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Native Education in Africa.

IN no part of the British Empire is the task of developing education services more difficult, onerous, and important than in British territories in Africa. In the Union of South Africa, the task is complicated by the language differences between the British, Dutch, immigrant Asiatics, and indigenous peoples, the different social customs and religions of the white, brown, and black elements, and the economic differences based upon the differing standards of living between these three distinct racial types. The situation in East Africa and parts of British Central Africa is much the same. In British West African territories, if we except the Cameroons, there is no white or Asiatic problem, but a complication exists because of an essential difference between the ideals underlying British colonial policy and those of the French and Belgians whose colonial territories are adjacent.

In his recent Rhodes Memorial Lecture at Oxford on "Native Policy in Africa", General Smuts pointed out that British colonial policy is enshrined in the Covenant of the League of Nations. Art. 22 of the Covenant lays down that to those colonies and territories taken from the Powers defeated in the War, which are inhabited by peoples not yet able to stand by themselves under the strenuous conditions of the modern world, there shall be applied the principle that the well-being and development of such peoples form a sacred trust of civilisation, and that this trust shall be carried out by the advanced nations. "The well-being and development of peoples not yet able to stand by themselves", says General Smuts, "can only mean the progress and civilisation of these backward peoples in accordance with their own institutions, customs, and ideas, in so far as these are not incompatible with the ideals of civilisation."

This is the ideal. It is one upon which education policy must be based in the British Colonial Empire, not only in the territories which the British administer under mandate from the League of Nations—and Great Britain, the Union of South Africa, Australia, and New Zealand, each have such mandates—but also in those territories for which we have been responsible for varying lengthy periods of years. In India for more than a century we have been attempting, however imperfectly, to put this ideal into practice. In West Africa, in Mauritius, in British Malaya, in the Sudan, our efforts have been in the same direction. Rhodes's conception of our responsibilities in Africa was substantially in harmony with the principle of

trusteeship : " white settlement to supply the steel framework and the stimulus for an enduring civilisation, and indigenous native institutions to express the specifically African character of the natives in their future development and civilisation ".

That the education of the natives of South Africa has only recently been developed in consonance with Rhodes's ideals has been due to the prejudices and short-sighted economic dogmas of the white settled populations. They attempt to justify their attitude by asserting that the native peoples can profit only by primary education, that they reach a phase of mental stupidity or ' saturation ' by the time they are adolescent. The intellectual successes of American West African negroes, and even the recent successes of South African Bantus at the South African College and the universities of Great Britain, leave many, we are almost tempted to say the majority of, Europeans in Africa, unconvinced that the native peoples are not inherently generally intellectually inferior. The consequence has been that, until quite recently, practically the whole responsibility for the education of the native peoples in South, West, and East Africa has been left to the various missionary bodies. In South Africa, although the native pays, in proportion to his means, much higher taxation than the white man, the amount spent on the education of the whites is many times the amount spent on five times the number of natives. Wherever there is a white settled population in our African Crown Colonies, the position is similar.

Fortunately, not even the active hostility of the majority of white settled peoples in Africa, South or East, has been able to withstand the explicit enunciation by the European powers of the principle of trusteeship with all its implications. The governments of the Union of South Africa, of Southern Rhodesia, of British West and East African colonies are now definitely committed to the provision of educational facilities for the African peoples, either directly by the creation of government educational institutions or indirectly by financial grants-in-aid to and government supervision of missionary schools and colleges, and a real start has been made. Since 1916 there has been a Native College in South Africa at which Bantu students can read for university degrees. In West Africa there are several institutions which take native students up to the standard of the entrance examination for universities in Great Britain or America —and there is every hope that before very long Achimota College on the Gold Coast will attain to the status of a university institution. At Makerere in Uganda a similar government institution has been created, one which already trains Africans for professional occupations, in addition to which Uganda boasts of several missionary institutions where the standard of education provided is above that of our matriculation. Nyasaland also provides, in many missionary centres, an advanced type of education for the natives. In Tanganyika the government has taken the lead in providing for the higher education needs of the native population, and in Kenya the training college for Jeanes (or itinerant) native teachers appears likely to exert a far-reaching influence upon the educational progress of the peoples of that country.

Southern Rhodesia, which enjoys a large measure of self-government, established a separate Department of Native Education at the beginning of 1928 under the direction of Mr. H. Jowitt. His first report,[1] which he presented to his legislative council recently, is worthy of careful study by those interested in African problems. Native education, considered as a government-aided system, covers a quarter of a century in Southern Rhodesia. In that period the number of grant-earning schools has increased from four to approximately 1600 : the grants have increased from £105 to approximately £40,000. The schools are classified under three heads : first-class schools are boarding schools under European supervision, following a prescribed code, including at least two hours industrial work a day, and with actual instruction by a European teacher on a reasonable number of days a year ; a second-class school is a day-school under a European teacher, who must give instruction on a reasonable number of days during the year ; and a third-class school is the ordinary kraal school where pupils are taught to read and write in a native language, with the elements of writing and arithmetic, for at least two hours a day. There are two government native schools which are not classified.

Altogether, about 2500 teachers, 270 of whom are Europeans, are engaged in the work of dealing with a school population of about 100,000. The classified schools are all the result of missionary effort, twelve distinct Christian missionary bodies having established schools in the colony. A large number of their schools have now been inspected by the officers of the new Department and the report throws an interesting light on their efficiency. The kraal schools are staffed for the most part by ex-scholars who have received no training for their

[1] Southern Rhodesia. Report of the Director of Native Education for the Year 1928. Pp. 48. (Salisbury : Government Printer, 1929)

work other than that provided by the primary school which they attended. Their standard of knowledge of school subjects is rarely above that of a boy or girl aged eleven or twelve in Great Britain. Their main work is to enable the pupils to gain sufficient knowledge to become Church members. Chief stress is laid on vernacular reading, particularly in relation to relevant portions of Scripture which must be mastered before the candidate can become a member of the Church. They are supervised by missionary superintendents, most of whom labour under the disadvantage of lack of knowledge of teaching technique and organisation of schools. The Inspector of Native Schools, Salisbury, in his first report to the Department, says, " I have on record at least 12 superintendents who are unacquainted with the Native language ".

As the Director of Native Education remarks, it would serve no useful purpose to attempt a meticulous survey of the present curricula in the missionary schools. He has inherited a medley of schools in various stages of growth, staffed for the most part by uneducated, unknowledgeable men and women, badly paid, inadequate to their duties and responsibilities, muddling along without proper guidance and without proper buildings or materials. The facilities for training of teachers have been practically non-existent. " It can be stated without fear of contradiction that professional training, in the common acceptation of that term, hardly existed in most of these [training] centres before 1928."

This picture of the state of native education in Southern Rhodesia is by no means unique in Africa. There are other British Crown Colonies where the conditions are much the same.

Nevertheless, the future is promising. A tremendous effort is now being made in every part of British Africa to improve the educational standards of the native peoples. There is opposition to overcome, it is true, but most colonies have now a Department of Native Education. Most of the directors are men of courage, able, like Mr. Jowitt, to express clearly and forcefully the underlying social aims of an education system and its requirements, and possessing his faith that most of the native peoples of Africa are educable up to a very high standard. A properly organised system of education for the native peoples of Africa is the first requisite to the building up in Africa of a people able to enter into co-operative partnership with the Europeans in the task of developing the immense natural resources of a mighty continent.

Origin of Coral Reefs.

The Coral Reef Problem. By Prof. William Morris Davis. (American Geographical Society Special Publication No. 9.) Pp. viii + 596 + 16 plates. (New York: American Geographical Society, 1928.) 6 dollars.

IN 1913 Prof. W. M. Davis began to investigate the controversial subject of the origin of coral reefs. Since that time he has written numerous papers, and travelled many thousands of miles to see reefs for himself. This present volume incorporates the material of those papers and voyages, and enables those interested in coral reefs to obtain his views conveniently.

The appearance of this book is an event of considerable importance in geographical literature. Most writers on coral problems have been biologists, with the result that speculations on the origins of the different types of reefs have been somewhat varied and often have had but slight reference to the fundamental teachings of geology and physiography. It is not intended in any way to ignore or belittle the great importance of the biological study of reefs: far from it. But it is questionable how far a study of reef features and details is able to throw any light on to the origin of the reef as a whole. Looked at as an entity, a reef must clearly bear a close relation to the island or mainland which it borders, and if a reasonable interpretation is to be made of its origin, the physiographical characteristics of the shoreline must receive careful consideration. If, on the other hand, we are dealing with atolls, little direct evidence of their origin can be obtained from them. But, by deduction, we may draw certain conclusions about atolls from a study of elevated reefs or barrier reefs of other areas. In fact, the greatest difficulty of the whole coral problem is the origin of atolls: and a final answer to it can probably only be given when, if ever, we have a large number of deep borings made through characteristic atoll-reefs. Meanwhile, geographers, geologists, geophysicists, and biologists are able to help in solving this mystery by deduction until such borings are made.

It is, then, in the stress laid upon the physiographical and geological side of the problem that Davis has made such an important contribution to the already voluminous literature on the subject. Whatever criticisms may be passed on the book, it must be admitted, frankly and sincerely, by all who are interested in coral reefs, that Davis has succeeded in throwing much new light on the

problems awaiting solution, and in focusing attention on an aspect of the subject which had been sadly neglected. The interesting fact which stands out so clearly from Davis's work is that we are brought back once again to Darwin's views on the origin of reefs, which were first expressed more than eighty years ago. Since then numerous other theories have appeared, all of which have, directly or indirectly, made some contribution to the problem, but their main characteristic has been that they did not agree with the subsidence theory of Darwin and Dana. Davis, after reviewing these theories, and applying his deductive methods to the study of reefs both in the field and from charts, finds much evidence for reverting, with one or two minor modifications, to the Darwin-Dana hypothesis.

The only theory which Davis considers is a serious rival to the Darwin-Dana theory is the glacial control theory of Daly. It is not relevant to review here the merits of this theory, but it is important to appreciate that much of the future work on reef origins will probably involve fluctuations of sea-level and oscillations of sea temperature in the glacial period. The locking up of water in the great ice-caps appears to be an accepted fact: but we have still much to learn about the ice age, and if, as Depéret and others suggest, we have to deal with not one, but several fluctuations of sea-level in recent times, the coral problem may take on an even more complicated aspect than it has at present. Further, if we are to assume subsidence —often of great magnitude—we must consider seriously how such movements can occur. Is it enough, in other words, to assume that such subsidence has taken place because deductions drawn from a study of reefs lead us to think so? Must we not review the evidence in the light of recent geophysical work on the earth's outer shell?

