unnatural, the thighs sometimes being so far bent that the knees were forced behind the shoulders. Certain features which are meaningless in their context point to an introduced ritual. Such, for example, is the practice of mummification even when the corpse was destined for cremation or other form of destruction; the pains taken to remove the epidermis, though the whole of the body was afterwards burnt; the laying of the body on a roof-covered platform; and the painting of the body with red ochre and the attempt to give it a life-like appearance by painting the shrunken eyes. In Egypt by the twenty-first dynasty an artificial eye of white stone with black inlay had superseded various experimental methods. In the Torres Straits artificial eyes resembling those of Egypt, sometimes cowrie shells, were employed. The Australians, lacking the necessary skill, sometimes packed the eyelid with cotton, indicating the pupil by a pigment.

POTTERY-MAKING.—Some interesting suggestions as to the development of technique in pottery-making are made by Mr. E. W. Gifford as the result of a study of the distribution of the methods employed in making pottery by hand among the Indians of the S.-W. United States ("Pottery-making in the South-West," *University of California Publications in American Archæology and Ethnology*, vol. 23, No. 8). The criterion of method is the use of a wooden paddle and stone or pottery anvil in shaping the vessel, the anvil, which is usually of mushroom shape if made of pottery, being applied inside, while the paddle is used to pat or tap the outside. In the south-west the unaided hand method of coiling is that of the Pueblo tribes and the Navaho; the anvil and paddle are found among the Yuman, Shoshonean, and Piman tribes. Outside the special area under investigation, the non-paddle method of coiled pottery is that of America from the Alaskan shore of Bering Straits to Argentina, the negro portion of Africa, and is found sparingly in Oceania. Pottery anvils occur in the Middle and Upper Mississippi Valley, as well as in the Lower Colorado River Valley, being discontinuous in distribution. The paddle and anvil technique is also found in the north-west of India, Assam, and extends from south-east Asia through Malaya into Melanesia, but is not found in Africa. The investigation supports the independent development of pottery in the Pueblo region, and justifies the belief that the non-paddle method is the older so far as the south-west is concerned. Though it is possible that Pueblo pottery had a northern Asiatic origin, the potteryless area of northern North America is an objection. The paddle and non-paddle methods may represent earlier and later diffusions from the old world. The areas of distribution of the three types of pottery-making, anvil, paddle, and non-paddle, show the paddle as intermediate and the non-paddle as peripheral, which would point to the seat of the invention in the central area of the potter's wheel, *i.e.* that in which Egypt and Mesopotamia are situated. On the other hand, the non-paddle coiling might have been invented independently in Africa, Eurasia, and America, while the paddle method was invented both in Asia and in America. The wheel being invented in the Old World did not spread to America until the coming of the peoples of higher culture.

JUVENILE SPECIMENS OF THE LUNG-FISH.—Apart from specimens raised from ova, in which the maximum period of survival was two years, no juvenile Queensland lung-fishes have been seen, until in February 1928 seven young specimens of *Ceratodus* were discovered hiding amongst water weed in the Enoggera Reservoir near Brisbane. They were found accidentally during the clearing of weed from the reservoir. Heber A. Longman gives a summary of the literature bearing upon *Ceratodus* and describes the appearance and habits of the young individuals, which are now living in one of the large aquaria in the Queensland Museum (*Mem. Queensland Mus.*, vol. 9, part 2, 1928). The specimens measured from 96 mm. to 150 mm. in length. As a rule they breath through their gills at a rate of about fifteen inhalations a minute, although when they are disturbed the rate may be increased to at least sixty-eight times. The lung is very rarely used in normal conditions in the clear water of the aquarium during the day-time. The fish are most active at dusk and during the night, and although for the most part they are extremely sluggish and torpid, when disturbed they dart from end to end of the eight-foot aquarium with extreme rapidity. Their eyesight appears to be very poor, and they seem, unlike most fishes, to be insusceptible to vibrations. They are fed upon live worms and shredded pieces of raw beef, but have been seen apparently feeding upon algal growths on the water-weeds in the tank.

NORTHERN KINORHYNCHA AND TARDIGRADA.—Lieferung XI of "Die Tierwelt der Nord- und Ostsee" (Akademische Verlagsgesellschaft m.b.H., Leipzig) contains good accounts of these two curious and interesting groups. The Kinorhyncha (VII. d_2), described by Adolf Remane, are minute animals living on mud and ooze on the sea bottom and on marine algæ. Dr. Mortensen has recently (1925) constructed a special net for collecting such organisms, which should prove extremely useful. Many species are only known in the larval condition and few have been seen to change into the adult. Before the last change takes place the animal may be sexually mature. Three orders, five families, and six genera, besides some forms not known in the adult state, are recognised from this area. All are minute, ranging from 180 μ to 1 mm. in length. They are elongated, bilaterally symmetrical animals, with 13 segments (rarely 14). There is a strong spinous cuticle with an anteriorly protruding proboscis reminding one of *Echinorhynchus*, at the apex of which the mouth opens. A true cœlom and blood system are apparently absent. The Tardigrada, by G. Rahm (XI*b*), contains a survey of the marine forms. Some are commensals or parasites on echinoderms, others occur on the sea bottom or above high-water mark. The capacity in the land forms for reviving after prolonged desiccation is well known, a dried-up ball

on being moistened soon becoming an active animal, and it is now known that the marine species act in the same way. No true metamorphosis takes place, the young being like the adult, but changing its skin frequently. Both the Kinorhyncha and the Tardigrada are now regarded by many as akin to the annelids, the former group being at one time placed near the rotifers, the latter, as in the present work, near or with the arthropods. Their affinities are very difficult to determine, and much more work is required before the question can be settled. Both groups offer a fertile field for marine zoologists.

INFECTION WITH MALE SCHISTOSOMES ONLY.—E. C. Faust (*Jour. Parasitology*, **14**, p. 62; 1927) records the presence of male schistosomes alone in experimental infections. Ten thousand living snails (*Oncomelania hupensis*), all found in the vicinity of Soochow at five periods from March to September 1926, were gently crushed one at a time, and twenty were found to be infected with the cercariæ of *Schistosoma japonicum*. Rabbits or dogs were submitted to infection with hundreds of mature cercariæ, but when examined post mortem from one and a half to five months later, only immature male worms were found. From 33 to 165 worms were present in the respective hosts, and a total of 725 in the nine hosts infected, and all the worms were male. In previous experimental infections from snails collected in the Soochow area no consistent series of only male or only female worms has been obtained. According to Cort's hypothesis (1921), that sex is differentiated in the miracidium stage and that all cercariæ which develop from a single miracidium are of the same sex, the results recorded would indicate that the snails were parasitised only by male miracidia, but it is conceivable that the dry conditions prevailing in the area may have been more severe on the female than on the male parthenitæ in the snails. Natural human infections acquired under such conditions might have consisted of male worms only, and hence could not have been diagnosed by the finding of eggs in the fæces. While such infections would not have the same destructive action on the liver and intestinal tract of man as those produced by males and females resulting in the extrusion of eggs into the tissues, if the males were numerous they might obstruct the mesenteric radicles and their secretions occasion an appreciable eosinophilia. Suspected schistosome infections in endemic areas where stool examination is consistently negative might be studied in the light of these experiments.

TEMPERATURE AND ELECTRICAL STIMULATION OF PLANT TISSUE.—In a recent paper, Dixon and Bennet-Clark discuss evidence for the belief that the electrical conductivity of a tissue is largely due to the permeability of the protoplasmic membranes of the component cells to ions, and that a change in conductivity is due to and proportional to a change in the permeability of the protoplasts (*Sci. Proc. Roy. Dublin Soc.*, vol. 19 (N.S.), No. 4). Their experiments show that there is a continuous change in conductivity with a continuous increase in stimulation until stimulation becomes lethal, and it is supposed that the rise in conductivity due to smaller stimuli is of the same kind as the rise observed with lethal stimuli. Some experiments on leaf tissue of *Hedera helix* showed that there is marked seasonal variation of sensitivity, seemingly unaffected by the temperature obtaining at the time of gathering the leaves. In spite of this, however, the temperature of the tissue when stimulated has a very profound effect upon the response. In general, rise in temperature brings about a decrease in resistance, and at temperatures between 20° and 35° C. a change of 1° may alter the magnitude of the response as much as ten per cent. At the temperature of 50° C. and upwards, the resistance never assumes a steady value, but decreases continually with time until the resistance characteristic of a dead and completely permeable tissue is attained.

THE SHIMABARA (JAPAN) EARTHQUAKE OF SEPT. 8, 1922.—A recently issued *Bulletin of the Imperial Earthquake Investigation Committee* (Tokyo) (vol. 10, No. 2), contains three brief notes on this important earthquake, one by the late Prof. Omori and two by his successor, Prof. A. Imamura. The Shimabara peninsula projects from the coast of Kiushiu, the southern island, and contains in its centre the great active volcano, Mt. Unzen. There were two strong shocks, the earlier and stronger at about 1.50 A.M., the other at about 11.3 A.M. As they originated in centres about 4½ miles apart, Prof. Imamura regards them as forming a twin earthquake. Prof. Omori shows that they differed in two respects from ordinary volcanic earthquakes. The depth of the focus was considerable, about 21½ miles, and the number of after-shocks was unusually great, amounting by noon on Sept. 11 to as many as 1417. A few months after the earthquake, a new line of levels was run along the north and east coasts of the peninsula, and a comparison with the earlier series, made about thirty years before, indicates a small but general rise of the peninsula by amounts ranging up to 8·3 cm. On the other hand, tidal observations made a few miles to the west point to a subsidence of 2 cm. or 3 cm. in about the same interval.