The book is divided into two parts and contains an excellent bibliography. The first part deals with the leading theories of coral reefs: the theories are stated and criticisms advanced. The second, and by far the larger, part of the volume is devoted to the study of the facts of the problem. It is rather difficult to read this second part: so many points are reviewed and so many cases cited, that to assess adequately the real value of the subject matter necessitates either a visit to critical areas, or, at least, a careful study of large-scale charts. Nevertheless, the facts are marshalled in a masterly way, and much convincing evidence is brought together to show that Darwin's views are often better able to explain the known phenomena of various types of reefs than are those of any other worker.

On the other hand, one cannot avoid the feeling that, at times, Davis has allowed deduction to play too big a rôle in the matter, even though he himself admits, in such cases, the theoretical nature of his reasoning. For example, the explanation of certain features observable in the Fiji Islands is related to a moving anticline, so that, as the anticline passes, reefs alternately rise and fall. Or, again, in his account of the Great Barrier Reefs of Australia, Davis bases much of his evidence on some work of Andrews in northern New South Wales. Andrews there postulated a three-cycle development, which, Davis suggests, may also possibly apply to the Great Barrier Reefs. Quite apart from the fact that Andrews later modified his views, and so undermined the possibility of such an application, it does seem rather unnecessary even to try to extend a process of evolution relative to a region well to the south of the Barrier, to the reef area itself, which extends over one thousand miles. Deduction may be carried too far.

The volume contains an admirable and brilliant review of the coral problem, and the deductions of the author are usually clear and incisive. But there is yet much to learn about coral reefs, and the honest doubter may be excused if he asks for yet more definite knowledge about particular reefs and views somewhat critically the circumstantial evidence that Davis presents in favour of a complete acceptance of Darwin's views.

J. A. STEERS.

The "Index Kewensis".

Index Kewensis Plantarum Phanerogamarum. Supplementum septimum nomina et synonyma omnium generum et specierum ab initio anni MDCCCCXXI usque ad finem anni MDCCCCXXV nonnulla etiam antea edita complectens. Ductu et consilio A. W. Hill. Confecerunt Herbarii Horti Regii Botanici Kewensis Curatores. Pp. iii+260. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 75*s*. net.

THE monumental "Index Kewensis" and its successive supplements are recognised as an indispensable part of the equipment of any important botanical institution, affording as they do a ready means of reference to the names, the first places of publication, and geographical distribution of all the known genera and species of flowering

plants published from the year 1753 down to the present day. In works of this character, the prompt appearance of the successive issues is of great importance, and it is therefore highly gratifying that new arrangements, mentioned in the preface, have made it possible to publish the seventh Supplement, which covers the period 1921–25, only three years after the appearance of the sixth, which covered the preceding quinquennium, 1916–20.

It may not be out of place to mention here a few of the many ways in which the Index is of service. If any question arises as to the correct or original way of spelling of a botanical name, the original spelling can be obtained from the Index, though obvious errors are of course corrected. Those interested in horticulture or economic botany may find out the native countries of the plants with which they are dealing and verify the names by means of comparison with the original descriptions cited in the Index. To the research worker in the systematic botany of the flowering plants, the Index, and especially its supplements, are absolutely indispensable, in view of the widely scattered nature of the literature: in illustration of this fact, it may be mentioned that about four hundred different periodicals were examined during the preparation of the present Supplement.

As each successive Supplement has been prepared, it has been the aim of those responsible to adopt any practicable modifications which would increase the general usefulness of the Index without altering its format. From the third Supplement onwards, lists of addenda, which were found to be very troublesome to consult, have been omitted, any new or corrected entries being inserted in the next issue. From the fourth Supplement, the dates of publication, so important for purposes of priority, have been inserted in all cases. The geographical information supplied is now much more detailed, the precise country or province being stated wherever practicable. Where new names are based on previously published ones, the latter are cited so that the connexion between the two names may be apparent.

A novel and invaluable feature incorporated in the present Supplement is a separate list of new genera, arranged under their families. This enables a botanist who is interested in one particular family, such as Orchidaceæ, for example, to see at a glance what new genera belonging to this family are contained in the supplement, information which is unobtainable from other sources without a prohibitive expenditure of time.

The present Supplement contains 260 pages, as compared with 222 in Supplement VI., the increase being due partly to the increased activity of botanical research during the period, and partly to the inclusion of many references which had been generally overlooked owing to their having been published in obscure periodicals or books. As regards the general style and typography, it may suffice to say that the present volume worthily upholds the high traditions of the Clarendon Press.

We are glad to see that Supplement VII. has been published only three years after the appearance of Supplement VI. The War naturally caused a delay in the appearance of Supplements V. and VI., but now, thanks to a special assistant (Miss M. L. Green) having been added to the Herbarium staff to supervise the laborious work of preparing the Index, the progress of the work has been considerably expedited. We notice in the preface that during the past twenty-two years the work of supervising the preparation of the Index has been entrusted to Dr. T. A. Sprague, who has carried out the work with great ability.

Sir Thomas Clifford Allbutt.

The Right Honourable Sir Thomas Clifford Allbutt, K.C.B. A Memoir by Sir Humphry Davy Rolleston, Bart. Pp. vii + 314 + 3 plates. (London: Macmillan and Co., Ltd., 1929.) 15*s.* net.

IT is fitting that Sir Humphry Rolleston should write a memoir of Sir Clifford Allbutt, his immediate predecessor in the chair of physic at Cambridge. Sir Humphry was closely associated with him in the great "System of Medicine", which has become a classic, and is near akin in his mental equipment both professionally and in his wide outlook. The memoir is so easy to read that only a close scrutiny shows how great has been the pains taken to get the facts accurately, to verify the references, and to maintain a due sense of proportion. All this Sir Humphry has done to perfection, and has succeeded in presenting a charming portrait of a learned physician who was also a cultured gentleman.

Born in 1836, a Yorkshireman, the son of the vicar of Dewsbury, Clifford Allbutt knew Charlotte Brontë and had seen Emily. He was thus able, in later life, to give a clear presentation of the position of the Brontës and to dispel the myths which were beginning to form round this remarkable family. As the son of a north-country vicar, he was not overburdened with wealth, but a classical scholarship defrayed the cost of his education at Caius College, Cambridge, from 1855. He decided,

however, to read science instead of classics, and took his degree after obtaining a first class in the Natural Sciences Tripos, gaining distinction in chemistry and geology. By this time he had shown some literary ability, had thought of becoming an artist, and had interested himself in music. The necessity of earning his living turned his attention to medicine. He entered St. George's Hospital, qualified, and settled in practice at Leeds, devoting himself from the beginning to medicine, and keeping himself during the lean years by writing for both lay and professional reviews.

Sir Humphry has taken Allbutt's life year by year, and elucidates his work by a running commentary which illustrates the main facts of a busy life with clearness and precision. First, the strenuous period (1861–1889), when as a physician he built up so great a consulting practice that he was nearly overwhelmed and accepted a commissionership in lunacy (1889–1892) as a relief. Lastly, the years (1892–1925), when he was Regius professor of physic in the University of Cambridge, a dignified post in which he found full scope for his many activities. During a portion of this last period, the similar post at Oxford was held by an equally remarkable man—Sir William Osler. Both were outstanding in their generation; in many points their characters agreed, in many they differed: Allbutt, a great English gentleman with the culture and something of the outlook of the older physicians, his thought based upon classical models; Osler a great humanist, with a wide knowledge of men gained in all parts of the world, one who looked forward rather than backward, versatile in all things, the founder of a school, endowed with an impish spirit he could not always restrain, which would have been quite foreign to Allbutt. Both were great teachers and brought to their classes an extensive knowledge of disease gained at the bedside. Both served their generation by writing text-books of world renown, so that their knowledge was not confined to the limited few who came into personal relationships with them. Both were absolutely honest in word and in deed, and both desired to advance professional knowledge by a wider education of the medical student, Allbutt by linking up human with animal pathology, Osler by improving historical knowledge and inculcating a love of the great masters in medicine and surgery.

These resemblances and these differences Sir Humphry brings out to admiration, and thus presents a picture of Allbutt as a leader of the medical profession. Incidentally, he shows how recent is the use of the clinical thermometer. Wunderlich, the second edition of whose book "On the Temperature in Disease" was translated in 1871, used a thermometer nearly a foot long and left it in the patient's armpit for twenty to twenty-five minutes. Allbutt, in 1867, had a short clinical thermometer made. It measured six inches in length, cost 7*s*. 6*d*. in a case, and recorded the temperature in five minutes. The length of the instrument was afterwards reduced to three inches, an index was supplied, Fahrenheit's scale was employed instead of the Centigrade, which would have been better, and by 1876 it was becoming standardised.

The book is illustrated with two portraits of Clifford Allbutt, which his friends will recognise as excellent likenesses, and there is a remarkably satisfactory index.

Heat Engines.

Steam and other Engines. By J. Duncan. Revised and enlarged edition. Pp. xi + 536. (London: Macmillan and Co., Ltd., 1929.) 6*s*.

IT has been very difficult during the last few years to recommend a text-book to the beginner in the study of heat engines, but it may be said that this new edition, containing as it does a treatment of the reciprocating steam engine, steam turbine, and internal combustion engine, has almost solved the difficulty. Entropy, total heat-entropy diagrams, and the mathematical treatment of steam turbines, are usually intended for advanced students; and to some extent their inclusion renders the book a little advanced for the first year man, while, on the other hand, the second year student will certainly find the treatment given rather insufficient. It would have been preferable to omit such semi-advanced matter and devote a special chapter to the study of condensers and air-pumps instead of using only four pages, and these mainly concerned with the marine condenser, for this important section of heat engineering.

Considerable additions have been made both in subject matter and illustrations, and these have been treated in the light of modern engineering practice. The chapter on the properties of steam calls for special comment. Here the author has added to his charts, so as to cover the higher pressures and temperatures now met with in large steam plants, and a valuable feature is the diagram showing the variations of specific heat of superheated steam at constant pressure with temperature and pressure. It is regrettable, however, that approximate formulæ should have been quoted for

liquid heat of water and specific volume of superheated steam, when the former can be read directly from Callendar's steam tables and the latter be calculated from the rational formulæ, also included in his tables.

It is surprising how many modern writers dealing with the action of steam in the cycles of a reciprocating engine still adhere to the old theory that initial condensation is almost exclusively responsible for all the losses, although it has been repeatedly shown by eminent authorities that this is not the case. The author is not altogether exempt from this criticism, despite the fact that 'leakage' is mentioned in a small paragraph.

The chapters on internal combustion engines form a welcome addition. The matter is well developed and the illustrations are numerous and well chosen, especially those dealing with the heavy oil engines, which are all of modern design. This part of the book, together with the description of a high-pressure marine steam plant, should prove of great interest to all engineering students.

The descriptive matter is very clearly developed throughout the book, indicative of the author's experience of good teaching practice, and the new edition can be said to be a distinct acquisition to a student's bookshelves.

Our Bookshelf.