VISCOSITY OF PETROLEUM PRODUCTS.—This subject was dealt with in a paper of the Research Association of British Motor and Allied Manufacturers, by H. S. Rowell and D. Finlayson, read recently before the Institution of Petroleum Technologists. Actual needs of car practice were considered and the conclusions were regarded from the point of view of the user. The fluidity of motor fuels was measured, and from the results obtained it appeared possible that viscometry, combined with densimetry, would be an effective method for the analysis of complex fuels. The authors have extended our knowledge of viscosity-temperature curves of lubricating oils into the relatively unexplored regions beyond 150° C., and they have proposed a new viscosity characteristic, viscosity multiplied by $\left(\frac{t+10}{100}\right)^3$, where t is temperature in degrees centigrade, in order to show more clearly ratios of the viscosities of different oils at the same temperature and the extent of difference in the viscosity-temperature variation of different oils.

STRONG ELECTROLYTES.—The outstanding flaw in Prof. Debye and Dr. Hückel's theory of strong electrolytes, that it leads in some cases to negative values for the ionic radii when compared with experiment, is removed in a paper published by T. H. Gronwall, V. K. la Mer, and K. Sandved in a recent issue of the *Physikalische Zeitschrift* (No. 12). Previous attempts to explain the anomaly had proceeded on the lines of a revision of some of the fundamental physical assumptions, but it is now shown that the error has actually been in the mathematical development, an insufficient number of terms having been employed in a certain series. The analysis involved is exceptionally heavy, but has been followed through with satisfactory results for dilute solutions of the ions produced from salts such as potassium chloride and zinc sulphate, and is to be extended to cases where the dissociation is unsymmetrical. In the following issue of the same

journal, Prof. Debye himself and H. Falkenhayn have extended the original theory to include the case of conductivity in alternating applied fields, when allowance is made for the Brownian motion of the ions.

THE INFRA-RED REGION OF THE SPECTRUM.—Sir Robert Robertson, J. J. Fox, and E. S. Hiscocks, in a series of papers published in the *Proceedings of the Royal Society*, Series A, vol. 120, No. A 784, p. 128, describe an experimental technique which permits of the employment of a rock-salt prism spectrometer for the determination of the fine structure of absorption bands in the infra-red region. They have applied this technique to the measurement of the absorption spectra of the gases ammonia, phosphine, and arsine. The oscillation bands found for these gases show definite series relationships. The main sequence of bands obeys approximately the relation $\nu = n\nu_0$, but the Kratzer relationship, which applies to dipoles, does not hold here. In all three gases, the wave number of the fundamental is much lower than expected. The ratios of the wave numbers of corresponding bands for any two gases are constant, indicating that the unit mechanism which accompanies the absorption process is similar for the three gases investigated. The oscillation of the molecule becomes slower as the mass increases. Two other sequences of bands are present, there being a close resemblance between the bands for arsine and phosphine. In the ammonia spectrum, there is found a band at $10{\cdot}55\,\mu$ which is unique. From the fine structure of a number of these bands, the moments of inertia and the radii of gyration of the molecules have been calculated. There is a constant ratio between the radii of gyration and the half diameter of the mean collision area of these gases found by Rankin, the radii increasing with the mass of the molecule. The researches have brought to light new types of rotation-oscillation bands which are characterised by the presence of very pronounced maxima in the centre of each band. It is not clear whether these maxima are due to zero branches of a hitherto unknown type or whether the bands are composite in character. A molecular model for ammonia, phosphine, and arsine is put forward tentatively. The experimental data are best interpreted on the assumption of a tetrahedral model.

THE QUANTITATIVE DETERMINATION OF HÆMOGLOBIN.—A large number of methods have been evolved for the quantitative determination of hæmoglobin, but practically all of them suffer from the disadvantage that the final result depends upon the comparative judgment of tints between a standard and the sample solution by the naked eye. In a recent paper published by the Institute of Physical and Chemical Research, Tokyo, K. Uchiyama describes how the silver iodide photoelectric cell may be utilised for the estimation of hæmoglobin. Three methods of procedure are explained, and these were found to yield satisfactory results. In the same way, the concentration of the colouring matter in any solution absorbing light to which the cell is sensitive may be determined.

CONDITION OF SPARINGLY SOLUBLE SUBSTANCES IN GELATINE.—Sparingly soluble substances, such as silver chloride or lead iodide, when formed in the presence of a gel, are sometimes considered to exist in the supersaturated condition. Results obtained by A. C. Chatterji and N. R. Dhar have shown that this view is probably incorrect and that these substances are mainly present in the colloidal state. This conclusion is based on conductivity measurements, and further results to support it are published in the *Journal of the Indian Chemical Society* (vol. v. No. 2). Silver chloride was formed in gelatine solution by the addition of equivalent quantities of silver nitrate and potassium chloride, and the results indicated that if the silver chloride were present in the ionic condition its conductivity should have been much greater than that actually found. Chatterji and Dhar also consider that results obtained by Bolam and Mackenzie (1926) with silver chromate and gelatine support the above conclusion.

THE DIELECTRIC POLARISATION OF LIQUIDS.—The calculation of the electric moments of molecules from dielectric constants is of considerable value in the elucidation of molecular structure, but this calculation cannot be applied in the case of molecules which are surrounded by strong fields of force, and in such cases it is necessary to use solutions in which the molecules with strong fields of force are surrounded by molecules with weak fields. An investigation of the dielectric constants and densities of solutions of the chlorobenzenes in benzene and hexane is described by C. P. Smyth, S. O. Morgan, and J. C. Boyce in the *Journal of the American Chemical Society* for June. A capacity bridge was used for the dielectric constant measurements. The results indicate that the molecules of the chlorobenzenes tend to orient themselves in such a way that neighbouring doublets oppose one another and thereby decrease the polarisation. This effect is most marked with molecules which have high electric moments, and increases with the concentration but decreases with rise in temperature. In a second paper in the same journal, Smyth and Morgan describe the results of the measurement of the dielectric constants of solutions of ethyl bromide, chloroform, and chlorobenzene in hexane over the entire range of temperature and concentration within which the mixtures are liquid. These data have been used to obtain approximate values for the polarisation due to shifts of atoms and groups within the molecule and also to obtain accurate values for the electric moments. The validity of the Debye equation for the variation of dielectric constants with temperature as applied to liquids at infinite dilution, was also verified.

A NEW TYPE OF TUNGSTEN-FILAMENT LAMP.—Attention is directed in the *Chemiker-Zeitung* for July 25 to a new German patented process for producing tungsten filaments for incandescent lamps, which are capable of producing much more intense illumination than has hitherto been possible. The process depends upon the formation of long single-crystals of the metal, which differ considerably in properties from the ordinary polycrystalline variety. They are not disintegrated at high temperatures like ordinary filaments and consequently they do not blacken the inner surface of the container. The preparation of such long or single crystals in the form of threads was described in 1926, and many attempts have been made to utilise this material in the form of coils for incandescent lamps. Hitherto these attempts have been unsuccessful, owing to the tendency of the bent single-crystal to revert to the polycrystalline condition during the burning of the lamp. This tendency, which appears to be due to the mechanical strain involved in wrapping or coiling the filament, has apparently been successfully overcome at the Technische Hochschule in Dresden, and it has been found possible to construct 5 kilowatt and 10 kilowatt lamps with an average intensity of 8000 candle-power, although a maximum intensity of 60,000 candle power is said to have been attained. The lamps have a life of 800 burning hours, and a company has been formed in Dresden for the purpose of manufacturing them. They are likely to replace arc-lights for many purposes in industry.

Regulations for International Radio Communication.

THE regulations that were arrived at by the International Radiotelegraphic Convention at Washington in November 1927 have now been published by H.M. Stationery Office (price 2*s.* 6*d.*). It is satisfactory to find that the regulations, although naturally somewhat complicated, were signed by the eighty governments which took part in the convention. They start with the definition of what is meant by 'radioelectric communication' or radio communication. It includes the transmission of writing, signs, signals, facsimiles, and sounds of all kinds by Hertzian waves. The International Bureau of the Telegraph Union is charged with the duty of collecting information of all kinds in connexion with radio services and of doing work for the international radio services.

Radio 'emissions' are divided into two classes, *A* and *B*, which consist of continuous waves and damped waves respectively. Class *A*, continuous waves (*C.W.*), are further subdivided into *A*1—the unmodulated waves which can be varied by a telegraphic key; *A*2, comprising the *C.W.* which are modulated at ordinary frequency and can be varied in a periodic manner at audible frequency; the final subdivision, *A*3, consists of *C.W.* waves modulated by speech and music. No new broadcasting station shall be authorised to work in the band of frequencies between 160 and 224 kilocycles (kc.), that is, between wave-lengths of 1875 and 1340 metres.

A full syllabus of the knowledge required by radio-telephone operators before they are granted the necessary certificate is given. The distress call has absolute priority over all other signals, and all transmissions which might interfere with it must immediately cease. This rule also applies to a radio-telephone distress call which consists merely of the spoken expression 'mayday,' which corresponds apparently with the French pronunciation of *m'aider*. In order to increase the safety of life in ships and aircraft, all stations in the mobile maritime service must watch for the distress wave 500 kc. (600 m.) from the 15th to the 18th minute and from the 45th to 48th minute after every hour, Greenwich mean time.

For mobile stations the use of damped waves is restricted to eight frequencies lying between 375 kc. and 1364 kc. (800 m. and 220 m.), but the use of one of these types, 665 kc. (450 m.) is forbidden in all regions where it interferes with broadcasting. The term radio beacon (radiophare) is confined to those stations the emissions from which enable the receiving station to determine its bearing. A direction-finding (radiogononiometric) station means one provided with special apparatus to determine the direction of the emissions from other stations. The words 'phare' and 'gonio' are always shown after the name of radio beacon and direction-finding stations respectively. It is to be noticed that administrations which have organised a radio beacon service accept no responsibility for errors due to utilising it.

In an appendix, international radiotelephonic procedure is described. The formulæ for calling and cutting off are given in French or English and are very familiar to many amateurs. In French, if *A* is calling *B*, he says, 'Allo *B*, allo *B*, *A* appelle, *A* appelle, Message pour vous, Message pour vous, over.' The 'over' seems to be English. In breaking off the communication, *A* replies, 'Allo *B*, *A* répond, exact, exact, coupant.' 'Coupant' means switching off. For land stations the geographical names are employed, but for mobile stations the radio call signs are used.

The Management of Small Woodland Areas.

IN matters pertaining to forestry, both the preservation of existing woodlands and reafforestation, the various States comprised in the United States of America hold varying positions and outlooks. Some are unquestionably facing the question in the spirit which its undoubted economic importance to the nation and to the individual States requires. The State of Illinois affords a striking illustration. A recent *Bulletin* (vol. 17, article 2, 1927) issued by the State Department of Registration and Education, Division of Natural History Survey, is entitled "A Manual of Woodlot Management," by C. J. Telford. This manual is addressed to those landowners who have woodlots (*i.e.* woodland areas) or idle land. "It is assumed," says the author, "that they appreciate the intangible benefits accruing from the woodlot as a refuge for wild life, as a local modifier of dry and cold winds, as a protection to the sources of local water supply, as a means of enhancing the beauty of the landscape, and as a place for recreation; and that they also appreciate the service to the nation rendered by productive forests." These are large assumptions upon which to base a manual of forestry, and the past history of most countries has shown but too often that, taken collectively, such an assumption has not been borne out by the reality. This being said, it will not be the author's fault if the landowners of Illinois do not realise some of the benefits which the application of the recommendations of this manual place it within their power to achieve.

Briefly, Mr. Telford commences by defining the true forest lands in the State, outlines the methods for the proper management of the woodlot, and gives the general returns to be anticipated from the managed production of wood. The point kept in view in his treatment of the subject is the growing of a wood crop for the production of revenue. In part the manual is a simple text-book on sylviculture, but the author goes further afield and discusses the methods adapted to the growing of timber in this particular State under different conditions of site and market, and the methods of measuring and marketing the products. Space precludes the possibility of dealing at any length with this little book, but attention may be directed to one or two aspects. The first is that the author confines himself entirely to the State of Illinois itself: the different soils, types of existing forest, the species occupying different areas, and those most suitable for replanting felled areas or blanks in existing woods or afforesting waste lands, and so forth. In other words, the work is a practical effort at providing the owner of woodlands or waste lands with the information necessary to improve their condition or plant them up, estimates of values and markets for different classes of materials being based on the existing and prospective demands within the State. Herein lies the value of the manual.

The author's recommendations are further assisted by the offer of the State Natural History Survey to help woodland owners with practical advice from the State officers as regards management. In this connexion the aims pursued by the Natural History Survey are given (in Appendix F) as follows: (*a*) To take account of the value of woodlands, existing or

proposed, for recreational uses, not only by the inhabitants of the larger cities of the State, but also by the country people and the inhabitants of the smaller towns whose home surroundings are often oppressively monotonous; (*b*) to consider the uses of forests as preserves of the primitive life of the State, of great interest and value to the student of science and his teacher and to the lovers of wild life; (*c*) to co-ordinate the forest policy of the State with the movement for the establishment of a system of State parks.

A study of this manual and the appendices may be recommended to all interested in the progress of afforestation in Britain and in the development of a forest policy on sound lines.

Mountain-Building Movements and the Genesis of Petroleum.

By HENRY B. MILNER.

THE influence of mountain-building movements on oil migration and accumulation has long been recognised, and is so plainly manifest in different petroliferous provinces all over the world, that it has become one of the least controverted theories in the general hypothesis of oil occurrence. In the past decade, the teachings of the Alpine school in Europe have especially helped to clarify this relationship, and developments in the oilfields of Galicia, Rumania, Iraq, Persia, Burma (to cite only a few) are constantly impressing us with its significance.

An unorthodox, and to some extent novel, aspect of the matter is viewed by Mr. John L. Rich in a paper entitled "Generation of Oil by Geologic Distillation during Mountain-Building,"[1] in which he follows more or less similar ideas put forward by Bailey Willis some years ago. He starts off with the fact that in regions of intense mountain-building movements, carbonaceous shales are seen to have lost their 'kerogen' or oil mother-substance, such hydrocarbon, however, being present in equivalent rocks without the metamorphic zone. The destiny of this 'lost' petroleum is traced in accordance with the latest theories of orogenesis, though not entirely by stages usually recognised in this particular natural history.

Rich defines at the outset his geosyncline, with its accumulation of thick series of bituminous sediments under deposition (conventionally) in a sinking basin. The next phase is mainly orogenic, concerned with the piling up of thrust-sheets *over* (the italics are mine) the geosynclinal sediments, this accompanied by a kind of synclinorial folding of the sediments beneath the nappes, further by the inevitable isostatic sinking. During this stage oil is generated by heat and dynamic movements, apparently beneath the nappe zones, the environment simulating that of a "giant high-pressure cracking still." There follow successively peneplanation and further unwarping of a regional character, and finally the delineation of three distinct zones. Zone 1 is the zone of distillation, *i.e.* intense dynamic metamorphism, where the bituminous rocks have suffered devolatilisation, carbon ratios are high, and possibly only small quantities of gas remain. Zone 2 is the zone of partial distillation, and what Mr. Rich calls *in situ* accumulation. In this zone the rocks are partly devolatilised, carbon ratios are medium, and oil is plentiful. In Zone 3 the unaltered rocks occur, and the influence of active dynamic distillation has not been felt; consequently carbon ratios are low, oil is scarce, and what there is of it has probably migrated either during orogenic movement or afterwards in response to hydraulic factors.

Thus it will be gathered that the author arrives at the explanation of this type of oil-pool in a somewhat different manner from that often given; also, he ascribes considerable importance to the upwarp phase, when rocks formerly subjected to distillation are exposed to inflow and artesian circulation of meteoric waters, causing extensive secondary migration of the oil. This putting of 'the cart before the horse' is probably the most contentious part of the theory. On the other hand, if there is anything in the hypothesis, then contiguous deposits to areas of carbonaceous shale occurrences, given the requisite evidence of earth-movement on a large scale, should be worth inspection for oil, undoubtedly an invigorating prospect. The author cites the Oklahoma-Kansas-Missouri-Iowa region as his example; possibly the reader may call to mind another.

[1] *Bull. Amer. Assoc. Petroleum Geologists*, vol. 4, pp. 1139-1149; 1927.

Herring Food.

DR. P. JESPERSEN, in an important memoir, gives a detailed account of the food of the herring in Danish waters ("Investigations of the food of the Herring in Danish Waters," *Meddelelser fra Kommissionen for Havundersøgelser*. Serie: Planton. Bind 2, No. 2, 1928. Copenhagen). This was undertaken at the instigation of the International Council for the Investigation of the Sea, and is part of a general scheme for working out the biology of the herring in different countries of Northern Europe.

The research is based on the examination of the stomach and intestine contents of a large number of fishes at different stages of development, with special reference to the diet during growth from larva to adult, noting variations in the nature and quantity of the food in different waters and at different seasons. More than 7000 fishes were examined, nearly 3000 of which were young stages between 4 mm. and 50 mm. in length, the remainder being adolescent and adult.

The results of the examination of the larval and young stages agree with former observers. It is found that those retaining the yolk are able to feed, although there is less food (chiefly green remains) inside them, in proportion to their size, than in the post-larvæ. After the absorption of the yolk sac much more food is taken, the size and amount of food increasing with the size of the fish. Phytoplankton and very small zooplankton is found in the smallest fishes, larger copepods and other small planktonic animals in those of larger size. Copepods predominate, especially *Temora longicornis* and, next in importance, *Pseudocalanus* and *Paracalanus*. The young herring 6-17 cm. in length, feed largely at all seasons, chiefly on copepods, but also at times on cladocerans, polychætes, *Sagitta*, and appendicularians. The adult herring 17-30 cm. in length, feeds mainly on Crustacea, but there is a considerable variation in its food according to season and locality. In the breeding season herring eggs are often eaten. In most localities, as has been shown by previous workers, spawning herring as a rule do not eat, although occasionally one finds full herring and those actually spawning with a large amount of food inside. Here they have been found to contain a considerable quantity of food,

especially the mature spawning herring. The young herring eat more than the adults; the relative number eating is greater and also the average number of organisms eaten per herring. The food varies in the herring from the four localities investigated. It is striking that no euphausiids, important as herring food elsewhere, find a place amongst the food of the Danish herring.