Geology of Gold (*South Africa, Australia, New Zealand*). By E. J. Dunn. Pp. x+303+163 plates. (London: Charles Griffin and Co., Ltd., 1929.) 35*s*. net.

THIS treatise is founded on the author's personal experience in South Africa, Australia, and New Zealand. In the first-named country he spent many years, from about 1872 to 1886, when he left for Australia. His knowledge of the geology of these countries, especially in regard to the occurrence of gold, is perhaps unique. It is not quite up-to-date in regard to South Africa; although in the early days Dunn was a pioneer in South African geology, having given the first description of the Pretoria Series under the name of Lydenburg Beds, and the name of Dwyka to the famous glacial conglomerate.

The book contains much material founded on the author's observations in mines he has reported on; and his notes and diagrams are of considerable interest in connexion with ore genesis. In twenty-two chapters, the first of which is an introductory description of the earth's crust, he deals with country rocks, fissures, faults, lodes, dykes, veins, indicators, conglomerate reefs, walls of lodes, sources of gold, solubility of gold, secondary deposition of gold, metasomatic gold, minerals associated with gold occurrence, the forms of lode and alluvial gold respectively, the distribution of lode and alluvial gold, deep leads, high-level leads, and gold in glacial deposits. A special chapter is devoted to a description of the famous Mount Morgan mine in Queensland, which, from its inception to the end of June 1926, yielded 5,305,979 ounces of gold and 139,427 tons of copper, of the aggregate value of £29,739,276. This chapter is of especial interest, as the author had an opportunity of studying the secondary enriched ore, which is a feature of the Mount Morgan mine. On the occasion of the author's first visit, the daily yield from this ore amounted to 1000 ounces of gold. Exact surveys were made by the author while yet the mine was in a youthful stage, and at intervals, until the last of the secondary ore was removed. In this way a record was secured, and a complete suite of samples collected, which in the end was presented to the Victorian Mines Department.

Special attention is given by the author to the occurrence of alluvial gold, from which the bulk of the gold production of Australia has been derived, and the author's photomicrographs of the different forms of alluvial gold are of great interest and invaluable for reference and comparison. There are 250 photomicrographs, of which 60 are of alluvial gold and the remainder of lode gold and country rocks. The 172 diagrams (plans and sections) illustrate the occurrence of lodes and veins, faults, dykes, saddle-reefs (Bendigo, Victoria), indicators, auriferous conglomerates (Transvaal), and alluvial deposits. F. H. HATCH.

The Nautical Almanac and Astronomical Ephemeris for the Year 1931 for the Meridian of the Royal Observatory at Greenwich. Standard edition. Pp. vii+865. (London: H.M. Stationery office, 1929.) Paper, 5*s*. net; cloth, 7*s*. net.

THIS issue marks an epoch in the history of the "Nautical Almanac"; it is the first drastic revision of its general arrangement since 1834. All elements that were formerly given for Greenwich mean noon are now given for mean midnight; also, all the data referring to the sun are grouped together, and the same is done for the moon. The rectangular co-ordinates of the sun are given for midnight only, but first and second differences are printed, also auxiliary interpolation tables. The co-ordinates are given both for the equinox of 1950·0 and for that of 1931·0. It is desired to encourage the use of the 1950 equinox, and tables are given for reducing observed positions to this equinox.

For the convenience of users of calculating machines, both natural and logarithmic values of the sun's radius vector, Besselian day numbers, etc., are given. Much fuller information than before is given relating to the satellites of the planets. These include satellites VI. and VII. of Jupiter, but not VIII. or IX.; it is to be hoped that they may be included in the future. The list of observatories has been revised and extended. The inclusion of Uranibourg among "Former observatories" will be welcomed. The table of Julian days has been expanded, and now includes day 0 of each month from 1850 to 1940; outside these limits there are reduction tables, which diminish the risk of error.

There are two interesting essays in the volume; that on the calendar is by Dr. J. K. Fotheringham, and it gives full details both of ancient and modern calendars. We learn that Ptolemy Euergetes anticipated Julius Cæsar in 238 B.C. in trying to introduce a leap day every fourth year; but the attempt remained unsuccessful until two centuries later. The other essay is on time, and contains the statement that in the 1933 Almanac the short-period nutation terms will be included in sidereal time, which will be given to the third decimal of a second. This is in recognition of the great improvement in clocks in recent years, as a result of which it is considered desirable to be able to obtain mean sidereal time, freed from nutation.

Dr. Cowell ascribes much of the credit of the improvements in the Almanac to the deputy superintendent, Dr. L. J. Comrie.

The Earth and its History: a Text-book of Geology. By Prof. J. H. Bradley, Jr. Pp. vii + 414. (Boston, New York, Chicago and London: Ginn and Co., Ltd., 1928.) 12*s.* 6*d.* net.

THIS book is "written for the general student who desires to be intelligent about the earth", but as a guide with that laudable object it cannot be regarded as wholly satisfactory. It is written in a vigorous and picturesque style, and is copiously illustrated with many excellent illustrations. Unfortunately, the author appears to have lost touch with modern advances in geology. The treatment of isostasy is feeble. The views of T. C. Chamberlin dominate in the discussion of cosmogony and orogenesis, and it is suggested that the belief in a formerly molten earth is fast losing its popularity. This is not the reviewer's experience. The account of the age of the earth is very inadequate, for the author has clearly not yet liberated himself from the former prejudice in favour of a '100 million year' earth. He is sceptical of the validity of radioactive methods—for no good reasons—but compromises with a chart showing 225 million years for the Cambrian and 500 million years for the oldest Archæozoic. Such a compromise is highly unscientific, for there is no evidence whatsoever, and never has been, supporting figures of this order. One would expect a new book on geology to refer to the investigations carried out under the auspices of the Carnegie Institution in the field of vulcanology, but here there is no mention of any such recent work. Despite its attractive features, the book cannot be regarded as other than old-fashioned in its treatment of current problems.

Radium Treatment of Cancer. By Stanford Cade. Pp. x + 158 + 13 plates. (London: J. and A. Churchill, 1929.) 15*s.*

THE author states in the preface that in this book he has tried to illustrate the technique of radium in cancer in various anatomical situations and some of the results obtained by it by quoting selected cases. After a few short chapters on radioactivity, the methods of irradiation and the general principles of radium therapy, the author describes, often with the aid of coloured plates, the surgical methods at present in vogue in the treatment of cancer by means of radium.

The book will probably prove of much interest to surgeons who require detailed information of this character. They may have some difficulty in the section on p. 6, devoted to units, as some of the statements require correction. The author says that the principle underlying modern radium therapy is that of prolonged irradiation with small doses. It might reasonably be objected that the main principles underlying this therapy are of a much more general character than one aspect of the time factor.

The book is well produced, and some of the coloured plates give good impressions of the local effects which can be got by means of radium inserted into the tissues.

Field Book of North American Mammals: Descriptions of every Mammal known north of the Rio Grande, together with Brief Accounts of Habits, Geographical Ranges, etc. By H. E. Anthony. (Putnam's Nature Field Books.) Pp. xxv + 625 + 48 plates. (New York and London: G. P. Putnam's Sons, 1928.) 15*s.* net.

IN this convenient volume, which the field naturalist can without grumble slip into his holiday baggage, or on occasion into his pocket, are described 1445 species and subspecies of mammals—the full complement of the American continent north of the Rio Grande. It is a masterpiece of condensation, discussing in detail the habits and characters of at least one prominent species in each group, and stating geographical ranges and external characters sufficiently to guide the layman in almost every case to the identity of even related species and subspecies. The task of identification is lightened by 32 plates, each containing from two to thirteen excellent coloured figures, by abundance of lively and characteristic pen drawings and photographs, and by maps illustrating the distribution of geographical races. The author has produced a model of what a field-book ought to be.

List of the Vertebrated Animals exhibited in the Gardens of the Zoological Society of London, 1828–1927. Centenary edition in 3 volumes. Vol. 1: *Mammals.* By Major S. S. Flower. Pp. ix + 419. (London: Zoological Society of London, 1929.) 25*s.*

DURING the hundred years of its existence the London Zoological Gardens have exhibited no fewer than 949 species of mammals, representing probably most of the forms ever likely to be seen in captivity. This systematically arranged list, however, is much more than a historical catalogue of zoo exhibits. It is a valuable work of reference, giving the standard scientific name of each species, references to the original description and to a figure where such exists, synonyms, and not least interesting, the popular, local, or trade name. The first and last of these items ought to make for the standardisation of popular and scientific names in the exhibits of museum collections, where a lack of uniformity in different institutions tends to confuse the ordinary visitor.

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.*]

Continents and Oceans.

EVER since Wegener published in 1915 his remarkable theory of the drift of the continents and the movement of the poles, most of us have viewed a map of the world with entirely different eyes, and it has become almost instinctive to look for correspondences between the outlines of the continents and relationships between the continents and the oceans.

In this short note I wish to comment on three or four of these relationships which have struck me in my own contemplation of the subject. I imagine that they have all been noticed before, but I do not remember seeing any discussion of them.

A thing which has struck me over and over again is the symmetry of the present distribution of land and sea with reference to the present position of the earth's axis. The north polar ocean is almost circular in shape and the pole is practically at the centre of the circle. Antarctica is a circular continent and the south pole is at its centre. The great land masses of the northern hemisphere send out protuberances towards the south which, roughly speaking, all extend to the same latitude, leaving a belt of ocean encircling the globe between latitude 40° S. and 70° S., which can truthfully be described as being symmetrical about the earth's axis.

These three examples of symmetry are clear and striking, but there is another example which, although less striking, appears to me to be of equal importance, and that is the orientation of the land masses themselves in relation to the earth's axis. If my reader will open an atlas at the map of the world on Mercator's projection, he will, I think, notice the following points. In the first place, the continents appear to be standing upright. This appearance is largely due to the north-south trend of the main peninsulas, but there is much more in it than that. The main continental masses appear to have been placed in the rectangular network of the Mercator projection in the most symmetrical way possible. The best way to explain what I mean is to consider the one continent which is abnormal. South America does not 'look straight'. One feels that it is necessary to give it an anti-clockwise twist to get it right. Looking now at North America, one does not have that feeling, it already looks straight; while Australia is itself almost rectangular with sides parallel to the network. Africa is quite upright, and when one considers the whole block of Africa, Europe, Asia, and Australia, one feels that in any different orientation it would not fit the framework of the Mercator chart. I find it impossible to put this in a more concise form or to express the symmetry in mathematical language; but every one who will take the trouble to look at the map will see what I mean. That the land masses are symmetrical to the network of a Mercator chart simply means that they are symmetrical to the earth's axis, thus I feel justified in considering this good evidence of the symmetrical arrangement of the present distribution of land and sea.