The whole work shows clearly that different food is eaten in different localities and different seasons, that different-sized herrings eat different sorts of food, and that adolescent herrings eat more than the adults. Also that copepods as a whole are the most important organisms in the food of the herring from Danish waters.

This memoir embodies a very large amount of work clearly stated, and is a most valuable addition to the literature rapidly accumulating on the biology of the herring.

Genetics of 'Bar-eye' in *Drosophila*.

THE allelomorphic series of mutations in *Drosophila* known as bar-eye and ultra-bar have been much investigated owing to their variability in the number of ommatidia present. It has been shown, for example, that increasing temperature (15° C. to 31° C.) causes a decrease in the number of facets which is of an exponential or linear order; and that this rate of decrease is more rapid in bar than in full eye, and most rapid of all in ultra-bar. Flies which are heterozygous for any of these genes are intermediate in mean facet number between the corresponding homozygous parents developed at the same temperature; but they approach more nearly to one parental condition than to the other, so that one of the conditions may be considered dominant. Near 27° C. is a critical temperature at which change of dominance takes place. Others have shown that at or near this temperature, growth and rate of development both cease to be accelerated. A rise in the frequency of crossing-over in the second chromosome has also been shown to take place at about this temperature, as well as the maximum amount of muscular contraction from a certain stimulus.

These results indicate that some general protoplasmic reaction is involved. More recently, Mr. A. H. Hersh (*Jour. Exptl. Zool.*, vol. 47, No. 2) has shown that in crosses of the bar series the Mendelian dominance differs in the reciprocal crosses as well as with the temperature at which the larvæ were reared, 27° C. being a critical point. He concludes that the cytoplasm of the egg plays some part in determining the size of the eye. Unlike reciprocal hybrids have long been familiar in *Œnothera*, but very few cases have been described in animals. It is suggested that characters in general may form a series with a few at one end determined solely by the cytoplasm, many at the other end determined wholly by the nuclei, and some between, such as the bar series, determined partly by both.

In another paper (*Jour. Exptl. Zool.*, vol. 50, No. 2) Mr. Hersh has analysed further the bar series. Zeleny showed that the compound eyes of such flies have a dorsal and a ventral lobe, which also shows in flies with full oval but mosaic eyes. Such bilobing is common in Diptera and occurs in other insects. Mr. Hersh shows that in the bar series, with increasing temperature, the number of facets in the ventral lobe decreases faster than in the dorsal lobe, and suggests that the optic stalk forms the line of separation between the two lobes. It is concluded that the genes of the bar eye series produce their effects by altering the distribution of growth in the developing organism.

University and Educational Intelligence.

LONDON.—The Connaught Hall of Residence (14 Bedford Place, W.C.1), recently presented to the University by His Royal Highness the Duke of Connaught, will be ready for students of any of the colleges and 'schools' of the University at the opening of the session in October.

THE University College of Wales, Aberystwyth, has established a Travelling Scholarship Fund which is used for the purpose of enabling members of the staff and students to visit foreign countries for the purpose of extending their studies. The grants made are quite small, generally £10, but are, the Council reports, greatly appreciated. Last year seven members of the staff, three past students, and forty students received such grants.

"ACCREDITED HIGHER INSTITUTIONS," a pamphlet issued as *Bulletin*, 1927, No. 41, by the United States Bureau of Education, shows that in the absence of any central controlling authority a fairly complete system for standardising educational institutions has been evolved by voluntary associations. It gives lists of institutions of higher education accepted by certain national and regional associations as meeting their standard requirements. Most of these requirements are set out in full, as are also the college, junior-college, and teacher-training college standards of the American Council on Education, which took the initiative in formulating standards for general adoption in accrediting institutions, but is not itself an accrediting agency. The other associations are: the Association of American Universities, five regional (Middle, Southern, North Central, North-Western, and New England) Associations of Colleges and Secondary Schools, the American Associations of Junior Colleges and of Teacher-Training Colleges, and a number of professional associations. Of fully accredited professional schools there are 71 medical, 26 dental, 53 pharmacy, 65 law, and 15 librarianship.

THE Council of the City and Guilds of London Institute has recently issued a report for 1927—the forty-eighth annual report since its incorporation. Of its three departments, namely, the City and Guilds (Engineering) College at South Kensington, the City and Guilds South London Technical Art School, and the Department of Technology, the first, which is the largest of the three colleges constituting the Imperial College of Science and Technology, was attended during the year by 506 students. Notwithstanding the continued depression of the engineering industries, the number of entries to the college is maintained, thanks to anticipations of a growing demand in the near future for electrical engineers. Of the 188 candidates for admission, 34 (more than twice as many as in the preceding year) came from schools outside Great Britain: 23 were from India. A very large proportion of the students, nearly 40 per cent, were scholarship holders, the total sum awarded by external authorities to students during the session being £16,346. Post-graduation classes in electrical engineering, the value of which has been recognised by industrial firms, increased notably, and 14 students were awarded the post-graduation diploma of the Imperial College. Since the formation of the Imperial College Appointments Board, 728 engineering students have been registered, of whom, so far as is known, only 17 are unemployed.

Calendar of Customs and Festivals.

September 16.

THE SAKAIA.—The ancient Persians celebrated a festival called by Greek writers τὰ Σάκαια, the Sakaia, attributing to it a Scythian origin. Varying accounts are given of how it arose. It seems possible that it was of Babylonian origin. The festival of the Sakaia at Babylon, according to Athenæus, took place on the sixteenth day of the month corresponding to the Attic Boedromion (September). At this festival, Athenæus says, the masters were ordered about by the slaves, one of whom governed the house, and was clothed like a king. In the Persian festival a condemned criminal was clothed like a king and allowed to rule the land, drink and misconduct himself with the king's wives; but afterwards he was taken away, scourged and hanged. In the spring festival at Babylon the king's insignia were taken from him, his ears were pulled and his cheek smitten.

THE ABBOT'S-BROMLEY (STAFFORDSHIRE) HORN DANCE.—This dance takes place on the Monday following the first Sunday after Sept. 14. It is still recognised as a solemn ceremonial and is danced in all seriousness, although a certain amount of licence is allowed the buffoon. The accessories, the reindeer horns, the ladle, and the bow and arrow, hang all the year round in the church, and the dance starts in the morning from the church after receiving the benediction of the vicar. The dancers are twelve in number, one being a boy who carries the bow and arrow. There are two musicians, a fool, a hobby-horse, a Maid Marian with the ladle, and six dancers who hold the horns on their heads as they dance.

This dance has an unbroken tradition of four hundred years, but is of course much older, and, so far as appearances go, might well be descended from the horned dancer painted in palæolithic times on the walls of the cavern of Les Trois Frères at Ariège in the south of France. It is clearly closely related to the bear and other mimetic animal dances of the tribes of north-eastern Asia and North America. During the day the dancers cover a circuit of about fifteen miles, dancing at each house they visit, and finish up by dancing up the village street, while everyone watches from the house door to share in the good luck. Whether the dance is propitiatory, sacrificial, or a piece of sympathetic magic, is obscure. The circuit over which it is danced shows that it is intended to secure communal good luck. It is obviously a hunter's mimetic ritual, and is probably the most primitive of the survivals in Great Britain.

September 18.

ST. FERRICOL, A.D. 304, saint and martyr: a Roman tribune at Vienne who became a Christian. On refusing to sacrifice according to pagan rites, he was imprisoned. On the third day his chains fell from him and he escaped. He swam across the Rhône, but was captured and beheaded.

It was customary for the anniversary of this saint to be celebrated with great pomp at Marseilles. Triumphal arches were erected and the whole town and the ships in the harbour decorated with flags. Gardeners and butchers took a prominent part in the procession which took place, proceeding to various altars and resting places which were decorated with flowers. The gardeners carried wax tapers, green boughs, flowers, and banners. The butchers wore long cloaks, bonnets of sixteenth century type, and bore cleavers. They led a fat ox decked with garlands and covered with a carpet on which sat a child as John the Baptist. The ox was led about for a week before the festival, bringing good luck to houses at which it left a trace of its visit. It was killed the day after the feast. Young girls representing nuns, saints, and the Magdalen, and boys dressed up as saints and priests, took part in the procession. The streets were strewn with flowers, which were also scattered on the bystanders. The procession proceeded to the port where all the ships were manned, and a special service of benediction took place.

September 21.

ST. MATTHEW'S DAY.—The Lord Mayor of London makes the annual presentation of a guinea to the two senior Grecians of Christ's Hospital, more familiarly known as the Blue Coat School. From an account given in the journal of Richard Hoare, Sheriff 1740–41, it would appear that the governors of the other hospitals throughout the city also attended on this occasion in the hall of Christ's Hospital, and after the service, speeches from the boys in commemoration of their founders, and the presentation of guineas by the Lord Mayor, and half-guineas by the Sheriff, an inquisition into the management of the hospitals by their respective governors was held, the City Marshal giving evidence. While this was taking place, the beadles of each laid their staves on the floor and took them up only when the Lord Mayor had declared himself satisfied.