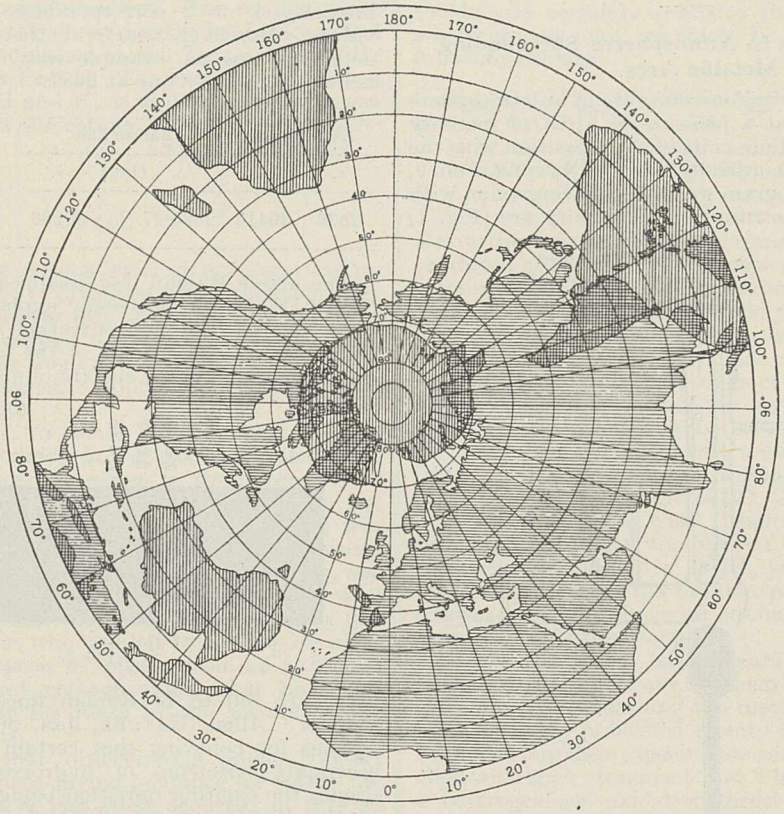

FIG. 1.

There is another characteristic of the present distribution of land and sea to which I personally have never seen any reference, namely, that, with one small exception, all the continents have oceans for their antipodes. That this might be expected to a large extent follows from the fact that the land masses are largely concentrated in one hemisphere, but I do not think many realise how completely the relationship is carried out in detail.

In Fig. 1 the distribution of land and sea in the two hemispheres is represented in such a way that every point in the northern hemisphere has its antipode superposed upon it. The land of the northern hemisphere is indicated by horizontal hatching, and the land of the southern hemisphere by vertical hatching. In the southern hemisphere there are four large land masses and it will be seen that three of these fall completely free of the continental blocks of the northern hemisphere, and the way in which Antarctica and Australia find oceans to fit them is almost uncanny. The southern part of South America is the only continental land of the southern hemisphere which has a continent as its antipode in the northern hemisphere: Is it significant that this is the only continent which we felt was not symmetrical to the earth's axis and required twisting to bring it straight, a twist which, it may be mentioned, would bring it clear of its Asiatic antipode?

The relationships which I have indicated may be entirely fortuitous or they may have a deep significance. I do not wish to discuss here which is the more probable, but I cannot help remarking that the chances against so many indications of symmetry being merely accidental must be very large. On the other hand, if they are not fortuitous but indicate some tendency to symmetrical distribution, that tendency must always have existed, and must be taken into account when discussing shifts of the pole. I do not wish these remarks to be considered to be evidence against the Wegener theory, for I feel more strongly than ever that only by a shift of the continents can the climates of other geological ages be explained.

G. C. SIMPSON.

Meteorological Office,
Adastral House, Kingsway, W.C.2.

Raman Spectra in Atmospheres Surrounding Metallic Arcs.

THE spectrum of the mercury arc in an atmosphere of carbon dioxide at a pressure of 6 cm. of mercury contains two faint lines coinciding in position with the two Raman lines recorded by Rasetti (NATURE, Feb. 9, 1929). Our spectrogram was taken in connexion with a study of the spectrum of the mercury arc (Fig. 1)

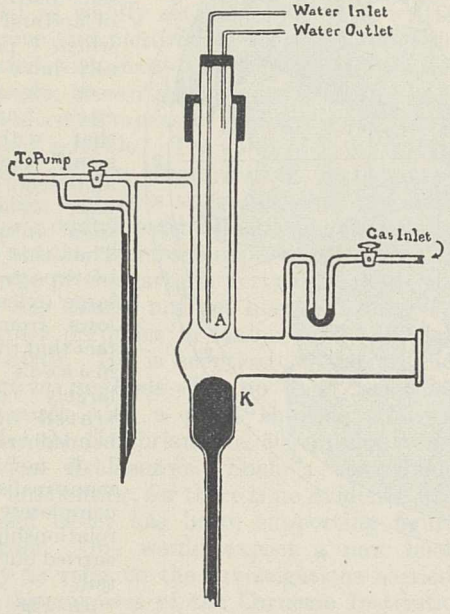

FIG. 1.—*A*, Water cooled anode; *K*, mercury cathode.

in atmospheres of foreign gases (*Indian Jour. Phys.* iv. 2, pp. 179-193; 1929):

Exciting Line.		Raman Line.		$d\nu$.	Rasetti's Value.
λ.	ν.	λ. (Int.)	ν.		
2536	39413	2622 (1)	38124	1289	1284 ± 10
		2628 (1)	38034	1379	1392 ± 10

That these faint lines are Raman lines of carbon dioxide is supported by the fact that they disappear when carbon dioxode is pumped out and do not reappear on the introduction of hydrogen. Other bright ultra-violet lines also show the corresponding Raman lines, which, however, are fainter than the above. This observation suggests a method of producing the Raman spectra of gases by running the exciting arc in an atmosphere of the gas. An attempt to obtain the Raman lines of carbon tetrachloride in the visible region by running a mercury arc in an atmosphere of carbon tetrachloride vapour was inconclusive on account of the complex band spectra occurring in the region.

Our results with carbon dioxide suggest a possible origin of at least some of the faint unclassified lines observed in all spectra. We have tested this hypothesis in the case of zinc and mercury, using Coblentz and Geer's extreme infra-red emission frequencies of mercury and zinc given in Kayser's "Handbuch der Spectroscopie", believing that they are molecular in origin. In the arc the formation of molecules, even in the case of monatomic vapours, is favoured by the presence of excited atoms. We find that in a considerable number of cases there are faint lines of intensity 1 or 2 corresponding to the calculated values. Moreover, nearly all these lines are marked nebulous; as an example may be mentioned the nebulous mercury line at 2687.

Exciting Line.		Raman Line.		$d\nu$.	Observed Infra-red Frequency.
λ.	ν.	λ. (Int.)	ν.		
2536	39413	2686·67 (1)	37209	2204	2206 (4·53 μ)

The above Raman line disappears when the arc is cooled (Fig. 2), a fact easily explained as due to the reduction in the concentration of the scattering molecular centres. Some of the faint lines of as yet unknown origin in the spectra of many celestial bodies

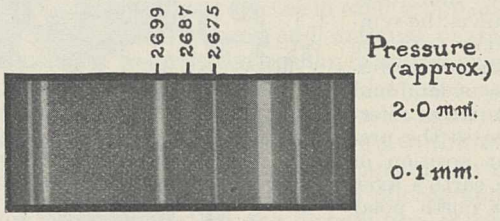

FIG. 2.

may turn out to be Raman lines produced in this manner. Allen (NATURE, Jan. 26, 1929) has given reasons for believing that certain faint lines in the secondary spectrum of hydrogen have a similar origin, the exciting radiation being the first few lines of the Balmer series. Kothari (NATURE, July 20, 1929) has adduced reasons for believing that the faint Fraunhofer lines are probably due to similar excitation and subsequent absorption, in the chromosphere of the sun.

A paper giving details will be published elsewhere.

B. VENKATESACHAR.
L. SIBAIYA.

Department of Physics,
Central College, Bangalore,
Oct. 24.

Norman Lockyer and the Total Solar Eclipse of 1875.

MAY I, for the sake of historical accuracy, beg leave to comment on two conflicting passages in the recently published volume, "The Life and Work of Sir Norman Lockyer", both referring to the total solar eclipse of 1875.

On page 82 it is stated that in Siam, clouds covered

the sun at the time of totality, and that the failure to obtain observations was disastrous from Lockyer's point of view. But in another place, page 245, it is, on the contrary, remarked that Lockyer found strong support for his dissociation hypothesis in the results of the 1875 eclipse observations.

A brief statement of the facts relating to this eclipse may serve to remove the confusion to which these conflicting passages may give rise.

The Committee of the Royal Society which organised the expedition decided to divide it into two sections, one of which was to proceed to Siam, while the other was to establish itself in Camorta, one of the Nicobar islands. When it appeared that Lockyer could not leave England at the time, owing to other duties, I was appointed head of the whole expedition so long as it remained united, while Meldola was to be leader of the Camorta section after their separation. It was this latter division that met with bad weather, the sky in Siam being cloudless. The results of the expedition were worked out jointly by Lockyer and myself and were published in the *Transactions of the Royal Society* (1878, Part 1). The photographs showed the calcium lines H and K, as well as some hydrogen lines at the base of the corona, but no other metallic lines.

ARTHUR SCHUSTER.

Yeldall,
Twyford, Berks.

SIR ARTHUR SCHUSTER'S letter gives interesting information about the 1875 eclipse, which the biography of Sir Norman Lockyer (for the relevant portions of which I am responsible) might well have included. It is not made clear there that the British expedition divided into two sections: apparently I assumed that Camorta was in Siam!

I have no reason to think, however, that there is any material inaccuracy in the passages referred to, although I have not now access to the papers before me when writing. Certainly the passages are not conflicting. The first states that Meldola, who was Lockyer's regular assistant, had a special programme of work arranged for him; that the expedition was fruitless through clouds, although other parties were better favoured; and that the misfortune was disastrous for Lockyer, who was left to develop his ideas without the guidance of observation at a crucial point. The second passage states that he found strong support for his ideas in the results of the eclipse observations.

It is evident that observations might support existing ideas without giving guidance for future development—which is just what occurred in this instance. What Sir Arthur Schuster makes clear, and is not stated in the biography, is that the better favoured other parties included a section of the British expedition.

HERBERT DINGLE.

Imperial College of Science and Technology,
Nov. 16.

Combustion of Acetylene.