September 22.

At Beddinton a custom was observed of conveying in procession through the village a rabbit decorated with scarlet ribbons, while a hymn in honour of St. Agatha was sung—a ceremony traditionally dating from the first crusade. All men and young women who met the procession extended their first two fingers—a gesture familiar as a protection against the evil eye—and said:

> "Gustin, Gustin lacks a bier.
> Maidens, maidens bring him here."

HARVEST.—Water charms are sometimes found in connexion with the harvest home. In Hertfordshire the farmer drove the last load to the barn at full speed, while the people he passed pursued with bowls of water which they tried to throw on his cart. In the same county a scramble followed the making of the 'dolly,' and either the leader or the man who secured it in the scramble ran with it to the farmhouse and tried to get in without being drenched by the maid who stood ready to receive him with a bucket of water at the farmhouse door.

It was a common custom to appoint a leader of the reapers, the 'Lord of the Harvest,' who led in all the operations and in the ceremonial performances. In the Norfolk harvest home, previously quoted, there was also a second known as his 'Lady' who performed certain functions with him at the harvest supper, soliciting largess from the farmer's guests in disguise. It may be noted that in Bedfordshire the 'dolly' took the name of 'Jack and Jill.' A female character appeared at a later stage in the Norfolk supper, when one of the characters, donning female attire, was attacked by violent toothache, for which the doctor was summoned. He appeared riding on another as his horse, and the tooth, a piece of tobacco pipe, was extracted by a pair of tongs, which caused so much pain that the 'lady' fainted—a piece of buffoonery which, like the mumming plays, may hide something of more serious import, and be a faint remembrance of the human sacrifices of more primitive harvest customs.

Societies and Academies.

LONDON.

Institute of Metals (Annual Autumn Meeting, Liverpool), Sept. 5.—**R. May**: Eighth report to the Corrosion Research Committee. Further investigations of 'impingement attack' were undertaken to interpret the results of certain tests on condenser tubes, and, in particular, to explain the relationship which appeared to exist between the effects of intermittent cavitation in the water and the effects of air-bubble impingement. The behaviour of protective films under various conditions of impingement has been studied by measurements of the 'film potential.' When there is no intermittent cavitation, 'impingement attack' can still take place as a result of air-bubble impingement, and it is concluded that there are two separate main causes of 'impingement attack,' namely, intermittent cavitation as shown by Sir Charles Parsons, and air-bubble 'impingement' as shown by Dr. Bengough, R. Pirret, and the author. Both depend on the occurrence of rotating motions of the water.—**Ulick R. Evans**: Corrosion at discontinuities in metallic protective coatings. The cracks produced by bending are more dangerous than uniformly distributed pores. If the coating metal is cathodic to steel, the steel is corroded; copper under some conditions causes marked acceleration of the corrosion of steel at exposed places, nickel being less dangerous. If the coating metal is anodic to steel, the coating suffers corrosion preferentially, the steel thereby receiving protection; thus steel coated with zinc usually suffers no corrosion even at cracks until the zinc becomes exhausted. Steel thickly covered with zinc usually fares better than thinly covered steel, notwithstanding the greater tendency to cracking; old galvanised sheet carried more zinc than the modern material and generally lasted longer. Coatings of aluminium or zinc-iron alloys are themselves less attacked than coatings of free zinc, but for that very reason they afford less sacrificial protection to the underlying steel in certain waters. Zinc itself is rather rapidly attacked when partially immersed in a chloride solution, but alternate salt-spraying and drying builds up a protective film.—**A. G. C. Gwyer, H. W. L. Phillips, and Miss L. Mann**: The constitution of the alloys of aluminium with copper, silicon, and iron. The ternary systems aluminium-copper-silicon and aluminium-copper-iron are considered. The former of these is eutectiferous, with a ternary eutectic of $CuAl_2$, aluminium and silicon, containing 26 per cent. of copper, 6·5 per cent. of silicon, and freezing at 525° C. The aluminium-copper-iron system is rather more complex; a peritectic reaction occurs at 590° C. between $FeAl_3$ and liquid resulting in the formation of a constituent isomorphous with 'X'; the latter forms a ternary eutectic with $CuAl_2$ and aluminium, containing 32·5 per cent of copper, 0·3 per cent of iron, and freezing at 542° C. A quaternary eutectic occurs at 26 per cent copper, 6·5 per cent silicon, 0·5 per cent iron, freezing at 520° C., the constituents being aluminium, $CuAl_2$, 'X,' and silicon. The paper deals exclusively with metastable conditions.—**C. J. Smithells, S. V. Williams, and J. W. Avery**: Laboratory experiments on high-temperature resistance alloys. A series of nickel-chromium alloys containing from 10 to 60 per cent of chromium, and a few ternary alloys containing tungsten and molybdenum, have been made from specially pure materials melted in hydrogen. For the binary alloys resistance to oxidation increases with increase in chromium content up to 30 per cent. With more than 40 per cent of chromium, a second phase appears and resistance to oxidation falls. Ternary alloys containing only 10 per cent of chromium show low resistance, while those containing 20 per cent of chromium show high resistance to oxidation. For high resistance to oxidation the oxide layer must contain at least 50 per cent of chromic oxide. The composition of the oxide layer is determined by, but is not generally the same as, the composition of the alloy. For the binary alloys resistance to sag at high temperatures decreases with increase in chromium content. The ternary alloys sag more than the binary alloys having a similar nickel content. Small amounts of impurities lower both the resistance to oxidation and sag.—**W. R. D. Jones**: The copper-magnesium alloys, Part 3. Notched-bar impact tests on forged and heat-treated copper-magnesium alloys are discussed. There is no advantage in adding more than about 2 per cent of copper to magnesium; alloys containing more than 5 per cent are brittle. The embrittling effect is decreased as the temperature rises. On exposure to cold, the toughness of these alloys has been decreased. Forging breaks down the eutectic network, improving the mechanical properties. Heat-treatment increases slightly the size of the globules of Mg_2Cu and the crystal grains, which are rendered equiaxed and more regular in size.—**J. E. Malam**: The Rockwell hardness test. The Rockwell ball test in its present form yields so-called 'hardness numbers' which are quantitatively misleading. Unscientific results are also obtained owing to the arbitrary numbering of the scleroscope scale. The whole subject of hardness testing should be examined by a representative committee.

Sept. 6.—**R. Genders, R. C. Reader, and V. T. S. Foster**: Die-casting of copper-rich alloys. Examination in the form of chill-cast bars and die-cast test-pieces has indicated that a variety of such alloys exists, suitable for die-casting and offering mechanical properties to meet varying requirements. The aluminium brasses have a wide range of properties, high proof stress, slow rate of attack on mould and core materials, and are cheap. Mould and core materials were tested by immersion in molten alloys; high-carbon steel and special steels of the heat-resisting type showed little deterioration, while low-carbon steel and engineering steels were rapidly attacked. The behaviour of cast iron in molten aluminium-bronze is largely influenced by the phosphorus content of the iron.—**S. L. Archbutt, J. D. Grogan, and J. W. Jenkin**: Properties and production of aluminium die-castings. Five alloys have been employed: namely, 4 per cent copper, 8 per cent copper, 12 per cent silicon, 4 per cent copper and 3 per cent silicon, and *Y*-alloy. Satisfactory castings were produced in the tubular form from all the alloys studied. With the test-piece form, castings of satisfactory mechanical strength were obtained in *Y*-alloy, 12 per cent silicon, and 3 per cent copper, 4 per cent silicon, but less satisfactory results were obtained with the binary copper-aluminium alloys owing to hot-shortness. In the investigation into hot-shortness the same five alloys have been studied together with *L* 5 alloy (copper 2·5-3·0, zinc 12·5-14·0 per cent). Hot-shortness is only exhibited at temperatures close to the temperature of commencement of melting; the range over which the rapid fall in impact strength takes place varies from 5° C. with the 12 per cent silicon alloy to 45° C. with *L* 5.—**T. F. Russell, W. E. Goodrich, W. Cross, and (in part) N. P. Allen**: Die-casting alloys of low melting point. Sixteen zinc-base alloys, having either copper and tin, or copper and aluminium, and—in some cases—with further additions of either nickel, cadmium, lead, or magnesium, have been examined. The copper-aluminium-zinc alloys are