IN NATURE of Nov. 16, p. 761, Messrs. G. B. Kistiakowsky and S. Lenher announce that they have recently demonstrated that "The oxidation of acetylene by oxygen proceeds at 250°-315° through the stages of glyoxal, formaldehyde, formic acid, carbon dioxide, and water" according to the scheme:

$$\text{"}\begin{matrix}\text{CHO}\\|\\\text{CHO}\end{matrix}\Big\} \xrightarrow{} \text{CO} + \text{HCHO} \xrightarrow{O_2} \text{H.COOH} \xrightarrow{O_2} \text{CO}_2 + \text{H}_2\text{O}$$
$$\begin{matrix}\text{CHO}\\|\\\text{CHO}\end{matrix}\Big\} \xrightarrow{} 2\text{CO} + \text{H}_2 \qquad\qquad \searrow\ \text{CO} + \text{H}_2\text{O}\text{"}$$

and that "All these reaction products have been isolated".

So long ago as 1905, in a paper entitled "The Combustion of Acetylene", by Mr. G. W. Andrew and myself (*Jour. Chem. Soc.*, **87**, pp. 1232-1248) embodying the results of a detailed experimental study of the subject, and particularly of the interaction between 250° and 350° of various mixtures of acetylene and oxygen in the ratios 2:1, 1:1, 2:3, 1:2, and 1:3 respectively—in the course of which polyglycolide $(C_2H_2O_2)_x$ had been detected, and both formaldehyde and formic acid isolated and identified—the following statements summarising the matter appeared: "Experiments on the slow combustion of acetylene prove that carbon monoxide and formaldehyde simultaneously arise at an early stage of the process, probably as the result of the decomposition of an unstable product $C_2H_2O_2$, such, for example, as $\begin{matrix}\text{C.OH}\\\ddot{\text{C}}\text{.OH}\end{matrix}$. The production of formaldehyde certainly precedes that of steam. The whole process may, we think, be represented by the following scheme:

$$\begin{matrix}\text{C.H}\\\ddot{\text{C}}\text{.H}\end{matrix} \rightarrow \left[\begin{matrix}\text{C.OH}\\\ddot{\text{C}}\text{.OH}\end{matrix}\right] \rightarrow \underbrace{\text{CO} + \text{H.C:O}}_{\text{H}} \rightarrow \underbrace{\text{HO.C:O}}_{\text{H}} \rightarrow \underbrace{\text{HO.C:O}}_{\text{OH}}$$
$$\overbrace{(2\text{CO} + \text{H}_2)}^{1} \qquad \overbrace{\text{CO} + \text{H}_2}^{2} \qquad \overbrace{\text{CO} + \text{H}_2\text{O}}^{3} \qquad \overbrace{\text{CO}_2 + \text{H}_2\text{O}}^{4}$$

Below the ignition point the formic and carbonic acids produced at stages 3 and 4, respectively, break down, forming steam and oxides of carbon, whilst above the ignition point the formaldehyde produced at stage 2 (or possibly also the dihydroxyacetylene at stage 1) is resolved into carbon monoxide and hydrogen," and further, that "the initial stage of the combustion involves the formation of an oxygenated molecule $C_2H_2O_2$ . . . which rapidly breaks down to carbon monoxide and formaldehyde, the last-named product being subsequently burnt, through formic and carbonic acids, to a mixture of CO, CO_2 and steam".

It was also found that "there is little to choose between the rates of combustion observed with mixtures corresponding to $2C_2H_2 + O_2$ and $C_2H_2 + O_2$, respectively, below the ignition point. An excess of oxgyen over and above an equimolecular proportion always retards the process."

While the recent experiments of Messrs. Kistiakowsky and Lenher have led them to adopt practically the same view regarding the mechanism of the combustion as we published twenty-four years ago, the results of our then experiments can scarcely be reconciled with their statement that "in packed vessels . . . a heterogeneous oxidation direct to carbon dioxide and water takes place". We found that, on continuously circulating a $C_2H_2 + 3O_2$ mixture in a closed circuit comprising (i) a combustion tube packed with porous porcelain maintained at 380° and (ii) apparatus for removing both condensable and water soluble products, 96·1 of acetylene burnt gave rise to 84·9 carbon dioxide, 74·7 carbon monoxide, 32·6 formaldehyde, 58·6 steam, and 4·6 hydrogen, reckoning all products as gaseous and occupying the same volume at the same temperature. From this it was deduced that of the total formaldehyde theoretically formed at stage 2 of the combustion, 4·8 per cent had decomposed into carbon monoxide and hydrogen, 33·9 per cent had appeared unchanged in the products, while the remaining 61·3 per cent had been further burnt, through formic and carbonic acids, to oxides of carbon and steam.

One outstanding feature of the explosive combustion of acetylene to which we then directed attention, and which distinguishes its case from that of ethylene, is

that *on explosion with less than its own volume of oxygen*, no steam formation (indicative of the thermal decomposition of monohydroxy-acetylene) can be observed. In such circumstances, half the acetylene is burnt through $C_2H_2O_2$ to $2CO + H_2$, the other half being resolved by the heat into its elements together with a small amount of methane. I therefore agree that, in the combustion of acetylene, unlike that of ethylene and of other hydrocarbons, so far there is no evidence of a primary monohydroxy-stage, the initial stage apparently involving the direct formation of an oxygenated $C_2H_2O_2$ molecule. WILLIAM A. BONE.

Imperial College of Science and Technology, London, S.W.7, Nov. 18.

High Temperature Allotropes of Manganese.

IN a communication entitled "A High-Temperature Modification of Manganese" (NATURE, Aug. 31, 1929) Messrs. Persson and Öhman confirmed, by means of the X-ray examination of the lattice structure of a series of copper-manganese alloys, the existence of the allotropic transformation of manganese which I had previously found to take place at $1191° \pm 3°$ C. and showed that its structure corresponded with that of the tetragonal modification, as determined by Westgren, of manganese obtained by electrolysis. They also found that the critical point $1024° \pm 3°$ C., on the other hand, did not seem to be accompanied by any change of crystal structure.

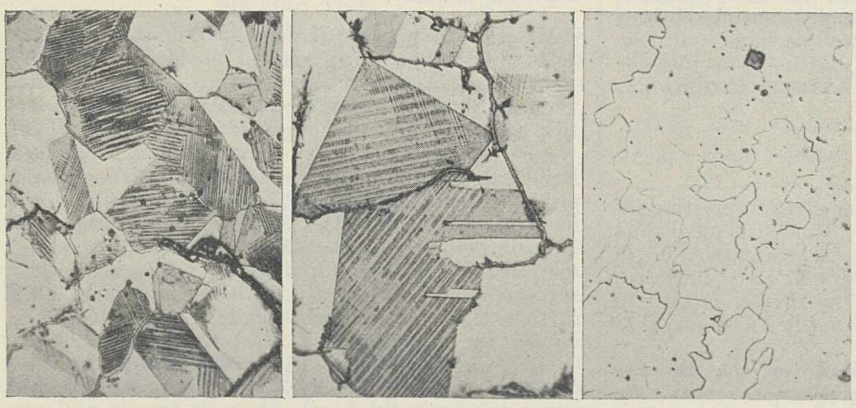

FIG. 1.—Microstructure of manganese after heat treatment at various temperatures and quenching in water. ×100. *A*, 2 hours at 975° C.; *B*, 2 hours at 1075° C.; *C*, 2 hours at 1220° C.

Shortly after the publication of my researches on manganese (*Jour. Iron and Steel Inst.*, **115**, 393; 1927) I carried out further experiments regarding the microstructure of the high temperature allotropes, and in view of Messrs. Persson and Öhman's results they may be of interest. Fig. 1 A and B show the microstructures of a sample of manganese which has been heat-treated in hydrogen for 2 hours at 975° C. and 1075° C. respectively and then quenched in water. It is evident on comparing these structures that no change in crystal structure has occurred on passing through the 1024° C. transformation point—which supports the view held by the above authors. Fig. 1 C shows the structure of the same sample of manganese which has been heat-treated in hydrogen for two hours at 1220° C. and then quenched in water; a change in structure has obviously occurred.

Messrs. Persson and Öhman suggest that, since γ-manganese, *i.e.* electrolytic manganese, is in reality a high temperature modification, that is sufficient to account for its rapid transformation into α-manganese by heating to 150° C. This also accounts for the fact that no thermal change was observed by me in pure manganese, prepared by distillation *in vacuo*, over ranges of temperature from 30° to 300° C. MARIE L. V. GAYLER.

National Physical Laboratory, Teddington, Middlesex, Nov. 8.

The Charge of an Electron.

LAST January I proposed a theory of electric charge which led to a definite prediction of the numerical value of the constant $hc/2\pi e^2$. Since then I have been trying to obtain fuller insight into the more obscure parts of the theory—places where it was necessary to trust to a sense of analytical form rather than to any definite conception of the physical or geometrical meaning of the formulæ. I think that I have now been able to bring the theory into an improved form.

I hope to publish the full investigation soon; meanwhile I may state a result of general interest. According to the new calculation the value of $hc/2\pi e^2$ is 137. It is difficult to explain briefly the change from the former result (136); but, broadly speaking, it is due to the recognition that the 'rotation', which I introduced to represent interchange of the two electrons, is not one of the 136 symmetrical rotations of a pair of electrons, but is an antisymmetrical rotation which must be counted in addition. This was not very apparent so long as the rotation term was introduced solely as a consequence of the Fermi-Dirac principle; but the present theory goes more deeply into the origin of the term and makes clear its relation to the symmetrical rotations. A. S. EDDINGTON.

Observatory, Cambridge, Nov. 20.

Forestry Research in India.

IN connexion with the article on the above subject which appeared in NATURE of Nov. 16, I should like to explain that the words "Towards the end of 1900 the first research work by the Forest Department was commenced, when a member of the forest staff was appointed", referred to the fact that this was the first whole-time appointment made with the object of undertaking a definite line of research. Executive officers of the Department had been engaged upon research work before (and after) 1900 in addition to their own duties, as exemplified by the valuable work done by the late Sir D. Brandis, J. S. Gamble, and many others. When the Research Institute was incorporated in 1906, all the research officers were drawn from the gazetted ranks of the Department.

In view of the lamented death of Sir Sainthill Eardley-Wilmot, only a few days after the opening of the new research buildings at Dehra Dun, it may be added that, next to Lord Curzon, the officer most responsible for the new scheme was Eardley-Wilmot, at the time Inspector-General of Forests to the Government of India; for it was due to his vision and enthusiasm that the Research Institute came into being. THE WRITER OF THE ARTICLE.

Quantitative Chemical Analysis by X-rays and its Application.[1]

By Prof. G. HEVESY, Freiburg im Breisgau.

THE late H. J. G. Moseley was convinced that his discovery of X-ray spectroscopy would prove to be of value to analytical chemistry. He had chiefly the analysis of alloys in mind, and his well-known photograph of the brass spectrum, showing the stronger copper and weaker zinc lines, can be considered as the first application of X-ray spectroscopy in the field of analytical chemistry. His untimely death prevented him from attacking any other problem than the connexion between atomic number and X-ray spectra. The result of his endeavour is well known; it led him to discover the fundamental law governing X-ray spectra.