approximately twice as strong as the copper-tin-zinc alloys. For any one alloy, the casting conditions—within reasonable limits—have only a small effect on the tensile strength when compared with the influence of the form of the test-piece, and of non-axial loading. The effects on the strength and on the permanency of dimensions, after atmospheric ageing, have been investigated, and tests of the so-called 'accelerated ageing' type have been made. The 'accelerated ageing' consists in subjecting the castings to the action of hot air, hot air saturated with moisture, and to steam at 100° C. Within the limits of the compositions examined, the effect of the chemical composition on the rate of growth is insignificant when compared with the effect of the *form* and mechanical condition of the actual casting.—**C. S. Smith**: The α-phase boundary of the copper-silicon system. The α-phase boundary has been redetermined by annealing and quenching experiments. The solubility reaches its maximum value, 6·7 per cent silicon, between 721° and 782° C. At 852° C.—the temperature of the peritectic horizontal—the solubility is 5·25 per cent, while at 400° C. it is only 4·1 per cent silicon.—**C. H. M. Jenkins**: The strength of a cadmium-zinc and of a tin-lead alloy solder. Although a general similarity in type between the two materials was found, the cadmium-zinc alloy shows markedly higher values under the various tests. The tensile strength of the cadmium-zinc alloy as ordinarily determined is approximately four times that of the tin-lead solder, but under prolonged stress tests the values obtained are approximately six times as great. At 120° C. both materials show a diminished resistance to prolonged stress, the numerical values falling to less than one-tenth of those observed at room temperatures.—**G. B. Brook** and **H. J. Simcox**: Note on practical pyrometry. An instrument has been designed which eliminates stray currents and magnetic fields of great intensity and is accurate even when placed in the field surrounding a conductor carrying as much as 20,000 amp.—**F. Hargreaves** and **R. J. Hills**: Work-softening of eutectic alloys.—The micrographic changes on working and annealing the lead-tin eutectic afford an explanation of the existence of the critical amount of work observed at about 30 per cent reduction. A recrystallised sample of eutectic softens when the amount of work exceeds about 20 per cent, showing that softening is not a peculiarity of the eutectic structure but is due to the presence of two phases. Experiments on 0·5 and 15 per cent lead-tin alloys are described; the latter behaves very similarly to the eutectic, whilst the former may be rendered softer than the cast sample by working.—**William Hume-Rothery**: Methods for the thermal and microscopic investigation of alloys of reactive metals. Methods and materials are discussed. The method, introduced by the early German workers, in which the composition of a phase is deduced from the duration of the arrests of the cooling curves, whilst difficult to carry out, is sound in the case of simple eutectic arrests where no solid solutions are formed; but in the case of peritectic reactions, or where solid solutions are present, the method is by its very nature unsound at all except very high temperatures.—**D. R. Tullis**: Note on the treatment of aluminium and aluminium alloys with chlorine. Most aluminium alloys contain dissolved gases; the methods devised for their removal are: The slow solidification method, the inert gas method, the active gas method. Chlorine has been used as a means of removing dissolved gases and comparison is given between the slow solidification and the chlorine methods.

PARIS.

Academy of Sciences, July 30.—**Charles Moureu, Charles Dufraisse**, and **Antoine Willemart**: Researches on rubrene. Coloured hydrocarbons of the rubrene family. Two new hydrocarbons analogous with rubrene have been prepared, dimethylrubrene and dibenzorubrene.—**Gabriel Bertrand** and **Mme. M. Rosenblatt**: Potassium and sodium in marine algæ. The statement, due to Boussingault, that potassium is not present in *Fucus*, is shown to be inaccurate. Marine algæ are unequally sensitive to the action of distilled water: some, like *Pelvetia canaliculata*, retain their alkalis practically unchanged after repeated washing with distilled water, while others, such as *Padina pavonia*, lose their alkali salts rapidly under the same treatment.—**V. Grignard** and **J. Dœuvre**: The constitution of citronellol and of rhodinol.—**Alex. Froda**: Some descriptive properties of functions of real variables.—**S. Saks**: A theorem of M. Montel.—**D. Lagrange** and **D. Rosenthal**: The influence of the form of the ends of the elements of certain soldered joints on the value of the breaking load and on the deformation.—**A. Danjon**: The curve of light and elements of the photometric double star β-Lyræ. The mean curve of light (diagram given) is symmetrical, except in the immediate neighbourhood of the principal minimum.—**A. Gougenheim**: The use of the prism astrolabe for the study of the variations of latitude.—**Louis Kahn**: The astronomical determination of a point with the aid of a conformal map, utilisable as an orthodromic map.—**Jean Cichochi**: The conductivity of pulverised salts.—**Henri Muraour**: The relation between the temperature of explosion of a powder and its velocity of combustion. Experiments were carried out with explosive composed of equal weights of gun cotton and nitroglycerol, mixed with varying quantities of centralite (symmetrical diethyldiphenylurea), in such a manner as to vary the explosion temperature between wide limits. It was found that the logarithm of the combustion velocity was a linear function of the explosion temperature.—**A. Sanfourche** and **L. Rondier**: Sulphonitrous and sulphonitric mixtures.—**G. Valensi**: The dissociation of chromium nitride. The nitride, of composition CrN approximately, was prepared by heating pyrophoric chromium with pure nitrogen at 800° C. The curves of dissociation of this substance for temperatures between 810° C. and 1000° C. are given.—**Mlle. Choucroun**: Rule relating to the diffusion of electrolytes in charged jellies.—**Jean Cournot**: Some cementations of steels by special alloys with a manganese base.—**Paul Dutoit** and **Armand Schnorf**: Calcium nitride. Studies on the various factors affecting the rate of combination of nitrogen with calcium, including the state of division of the metal, the catalytic effects of traces of impurities, and the effect of temperature.—**Ch. Mauguin**: The X-rays do not always give the true network of crystals. Examples drawn from the study of micas.—**Jacques de Lapparent** and **Ernest Stempfel**: Dehydrated gibbsite. Crystallised aluminium hydroxide on dehydration by heating does not leave an amorphous residue.—**G. Nadson** and **N. Krassilnikov**: A new genus of Endomycetaceæ: *Guilliermondella*.—**H. Colin** and **R. Franquet**: The genesis of starch in the bean.—**L. H. Dejust, Mlle. Van Stolk**, and **E. Dureuil**: The presence of ergosterol in human blood. The mixture of cholesterol and ergosterol was extracted from blood serum by suitable solvents and the presence of the latter demonstrated by means of its absorption spectrum.—**Swigel Posternak** and **Théodore Posternak**: The lability of the chains of serin-phosphoric acids and a general reaction for tyrines.—**A. Magnan** and

A. Sainte-Lague: A method of morphometry of fishes.—A. Sartory, R. Sartory, Marcel Meyer, and Jacques Meyer: Study of a new case of osseous mycosis.

GENEVA.

Society of Physics and Natural History, June 7.—M. Minod: A new stand for drawing in a camera clara. The author describes an apparatus based on the principle of the camera clara and allowing a magnification up to 15 times of objects in strong relief, by the successive focussing of different planes.—Amé Pictet and Hans Vogel: The synthesis of raffinose and that of sugar in general. Raffinose has been obtained synthetically by heating in a vacuum for an hour at 160° C. an equimolecular mixture of saccharose and galactose. The authors emphasise the fact that this synthesis is not the result of chance reactions. In the biological field it appeared to them that in the mammal at certain times a part of the glucose of the blood is transformed by the transposition of one of its hydroxyl groups into galactose, and that the latter unites with another portion of glucose to form milk sugar.—F. Chodat and V. Pfister: The bacteriological study of a vinegar factory. The following organisms have been found: *Bacterium xylinum*, inactive and objectionable, inactive Micrococci, active types of *B. acetosum* and *B. Schutzenbachii*; yeasts, *Wilbia anomala* producing the esters of the vinegar.—E. Joukowsky: The periodical variation of the proportion of materials in solution in the water of the Arve at Geneva. The author traces for the year 1890, from daily data, the curve showing the variation in the total solids in solution and suspension in the water of the Arve, and also the curve of average temperatures of that region. From these curves it is concluded that the chief source of dissolved chalk must be the water produced by melted snow (cold water with high solvent power) which is added to the water filtering in slowly, whilst the materials in suspension arise from running waters with rapid circulation.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 14-15).—V. N. Ipatiev, N. A. Orlov, and A. D. Petrov: The hydrogenation of ketones under pressure. Hydrogenation of the ketones under pressure leads easily to the formation of the respective aromatic carbohydrates, but fully hydrogenated products are obtained only with difficulty.—A. Frank-Kamenetsky and V. Koncevič: The Emykey saline spring on the Osinskij island on the Angara River. Analyses of water of the spring.—V. V. Bogačev: A new find of Mediterranean elements in the Caspian fauna. The mollusc *Mytilaster lineatus* known from the Black Sea was found in the Caspian, where it probably must be regarded as a post-Pliocene immigrant.—A. I. Tolmačev: A new arcto-alpine species of *Senecio*. Description of *Senecio tundricola*, sp. n., from Arctic Siberia.—L. N. Bogojavlenskii: A radium deposit at Uchta. Water from the oil-wells in the Uchta oil-fields proved to contain radium in a quantity exceeding that known from any other analogous sources. It is interesting that high concentration of radium and mesothorium coincides with complete absence of uranium and thorium.—A. N. Pylkov: Preparation of ionium from a Ferghana mineral. Certain preparations of ionium were obtained from the crude urano-copper-vanadium ore from the Ferghana mines.—B. Zemliakov: The ancient continental dunes of the Nizhni-Novgorod province. The dunes are studied in some detail, and it is concluded that they date back to one of the interglacial periods.—D. S. Beliankin: The problem of mullite. Mullite is a homogeneous solid solution of Al_2O_3 in sillimanite, according to some authors, but detailed studies of its properties show that mullite should be better regarded as quite independent from sillimanite.—V. Bodylevskii: Notes on the *Aucellæ* from the Taymyr collection of Middendorf.—L. Ahrens: The northern limit of distribution of the lizard *Eremias arguta* in eastern Europe. The species was discovered in the Kursk province, considerably farther north than before.—A. I. Zaitseva: Ferrous phosphate from the Bargusin region in Siberia. An analysis is given.—E. F. Miram: Description of the hitherto unknown male of *Metrioptera pusilla* Mir. (Orthoptera) from the Kherson province.—E. Cheisin: A preliminary communication on some parasitic infusoria of Lake Baikal. Descriptions of several new species.

ROME.

Royal National Academy of the Lincei, April 15.—G. Cesàro: Viviani's curve. The case of a spherical curve projected on to the base of a hemisphere following a circumference tangential to this base is considered, and it is shown that the surface intercepted by the curve on the sphere is expressed by the product of the square of the radius of the sphere, and the difference between the latitude of the culminating point of the spherical curve and the sine of such latitude. Thus, if $2S$ and ϕ are the surface and the latitude respectively, $S = R^2(\phi - \sin\phi)$. The case of Viviani's window corresponds with $\phi = \pi/2$, so that $S = R^2(\pi/2 - 1)$, and Viviani's curve represents the points of the sphere for which the longitude is equal to the latitude. The stereographic projection of Viviani's curve on the base of the hemisphere is a strophoid, and, if the term spherical strophoid is applied to a curve analogous to the plane strophoid, but constructed with a circumference of a great circle instead of with a straight line, Viviani's curve represents a spherical strophoid.—G. A. Crocco: The torsional rigidity of aeroplane wings.—R. Calapso: Reduction of the projective deformation of a surface R to the transformation C_m of isothermal surfaces.—G. Vitali: Covariant derivations in generalised absolute calculus.—G. Vranceanu: Periodic solutions to very large periods in mechanics.—E. Gugino: The problem of the elastic equilibrium of rotating bodies with cylindrical contour.—A. J. McConnell: The principle of stationary action and stability in a static gravitational field. On the basis of Levi-Civita's combination of the equations for the motion of a material point in a static gravitational field to a variational formula, which may be interpreted as a principle of stationary action, the stability of a trajectory in such a field is discussed.—F. Sbrana: The plane motions of an incompressible fluid, in which the stream lines are isotachic.—C. Dei: The phase of the thermionic saturation current in a circuit with pulsating voltage. The conditions in a circuit having in series a valve, an ohmic resistance, a coil of known coefficient of self-induction, and a pulsating electromotive force of the type $E = \bar{E} + E_0 \sin \omega t$, but sufficient for the valve to be always saturated, are considered.—A. Rostagni: An influence of X-rays on the crystallisation of bismuth. No appreciable alteration can be detected in the thermo-electric properties or the specific heat of bismuth as a result of exposure of the metal to the influence of X-rays.—G. Carobbi: Chemical investigations on the olivine of Linosa (Pelagic Islands). It is not certain whether the ferric iron, almost always found in olivines of volcanic origin, owes its presence to alteration, or whether it is pre-existent in the molecule as an isomorphous substituent of the ferrous iron and magnesium. If, however, all the iron found by the author's analyses is calculated as ferrous oxide,

and the sum of all the components is made up to one hundred (water being neglected), molecular ratios are obtained which are in absolute accordance with those required by the formula of olivine. The small proportions of lead present apparently replace isomorphically the magnesium and the other metals of its isomorphogenic group.—**F. Rodolico**: Investigations on sulpho-salts (5). Additive compounds with urotropine. Gradual replacement of the oxygen of the additive compounds, $MgMoO_4$, $C_6H_{12}N_4$, $10H_2O$, and $MgWO_4$, $C_6H_{12}N_4$, $10H_2O$, by sulphur is not accompanied by corresponding morphotropic variations in the crystals.—**G. Spagnol**: Chemical factors which determine the fixation of colloids. Experiments on dogs, rabbits, guinea-pigs, and moles show that, if chloroform is applied for a few seconds to the skin of an animal, and, almost at the same time, a colloidal substance is injected endovenously, the colloid becomes fixed in the tissues, corresponding exactly with the place of application of the chloroform. If the duration of the latter is 5–15 seconds, the fixation of the colloid takes place mainly in the cutis and the subcutaneous tissue, whereas with an application of 1–2 minutes, certain of the underlying muscles are affected. Histological examination shows that the colloid is, to a slight extent, fixed in the granular state on the walls of the blood vessels, but mainly diffuses in a highly disperse state into the surrounding tissue, and there soon passes in a granular condition between the phagocytes. This fixation is observed only with electro-negative colloids. Analogous results are obtained if carbon tetrachloride, ethyl bromide, or ether is used in place of the chloroform.—**A. Cavinato**: New investigations on the transformations of scolecite. The optical transformations occurring when scolecite is heated are related to the dehydration produced.—**R. Savelli**: Humification of cellular membranes in *Beta vulgaris*. Humification, which is normal and general for the fruit of all varieties of the beet, is shown also in the root in exceptional varieties, resulting possibly by mutation, and would hence depend on a new factor determining a new localisation of a phenomenon which pre-exists and forms a part of the normal physiology of the plant.—**G. Santori**: The influence of partial irradiation of the bone on the stromatic system of the osseous medulla and of the remaining hæmo-lymphatic apparatus. Localised action of X-rays on the tibial osseous medulla of the rabbit induces in the hæmo-lymphatic apparatus modifications which are greatest in the medulla directly exposed to the rays, but sensible also in the non-irradiated medulla and in the other organs of the apparatus. The alterations in the osseous medulla affect all its components—the specific cellular elements, and the stromatic apparatus; those in the spleen, lymph glands, and liver are mainly in the vasal and reticular components; appreciable alterations were observed in one case only in the thymus, and never in the suprarenals.—**E. Barsali**: Contribution to the study of radioscopy in vegetable organisms. Results are described which justify the hope that in the vegetable as well as in the animal kingdom radioscopy may prove of service, particularly in pathological cases.—**A. Galamini**: Alimentary value of the potato for albino rats. Raw potatoes, even if ingested in large quantity, do not form a sufficient food either for the growth or for the life of the albino rat. Boiled potatoes enhance the resistance towards contagious, broncho-pneumonic processes less than a complete diet. Growing rats die after losing 29-27 per cent of their weight, while with adults the diminution is 40 per cent; the loss is more rapid with raw than with cooked potatoes. When either of these is administered for a long time, alkaline urine, diarrhœa, stoppage of the bowels, and dilation of the ileo-cecal tract are observed.—**Constantino Gorini**: Progressive culture and microbic dissociation. In the natural dissociations of the acido-proteolytes, such as *Bacillus acidificans presamigenes casei*, the biochemical manifestations are accompanied by cultural morphological phenomena, which are characterised particularly by variations in the colonies, mainly into two principal types, and by variations in the aggregation and in the cellular mobility, which may be controlled by means of the author's progressive culture, so that the more active and mobile granular type may be selected. By the same means it is possible to detect, in a group of sporogenic bacilli, a transitory mobility restricted to initial stages of development, this giving rise to colonies of a type differing from the type characteristic of the respective species.

SYDNEY.

Royal Society of New South Wales, July 4.—A. R. Penfold and F. R. Morrison: The occurrence of a number of varieties of *Eucalyptus dives* as determined by chemical analysis of the essential oils (2). A field inspection was made in the Tumbarumba District of New South Wales in connexion with Variety 'C.' This field had been closed to commercial distillation for some time on account of the periodical occurrence of phellandrene, which spoilt an otherwise excellent oil for pharmaceutical purposes. Belts of country were resolved into 'good' and 'bad' by simply crushing the leaves between the fingers and judging according to the odours evolved. The examination of the essential oils from representative samples of leaves and terminal branchlets confirmed in a remarkable manner the field observations. Opportunity was taken to test out the new cresol method for determination of cineol in these oils. It was found necessary, however, to make the determination on the portion of oil distilling below 190° as the presence of terpineol in the hard boiling fraction gave high results. The method is strongly recommended as a standard one.—**R. J. Noble**: Some observations on the woodiness or bullet disease of passion fruit. The disease may be recognised in the stunting of the vines, in twisting, curling, or mottling of the foliage, and in the hard malformed fruits of *Passiflora edulis*. The hardening of the fruits is due to lignification of the inner parenchymatous tissues of the pericarp. The disease occurs generally in the winter months, but is considered one of the major causes of unproductiveness of passion fruit vines in N.S.W. Infection experiments have demonstrated that the disease is due to the action of a virus which may be transferred by mechanical means. Control measures are recommended.

Official Publications Received.

BRITISH.

Melbourne Astrographic Catalogue, 1900·0. Vol. 2: Zones −67° and −68°. Rectangular Co-ordinates and Diameters of Star Images, from Photographs taken and measured under the direction of R. L. J. Ellery and Pietro Baracchi. Revised and prepared for publication under the Supervision of Dr. J. M. Baldwin. Pp. xi+291. (Melbourne: H. J. Green.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 380, August. Pp. 805-908+xxx. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Reports of the Imperial Economic Committee. Tenth Report: Timber. (Cmd. 3175.) Pp. 52. (London: H.M. Stationery Office.) 9*d.* net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1137 (Ae. 307): Tests of a Metal Airscrew in a Closed Tunnel for Comparison with American Tests in an Open Jet Tunnel. By H. C. H. Townend and J. H. Warsap. (T. 2548.) Pp. 4+5 plates. 6*d.* net. No. 1139 (Ae. 308): The Connection between Lift and Circulation for an Inclined Flat Plate. By A. Fage and F. C. Johansen. (T. 2558.) Pp. 7+1 plate. 6*d.* net. (London: H.M. Stationery Office.)