The first application of X-ray spectroscopy to the analysis of minerals was made in 1922 by Hadding in Siegbahn's laboratory. Shortly afterwards, Goldschmidt and Thomassen made a very exhaustive examination of the relative abundance of rare earth elements in a great number of different minerals. By comparing the intensity of the X-ray lines, they concluded that very marked differences exist in the relative abundance of neighbouring even and odd elements, and confirmed the generalisation put forward by Harkins and Oddo.

The important problem studied by Goldschmidt and Thomassen could be most satisfactorily solved without a strictly quantitative analysis, the differences between the abundance of neighbouring elements being very marked. The necessity for a strictly quantitative application of X-ray spectroscopy was, however, apparent when in the same year Coster and myself had to face the problem of the separation of hafnium from zirconium. The two elements being so similar, it was necessary when testing the efficiency of a separation method to determine small differences in the hafnium-zirconium ratio. We added to the sample to be investigated just sufficient tantalum oxide to make the hafnium La_1 and tantalum La_1 lines appear in equal intensity on the photographic plate, and concluded that in this case the unknown number of hafnium atoms present equalled the known number of tantalum atoms. Later, tantalum oxide was replaced by lutecium oxide and the intensity of the hafnium-$L\beta_1$ and lutecium-β_2 lines compared. The wave-length difference of two lines amounts in the latter case to four X-units only, corresponding to $\frac{1}{5}$ mm. on the photographic plate. Closeness of the wave-length of the lines to be compared is of great advantage. The intensity ratio of these lines was determined experimentally and was found to be 2·55. Similar considerations to those which led to the choice of lutecium as the reference substance for the determination of hafnium induced us to take erbium as a reference substance when estimating tantalum, the lines to be compared being in this case tantalum-La_1 (1518·3 X units) and erbium-$L\beta_2$ (1510·6 X units), to use niobium or thorium when estimating zirconium, and so on.

[1] Paper read at a joint discussion between Sections A and B of the British Association at Johannesburg on Aug. 1.

The investigation of cases like those above mentioned, where a mixture of a few refractory oxides is to be analysed, can easily be carried out. In other cases, however, we encounter appreciable difficulties.

SOURCES OF ERROR AND THEIR ELIMINATION.

(*a*) Error is due to the fact that the initial ratio of the unknown element to the reference element in the surface layer of the sample, which alone is accessible to the exciting action of the cathode rays, changes during the experiment. (The half-value depth for β-particles, for example, accelerated by 20,000 volts is, in zirconium oxide, only 2×10^{-5} cm.) This change, chiefly investigated by Coster and Nishina, is due to the effect of cathode rays on the sample; under the action of the latter, chemical reaction or melting of the sample can occur, which may lead to a partial separation or shift of one of the two elements to a deeper part of the sample which is inaccessible to the cathode rays. Their action may in the same way lead to evaporation or electrostatic repulsion of one or both components.

(*b*) The presence in the sample of other substances than the element to be estimated and the reference substance, which we shall for the sake of brevity call 'impurities', though they may constitute the larger part of the mixture, may influence the intensity ratio of the two lines. First, one of the two lines may be absorbed more strongly by the impurity than the other; and secondly, the X-rays emitted by the impurity may excite the two lines to be compared by secondary action and increase their intensity. This excitation can be a selective one, and can lead to a false intensity ratio due to the presence of the impurity.

The errors due to causes discussed under (*a*) can be eliminated by avoiding the use of cathode rays for the excitation of the X-ray spectrum of the sample to be investigated. Not the sample itself, but a target of tungsten is bombarded by cathode rays, and the X-rays thus produced are used to excite the spectrum of the sample to be investigated. This method of X-ray analysis, where the secondary radiation is analysed, will be denoted as the secondary method, and the usual method, where the spectrum is excited by cathode rays, as the primary method. The secondary method has been used in several cases in recent years both by Glocker in Stuttgart and in my laboratory, and has been found to work very satisfactorily. In my laboratory an electronic tube constructed by Coster, and admirably suited for this purpose, is used. By using 40 k.w. and 10 milliamp., a fairly strong copper-Ka line can be obtained in the course of three minutes. The energy necessary to produce a secondary line is very appreciably greater than that for a primary line of equal intensity, but in the case of the secondary method a much larger current can be used—up to 100 milliamp. and still higher.

This is due to the fact that in the latter case the energy is distributed over the large surface, whereas in the former case it has to be focused on a comparatively small surface of the sample.

Besides the above-mentioned advantages, a further advantage should be emphasised. When determining elements present only in minute amounts in the sample, it is often necessary to expose the plate for a long time to the action of the X-rays: in the case of the primary method, the time of exposure is limited by the fact that the continuous radiation emitted by the anticathode darkens the plate and covers the weak lines. In the case of the secondary method, the continuous radiation reaching the plate being negligible, the exposure can be continued for a very long time.

The curve on the left of Fig. 1 shows the analysis of cyrtolithe obtained by the secondary method; while that on the right shows the analysis obtained by the primary method. From the former the hafnium oxide content works out to be 11·1 per cent, in good agreement with the value obtained by analysing the zirconium oxide plus hafnium oxide extracted from the mineral (11·3 per cent), while the primary method gives an entirely false result.

While the errors due to the effect of cathode rays can be successfully eliminated by using the secondary X-ray method, as mentioned above, we may still encounter those discussed under (*b*). Selective absorption will occur when the absorption edge of an impurity, present in large quantities, is situated between the two lines to be compared. In this case a selective absorption of the line of the shorter wave-length can occur; for example, between nickel-$K\alpha_1$ (1655 X-units) and cobalt-$K\alpha_1$ (1785 X-units) the iron-K edge (1740 X-units) is situated. The presence of large amounts of iron

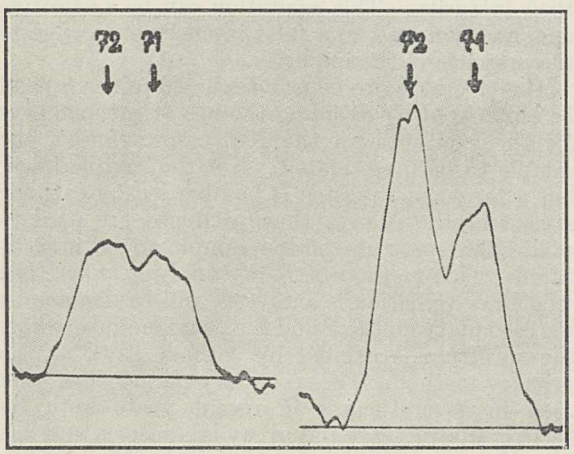

FIG. 1.—Photometer curves of cyrtolithe excited by X-rays (left) and by cathode rays (right).

in the sample can accordingly influence the intensity ratio. The most general remedy for such an error is to use very closely situated lines: when the wave-length difference is very small, the probability that an absorption edge will be situated between the two lines is only minute.

An example of the other case, in which strong lines of impurities are situated between the edges of the two elements to be compared, is the presence of large amounts of zinc in a mixture of tantalum and erbium. The strongest lines of the K spectrum of zinc (α_1; α_2; β_1) are situated between the edges of the latter elements. The zinc lines can thus excite erbium but not tantalum, and are bound to shift the equal intensity ratio in favour of erbium.

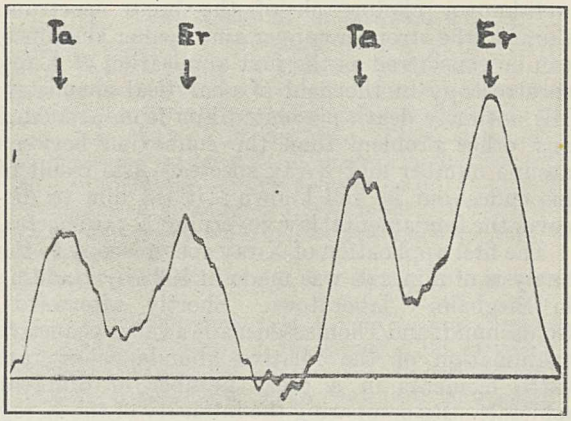

FIG. 2.—Photometer curves of equal intensity mixture of tantalum and erbium alone (on left), and of the same mixture with the addition of five atoms of zinc for each atom of erbium (right).

On the left-hand side of Fig. 2 is seen the photometer curve of the equal intensity ratio of an erbium–tantalum mixture, and on the right-hand side the same with five atoms of zinc present for each atom of erbium. The equal intensity ratio is altered by 20 per cent owing to the presence of the large amounts of zinc. In the not very probable case that tantalum should have to be determined in the presence of a large excess of zinc, a corrected equal intensity ratio would be necessary, or the erbium abandoned as reference substance and replaced by, for example, iridium.

A third case of disturbance is encountered when the absorption edge of the impurity is situated between the absorption edges of the two lines to be compared. This has, again, a weakening effect on the intensity of the line of the element with the absorption edge with the shorter wave-length.

The most general remedy for the disturbances we have just mentioned is the use of reference lines with closely situated edges. We mentioned previously as a remedy for other selective absorption errors the use of reference elements with closely situated lines; as both requirements—closely situated lines and edges—can only be found in a limited number of cases (about twenty), the X-ray analyst finds himself compelled to compromise between these two requirements. To be able to carry out accurate quantitative analysis of minerals or alloys with a great number of constituents, it is necessary to ascertain if large amounts of disturbing impurities are present and choose the reference lines suitable to the special case. If only an approximately quantitative method of determination is needed, these precautions are not necessary, nor are they necessary if an accurate analysis of a mixture of a few refractory oxides, for example, $ZrO_2 + HfO_2$ or $TiO_2 + Ta_2O_5 + Nb_2O_5$ is to be carried out.

Full tables containing suitable reference lines for elements between sodium and uranium will be published shortly.

APPLICATIONS OF THE ANALYTICAL X-RAY METHOD.

The chief field of application of the method of quantitative X-ray analysis is the determination of rare elements in minerals and alloys, but it can be applied to practically any element.

Minerals.—The determination of hafnium, which can only conveniently be done by the X-ray method, has already been mentioned. A further example of X-ray spectroscopy as applied to minerals is the case of tantalum and niobium. These can be separated by different chemical methods, but it is scarcely possible to effect a separation, or even to show the presence of the elements, when only traces are present in the mineral. For example, the presence of tantalum or niobium in the most important titanium minerals, such as ilmenite, titanite, rutile (apart from ilmeno-rutile and struverite, which are rich in tantalum and niobium), was not known before the application of X-ray analysis, in spite of the fact that the largest amounts of tantalum or niobium in the earth's crust are actually to be found in titanium minerals. This is due to the fact that niobium and tantalum generally accompany titanium in laboratory separations, and have likewise been deposited together by geochemical processes. They show conspicuously the phenomenon of a comparatively rare element being masked by a very similar abundant one, a phenomenon investigated by Goldschmidt and named by him ' camouflage '.