Western Australia: Geological Survey. Bulletin No. 83: Maps and Sections compiled by H. W. B. Talbot, to accompany his Report on The Geology and Mineral Resources of the North-West, Central and Eastern Divisions between Long. 119° and 122° E. and Lat. 22° and 28° South. Pp. ii+15 plates. (Perth: Fred. Wm. Simpson.)

FOREIGN.

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review, Supplement No. 31: Climatological Data for Northern and Western Tropical South America. By W. W. Reed. (W. B. No. 952.) Pp. iii+21. (Washington, D.C.: Government Printing Office.) 10 cents.

University of Colorado Bulletin. Vol. 28, No. 10, General Series No. 259: Catalogue, 1927–28; with Announcements for 1928-29. Pp. 521. (Boulder, Colo.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. On a Collection of Birds from the Pará Region, Eastern Brazil. By Witmer Stone. (With Field Notes by James Bond and Rudolph M. de Schauensee.) Pp. 149-176. Species of Polygyra from Montana, Idaho, and the Pacific Coast States. By Henry A. Pilsbry. Pp. 177-186. On the Relationship of certain New or Previously known Genera of the Acridine Group Chrysochraontes (Orthoptera, Acrididæ). By James A. G. Rehn. Pp. 189-205. (Philadelphia, Pa.)

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 1, July. Pp. 104. (Washington, D.C.: Government Printing Office.) 25 cents.

International Union of Scientific Radio Telegraphy. Papers of the General Assembly held in Washington in October 1927. Vol. 1: Scientific Papers presented in the Public Session. (Original Texts.) Pp. 78+4 plates. (Bruxelles.)

CATALOGUES.

A List of X-ray Tubes, including Gas and Hot Cathode Types. Pp. 32. (London: Cuthbert Andrews.)

Light on the H.T. Battery. Pp. 24. (London: Ripaults, Ltd.)

Diary of Societies.

FRIDAY, SEPTEMBER 14.

CERAMIC SOCIETY (Refractory Materials Section) (at Royal Technical College, Glasgow), at 10 A.M.—C. Edwards: Jointing Cement.—W. J. Rees: A Comparison of the Properties and Industrial Durability of Lime-bonded and Clay-bonded Silica Bricks.—W. J. Rees and D. W. Hubbard: The Dissociation of Carbon Monoxide in Contact with Fireclays and Silica.—C. E. Moore: Drying Cracks.—A. J. Dale: Aluminous Refractories and their Industrial Significance.

SATURDAY, SEPTEMBER 15.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Town Hall, Swanage), at 11.30.

PUBLIC LECTURES.

WEDNESDAY, SEPTEMBER 19.

CHARACTER BUILDERS' ASSOCIATION (45 Lancaster Gate, W.2), at 8.—T. Cooke: Temperament in Relation to the Endocrine Glands.

FRIDAY, SEPTEMBER 21.

CHARACTER BUILDERS' ASSOCIATION (45 Lancaster Gate, W.2), at 8.—T. Cooke: The Analysis of Temperament.

CONGRESSES.

SEPTEMBER 14–17.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Fifth Annual Conference) (at New College, Oxford).

Friday, Sept. 14.

At 7.15 P.M.—
Address by the President of the Conference.

At 8.30-9 P.M.—
Dr. R. S. Hutton: The Work of Aslib.

At 9-10 P.M.—
Dr. A. P. Thurston: Patent Law Reform, with Special Reference to the Search for Novelty.

Saturday, Sept. 15.

At 9.30-12 NOON.—
N. Parley: The Direct Reproduction of Books and Manuscripts.
Dr. E. H. Tripp: Certain Aspects of Agricultural Research.
J. Forbes Marsden: The Literature of Scientific Management.

At 12-12.45 P.M.—
H. H. Johnson: Existing Types of Indexes to Technical Periodicals.
V. Garrett: An Index to Business Data.
J. N. L. Baker: Cartography and the Research Worker.

At 5.30-6.30 P.M.—
Annual General Meeting.

At 8.30-10 P.M.—
H. Jenkinson: The Librarian as Archivist.
F. M. Earle: Vocational Selection and Guidance.
A. Esdaile: Unification of the Library Resources of London.

Sunday, Sept. 16.

At 9.30-11.45 A.M.—
Dr. W. Rosenhain: Scientific Abstracts.

At 11.45-12-45 P.M.—
A. Farquharson: Civic and Regional Surveys: their Relation to Information Bureaux.

At 5-6 P.M.—
C. R. Griffin: A Book-Review Digest.
Capt. J. S. Allan and N. Parley: The Durability of Paper.
Lieut.-Col. J. A. A. Pickard and C. G. Ingall: Information on Accident Prevention.

At 8.30-9.15 P.M.—
Dr. S. C. Bradford: The Necessity for the Standardisation of Bibliographical Methods.

At 9.15-10 P.M.—
Lieut.-Col. J. M. Mitchell: The Aslib Directory.

SEPTEMBER 15–22.

GERMAN SOCIETY OF NATURALISTS AND PHYSICIANS (at Hamburg). Among the lectures are: World Economics and National Food Supply, F. H. Witthoefft; The Importance of Wöhler's Synthesis of Urea, Prof. Walden. The Blood Group Problem, Photochemistry of Iron Carbonyl Compounds, Combating Cattle Plagues, Naegeli's Micellar Theory, and the Importance of Isostasy in the Shaping of the Earth's Surface, Scientific Results of the Voyage of the *Meteor*, Short-wave Telegraphy, Chemistry of Hormones and the Female Sexual Hormone. In the medical group the Onset and Disappearance of Epidemics and the Influence of Psychic Factors on the Sympathetic Nervous System will be dealt with. Popular evening lectures will deal with the Ultramicroscopy of the Molecule by the use of Röntgen Rays, the World and Environment, Health and Housekeeping, Colour and Scent of Flowers, Communities of Men and Bees.

SEPTEMBER 19–22.

NATIONAL GLASS CONVENTION (at Bournemouth).—Discussions on the Organisation of the Glass Industry and a Conference on the Legislation Concerned.

SEPTEMBER 19–25.

FOLK-LORE SOCIETY JUBILEE CONGRESS, 1928 (mainly at Society of Antiquaries).

Wednesday, Sept. 19.

At 4 P.M.—
Opening Session.

At 8.30 P.M.—
Reception at the Wellcome Historical Medical Museum, 54A Wigmore Street, W.

Thursday, Sept. 20.

At 10 A.M.—
Sir Richard Temple, Bart.: Presidential Address.
Mrs. Banks: Some Traditions of Stone-carrying Women.
T. W. Thompson: British Gypsy Marriage and Divorce Rites.
Prof. F. Starr: Filipino Folk-lore.
Rev. Prof. A. H. Sayce: Egyptian Folk-lore.

At 8.30 P.M.—
(At Imperial Institute.) Prof. Pospisil: The Folk-dances and Customs of Central and Eastern Europe (Lecture).

Friday, Sept. 21.

At 10 A.M. and 2.30 P.M.—
Prof. H. J. Rose: Mummers' Plays in Attica.
Prof. R. M. Dawkins: The Study of Folk-lore in Modern Greece.
Mrs. Hasluck: A New Dervish Order in Albania.
Prof. Gwynne Jones: Some Survivals of Folk-belief in Modern Wales.
M. Beza: Demetrius Contemir's Contribution to Folk-lore.
Mrs. H. H. Spoer: Hebrew Amulets.

Saturday, Sept. 22.

Excursions to Oxford and Cambridge.

Monday, Sept. 24.

At 10 A.M. and 2.30 P.M.—
Prof. Pettazzoni: Confession of Sins in Primitive Religions.
Dr. J. L. Myres: Paper.
Miss B. C. Spooner: The Fragments that are Left in N.E. Cornwall.
Dr. MacCulloch: The Arthurian Legend.
Miss Mona Douglas: Animals in Manx Folk-lore and Song.
R. E. Enthoven: Tree and Animal Worship in Western India.

At 8.30 P.M.—
(At Caxton Hall.) Demonstration of Folk-dances; Children's Singing-games; Folk-songs.

Tuesday, Sept. 25.

At 10 A.M. and 2.30 P.M.—
Prof. Elliot Smith: The Survival in English Folk-lore of a Story from the Rig-Veda.
Dr. E. Jones: Psycho-analysis and Folk-lore.
Dr. Röheim: Mother Earth and the Children of the Sun.
H. Simpson: Medical Magic among the Berbers of Algeria.
Prof. G. Schütte: Bull Worship among the Kimbri.

SEPTEMBER 24–27.

INTERNATIONALE TAGUNG FÜR BRÜCKEN- UND HOCHBAU (at Vienna).

SEPTEMBER 24–27.

INTERNATIONALE TUBERKULOSEKONFERENZ (at Rome).

SEPTEMBER 24–28.

DIE TAGUNG DER BALTISCHEN GEODÄTISCHEN KOMMISSION (at Berlin).

SEPTEMBER 26–29.

PALÄONTOLOGISCHE GESELLSCHAFT (at Budapest).