Tantalum and niobium being in many cases only present in a concentration of 1 in 1,000,000, it is necessary before applying the X-ray method to increase the concentration by a chemical one. Such a combination of chemical and X-ray methods proves in several cases to be very useful, especially in determining the abundance of the rarer elements in the lithosphere or in meteorites. While exhaustive data are available on the abundance of the more common elements, as shown by the well-known work of Clark and Washington, before X-ray methods were introduced, scarcely any data were available on the abundance of many of the rarer elements, though these constitute the majority. To determine the abundance of the latter in the lithosphere, the following method proved very useful. A large number of samples of igneous rocks were taken, in the same proportion as they occur in the earth's crust, and the mixture of the samples analysed by combined chemical and X-ray methods.

Alloys.—The method of quantitative X-ray analysis is very useful in investigating both common metals, such as commercial samples of iron, and also alloys of precious metals such as platinum. In the former case, minute amounts of vanadium, chromium, and so on, can also be determined by other than X-ray methods, for example, by the recently highly developed method of electro-analytical titration, but in this case it is necessary to dissolve the alloy, whereas in the X-ray investigation this is not necessary so long as the proportion of the metal present is not less than one in ten thousand. The X-ray method has greater advantages in the case of the platinum metals, where chemical analysis is very tedious.

Soil Samples.—The analysis of soil samples should be quoted as a third case. The phosphorus content, for example, can be determined conveniently and quickly by adding zirconium oxide to the sample and comparing the intensity of the phosphorus-$K\alpha_1$ and zirconium-$L\beta_1$ lines.

We have discussed so far the use of X-ray emission spectra for analytical purposes. An entirely different method of X-ray analysis makes use of the selective absorption by the sample containing the element to be determined. This method, worked out by Glocker, can be used where one heavy element is present in large excess over several light ones, but in general it is preferable to use the emission method.

We may refer in passing to the great progress made in quantitative optical spectroscopy. This progress is due to a great extent to the fact that the principle which was found very useful in the domain of X-ray spectroscopy, namely, the addition of a reference substance to the sample to be investigated, has also been introduced into optical spectroscopy. In the case of elements such as lead, zinc, cadmium, or the alkali metals, the optical method can be used with equal advantage, or in some special cases even more successfully than the X-ray method, but in the case of elements forming refractory compounds, such as the titanium group, the vanadium group, the rare earths, and so on, the optical method encounters serious difficulties which do not occur in the X-ray method.

SUMMARY.

Quantitative analysis by X-rays is best carried out by first mixing the substance to be determined very thoroughly with a suitable reference substance. The intensity ratio of the reference line and the line to be determined is determined empirically beforehand. To avoid the disturbing effect of cathode rays, the sample is bombarded by X-rays, and the secondary spectrum investigated. As the presence of large amounts of certain impurities can influence the intensity ratio of the lines to be compared, it is necessary to know for each element under which conditions an exact determination is possible, and to choose the reference line accordingly. In the case of an approximate determination, and also in several cases of exact determination, this precaution is not necessary. The chief application of the method is the determination of rare elements present only in small amounts, where chemical methods more or less fail and the advantages of the X-ray method are most pronounced. Very promising also is the combination of the chemical and X-ray methods, as this allows, for example, a determination of all the rarer elements in the earth's crust and in meteorites. The analysis of soil samples (determination of the phosphorus content, etc.) and of alloys are further important applications.

Cancer Research.

THE twenty-seventh annual report of the Imperial Cancer Research Fund contains, in addition to the usual survey of the work published from the laboratory during the year, an unusual feature in the form of a review by Dr. W. Cramer of certain aspects of experimental carcinogenesis. It is proposed to include such critical commentaries in future reports, and there can be no doubt that this policy will enhance the value of these publications, for in no branch of medical research is it more necessary to pause from time to time to order our conceptions of the central problems.

The criticism is often made by those who are uninstructed in the facts that cancer research is sterile of results, and if by results is meant the complete explanation of malignant disease and the production of a perfect cure for it, the criticism is justified. But those who are better informed realise that, apart from some stupendous fluke, the secrets of cancer will only be revealed by persistent and laborious work in as many directions as possible. Unemotional work of this nature has been carried on by the Imperial Cancer Research Fund for twenty-seven years, and though it has not resulted in the elucidation of the main questions, it has provided us with such a wealth of detailed knowledge that we may claim to know more about the malignant processes than we do about many other biological phenomena that are accepted as the commonplaces of existence.

In this summary of the work of the current year, Dr. J. A. Murray, Director of the Fund, directs attention to certain observations which are of considerable interest. Continuing his work on carcinogenesis, Dr. W. Cramer has come to the conclusion that the development of carcinoma is not entirely due to changes occurring in the epithelium, but depends to some extent upon the removal of local inhibitory factors present in the other tissue elements. His observations suggest that the process of carcinogenesis consists of two phases—one a process of long duration which induces the condition of potential malignancy in the epithelial cells, and the other, a breaking down of the local resistance or inhibition which prevents the realisation of this potential malignancy. Exactly which of the tissue elements are concerned in this inhibition is not known, but it is possible that the wandering cells which accumulate under the hyperplastic epithelial cells of skin which has been treated with tar may be responsible. Certain observations by Dr. Ludford may have a bearing on this question. He has shown that in tumour-bearing animals vitally stained with trypan blue, the macrophages which take up the dye tend to accumulate around the tumours, though this distribution varies considerably in different types of growths. In view of the fact that the same type of macrophage is concerned with the taking up of metallic colloids from the blood-stream, it is possible that the action of metals on tumours may be an indirect one exercised through the macrophages.

Continuing his observations on the metabolism of the malignant cell, Mr. Crabtree, applying the method developed by Prof. Warburg to the numerous strains of transplantable tumours available in the laboratories of the Fund, has confirmed Warburg's discovery that the cancer cell can split sugar into lactic acid in a far greater degree then normal cells. Since this process is not confined to the cancer cell, it cannot be utilised as a test for malignancy, but it does indicate an important metabolic activity in which the tumour differs from the normal tissue; and since the metabolism of a cell is an expression of its vitality which can be measured, this technique offers a far better method for the study of the mode of action on the cell of therapeutic agents than we have hitherto possessed. Mr. Crabtree has started an investigation along these lines on the therapeutic action of radium which promises valuable results.

Owing to the work of Gye and Barnard, much attention has been directed of recent years to the study of the filterable tumours of fowls. Dr. A. M. Begg has studied such a tumour which in the course of three years has altered in character from a slowly growing fibro-sarcoma of low malignancy to a more cellular, more malignant tumour transmissible by cell-free extracts. It is highly probable, though not proved, that the tumour acquired the property of filterability with its assumption of a greater degree of malignancy.

An exceedingly significant observation on the Rous tumour has been made by Dr. Begg and Dr. Cramer. It has been claimed that it is possible to transform normal cells of the fowl into malignant cells by the action of various substances such as arsenious acid, indol, and skatol. Further reports have been published of the isolated production of the Rous sarcoma by the inoculation of extracts of normal fowls' testis or pancreas. These results have not been confirmed by other workers, but Drs. Begg and Cramer have brought forward evidence to show that such tumours may accidentally occur from the unsuspected contamination of laboratory apparatus with the virus of the Rous sarcoma. Such accidents are not unknown in the history of bacteriology, and the suggestion is made that these anomalous findings were due to experimental errors.

Dr. Cramer's review of experimental carcinogenesis is worthy of special study. The study of tar cancer in mice has thrown new light, for example, on such matters as the age incidence of malignant disease, and its occurrence in certain industrial occupations. It is responsible for the conception that different individuals of the same species vary in their susceptibility to the factors which are known to be associated with the development of malignant disease. If a certain proportion of human beings are susceptible to these factors, irrespective of dwelling-place, climatic or social conditions, the total incidence of cancer in all forms is likely to be the same in every nation; but local circumstances might lead to the relative prevalence of, say, intestinal or uterine cancer in any nation. This conception would offer a satisfactory explanation for the difference in the organ incidence of cancer which is such a striking feature in the statistics of different countries.

Obituary.

DR. CHARLES HOSE.

DR. CHARLES HOSE, whose death on Nov. 14 we much regret to record, was born on Oct. 12, 1863. From his father he inherited that love of wild Nature which characterised him throughout his life. As a boy, he was a keen naturalist and continued his habit of collecting and observing while at Felsted School. In 1882 he was admitted to Jesus College, Cambridge, but did not take a degree, as in his second year his uncle, the Bishop of Singapore, Labuan, and Sarawak, obtained for him a cadetship under Rajah Sir Charles Brooke, and on April 15, 1884, he landed at Kuching and was at once sent to the Baram district, where he remained for about eighteen years. In 1904 he was appointed Resident of the Rejang district and retired on Aug. 20, 1907, when he returned to England. In 1916, Dr. Hose was appointed superintendent of the munitions factory at King's Lynn, and in 1918 was chairman of the Cotton-waste Mills Investigation Committee.

Dr. Hose was given an honorary Sc.D. at Cambridge in 1900, and was elected an honorary fellow of Jesus College in 1926. He was a member of various scientific societies and the recipient of orders from several European countries. A list of the publications by Charles Hose, compiled by Prof. G. H. F. Nuttall, is given in "Fifty Years of Romance and Research of a Jungle-Wallah at Large" (1927), in which book will also be found an enumeration of the new genera and species of animals collected by him. A perusal of the titles of the papers written by Dr. Hose or with his collaboration, and of those dealing with the specimens he collected, will give some idea of his remarkable energy and the width of his interests. The result of his labours has been to add greatly to our knowledge of the zoology of Sarawak, and all anthropologists acknowledge the unrivalled extent and value of his contributions to the ethnography of that country.

Mention should also be made of the prolonged investigations made by Hose into the cause of beriberi; he came to the conclusion that the principal cause of this disease in Borneo was the consumption of mouldy rice. It is now admitted that the disease is frequently due to a preponderant consumption of white rice, that is, rice which has been polished by the removal of the husk and outer layers which alone contain the all-important vitamins. Dr. Hose's observations and experiments provided valuable data towards the elucidation of this problem. It was also due to his persistent efforts that the wealth of Sarawak has been enormously increased by the discovery and development of the greatest petroleum-producing area, except Burma, within the bounds of the British Empire. Hose was an insatiable collector, and a large number of museums throughout the world contain zoological and ethnographical specimens and collections given by him, but he did not neglect plants and geological specimens.

When I was preparing for the Cambridge Expedition to Torres Straits, I received a most cordial invitation for my party to visit Dr. Hose in the Baram district. His offer was so tempting in its promises that I could not refuse, and the results of that visit have been far-reaching. We had the opportunity of seeing the respect and affection in which the Resident was held by the varied tribes of the district, and how they came to him with their difficulties, which were often of a personal and intimate nature. None of us will forget the wonderful gigantic peace celebration which cemented friendship between various estranged tribes and incidentally proved the power and beneficence of the Government.

We found that Hose had a very extensive and detailed knowledge of the natives, which was stored in his remarkable memory and more or less recorded in notes. He then began to collaborate with Dr. W. MacDougall, and the partnership finally resulted in the great and richly illustrated work, "The Pagan Tribes of Borneo" (2 vols., 1912), which will be a lasting memorial to Charles Hose. It was a happy combination, for though he was supreme as a collector and observer, Hose had never had a scientific training, and the method and restraint of MacDougall were of great service in bringing the great wealth of crude matter into due form.

To the last Dr. Hose retained his youthful enthusiasms and outlook; he was always seeking to know about things, and when that knowledge was obtained he utilised it in various ways. He was essentially a field naturalist, and these qualities, combined with his genial character and his sympathetic appreciation of native thought and custom, enabled him to become a notable administrator who has left an indelible impression on his beloved Sarawak. A. C. HADDON.

PROF. RICHARD ZSIGMONDY.

SCIENCE generally has suffered a very severe loss by the recent death of Prof. Richard Zsigmondy, late Director of the Institute for Inorganic Chemistry at Göttingen. For years he has been one of the most prominent figures in the field of colloid chemistry.

Richard Zsigmondy was born in Vienna on April 1, 1865. Even as a young boy he showed great aptitude for experimental science, and he pursued the study of chemistry at the Technical High School at Vienna and at the University of Munich. After graduating for the degree of D.Phil., he became private assistant to Prof. Kundt at Berlin, and in 1893 he obtained his "Privatdozent" at the Technical High School at Graz. Four years later he was employed as scientific worker by the well-known firm of glass manufacturers, Schott of Jena. The outcome of his investigations with this firm was the preparation of a specially uniform Jena opalescent glass. After leaving the firm, Zsigmondy became a private teacher in Jena, and it was during this period that

he carried out and completed some of his most well-known investigations.

Zsigmondy's early work was concerned with glass and the colours produced by the presence of metals or metallic oxides. This led him to take up the study of colloid chemistry, and in 1898 he published his well-known work on colloidal gold. He successfully prepared gold sols of reproducible properties and showed that they owed their colour to minute particles of metallic gold, which were held in suspension by the electric charge they possessed. He further showed that removing this charge by the addition of electrolytes precipitated the gold and it was impossible to bring the precipitate back into suspension. Zsigmondy very quickly realised that the colour of his gold sols closely resembled that of gold ruby glass, and he turned his attention to this material, with the result that he definitely proved that ruby glass also owed its colour to the presence of very minute crystals of metallic gold.

Another problem which was attracting a great deal of attention at this time was the constitution of Cassius purple. Very many chemists, including Berzelius, believed that this substance was a chemical compound, but the whole question was satisfactorily solved by Zsigmondy when he synthesised the purple from colloidal gold and colloidal stannic acid. Furthermore, his method of determining the relative protective power of hydrophyllic colloids by means of the gold number is familiar to all colloid chemists.

These investigations on colloids proved that for the successful observation of these small colloidal particles more refined apparatus was necessary. Zsigmondy concentrated his energies on the solution of this problem and conceived the idea of the ultramicroscope, which, with the collaboration of Prof. Siedentopf, he brought out in 1904. This new apparatus enabled chemists to observe particles which hitherto had been invisible and it gave a new impetus to the direct study of the Brownian movement.

In 1907, Zsigmondy was called to Göttingen as Director of the Institute for Inorganic Chemistry, which he converted into a school of colloid chemistry where students from all over the world collected to study this branch of chemistry. During the early period of his stay at Göttingen, Zsigmondy turned his attention to the study of gels and gel structure, and he put forward the generally accepted capillary theory for the explanation of vapour pressure curves of silica gels as determined by van Bemmelen. His work during this period gave the study of gel structure a new interest and importance in the minds of chemists.

Later, Zsigmondy became interested in the preparation of collodion membrane filters. With characteristic thoroughness he explored the various ways and means of obtaining reproducible filters of definite and uniform pore size. This was essential if the filters were to be of any use in either colloid chemistry or bacteriology and biology. The final outcome of a period of intensive investigation and experiment was the preparation of the now widely used Zsigmondy membrane filters. These investigations were carried still further with the production of very uniform ultrafilters of varying pore size down to a diameter of about 4 $\mu\mu$. With further work he succeeded in preparing 'cella' filters for use with organic solvents. Zsigmondy was awarded the much-coveted Nobel Prize for chemistry for 1925 in recognition of his important pioneer work in the comparatively new field of colloid chemistry.

Zsigmondy made some excellent contributions to the literature on colloids in general. In 1905 his "Erkenntniss der Kolloide", containing a full account of the development of the ultramicroscope and of his original work, was published. The first edition of his general treatise on colloid chemistry appeared in 1912, and a completely rewritten edition in 1927. Another contribution, in which he collaborated with Dr. Thiessen, is "Kolloides Gold", which is one of the few standard works on the subject.

In February 1929, Zsigmondy was forced by failing health to retire from his duties at the Institute, and in October last he died at his home at Göttingen. To those who had the privilege of working under him, it was felt as a personal loss of an inspiring teacher and a sincere friend, while the whole scientific world must feel that one of its great men has passed away.

Dr. T. Wemyss Fulton.

More than fifty years ago Thomas Wemyss Fulton and I worked side by side in Turner's dissecting-room in Edinburgh, with David Bruce and Noël Paton among our comrades there. D. J. Cunningham, then senior demonstrator, was studying the anatomy of the *Challenger* marsupials; the junior demonstrator was designing the Cathcart microtome; and the laboratory attendant, 'old Stirling', the real first inventor of the microtome, was making his exquisite preparations, as Goodsir had taught him to do. A prize, of some value for those days, was given for the best dissections of the year; I have forgotten its name, but I remember that I won it one year and Fulton the next. Scholarships were few and scanty. Many of us found some employment, to help pay our way—in part or whole; and Fulton, with indomitable strength, courage, and self-denial, was a telegraphist by night in the G.P.O. and a medical student by day. He graduated with first-class honours; and when he took his M.D., three years later, his thesis was a study of 'telegraphists' cramp', based both on observation and experience.

John Murray, a good judge of men, took Fulton as one of his assistants in the task of seeing the *Challenger* Reports through the press. After a couple of years of this useful experience, Prof. Cossar Ewart brought him into the Scottish Fishery Board's service; and there he remained, afterwards becoming the Board's scientific superintendent under the Act of 1895.

Dr. Fulton's own papers began to appear in the

Board's report for 1888, and the output went on steadily for thirty-four years. He made countless observations and not a few discoveries regarding fishes, their early development and subsequent rate of growth, their migrations and distribution, their habits and their food. Some of his best papers were those in which he demonstrated (in 1895 and later) the cyclonic surface-currents of the North Sea, and the influence of this circulation on the distribution of fish-eggs and young fishes.

Beam-trawling began in Scotland just a little while before Fulton came to the Fishery Board; the otter trawl followed about 1895, and at once ousted the beam; and the fishermen complained bitterly of the new industry. At first the Board was little in favour of restrictions; in 1884 it pronounced against a *mare clausum*, adding, however, that "the true principle is freedom, *qualified by such regulations* as in the common interest may be found just and necessary". Dr. Fulton's sympathies were all with the line-fishermen; he wished to protect them, and his influence had a deal to do with shaping the policy which closed the Firths of Forth and Clyde and the great area called the Moray Firth. He convinced himself, more than forty years ago, that there had "already been a gradual and considerable diminution of the average catch of Scotch beam-trawlers, per ton of the vessel's tonnage"; and he said that "it would not be seriously contested that the supply of fish, relative to the machinery of capture, has diminished and is likely to continue to diminish".

Very difficult questions soon arose out of the closure of the Moray Firth, and helped to turn Fulton's attention to the thorny subject of maritime law. In 1911 he published his *magnum opus*, on the "Sovereignty of the Sea". The lawyers have not always, I believe, seen eye to eye with him on matters of opinion or interpretation; but the book, obviously and admittedly, is a mine of historical information and curious learning. The earlier chapters, especially those on our troubles with the Dutch in Charles II.'s time, are delightful reading. D'ARCY W. THOMPSON.

COL. SIR THOMAS HOLDICH, K.C.M.G., K.C.I.E.

SIR THOMAS HUNGERFORD HOLDICH, who died on Nov. 2 at the advanced age of nearly eighty-seven, spent most of his active life in the Survey of India, where he was largely engaged on Frontier and trans-Frontier work. His commission in the Royal Engineers dates so far back as 1862. His first war service was with the Bhutan Expedition in 1865, followed by the Abyssinian campaign in 1867 and the second Afghan War in 1878–80. But his survey career will chiefly be remembered by his work on successive boundary demarcation commissions, and probably he served on more of these than any other office. In 1884 he was with the Russo-Afghan Boundary Commission in connexion with which the once famous, though now almost forgotten, Panjdeh incident took place. As superintendent of frontier surveys he was concerned with the extension of maps on and beyond the Indian frontiers. During this period he was engaged in 1894 on the demarcation of the eastern boundary of Afghanistan, between that country and the frontier tribes. In the following year he was with the Pamir Boundary Commission. Finally, he was appointed chief commissioner for the demarcation of the frontier between Persia and Baluchistan. In 1898 he retired after thirty-six years' service in India.

With such a record it is not surprising that Holdich was appointed, shortly after his retirement, to be a member of the tribunal dealing with the disputed boundary between Argentine and Chile, which had been referred to King Edward as arbitrator. This tribunal, presided over by the late Lord Macnaughton, heard evidence from both sides in London. A stage in the proceedings was reached, however, when it became necessary, through lack of geographical information, that the country in dispute should be inspected. For this purpose Holdich and a party of survey officers visited Chile and the Argentine during the winter of 1901–2. After the additional evidence thus collected had been placed before the tribunal, King Edward gave his award in the autumn of 1902.

In the meantime, the two countries decided that the actual boundary, as awarded, should be marked out on the ground in the presence of a commission appointed by the British Government. Holdich became chief commissioner for this purpose and again visited South America in the winter of 1902–3. The final settlement of this important boundary, which had been the cause of continuous and dangerous friction between Argentine and Chile, was at last completed. This was one of Holdich's most successful achievements. He possessed in an eminent degree the art of conciliating divergent elements, which gave him a great advantage in dealing with questions of this kind. He had the pen of a ready writer and was also a fluent and pleasant speaker. The excursions which he made into the historical and picturesque aspects of trans-frontier exploration were much appreciated. He was also an admirable artist, and brought back many pictures of the various places he visited.

Holdich's inclinations always seemed to tend towards the political, artistic, and literary, rather than to the scientific side of life, which did not really interest him. For his various services he was made at different times K.C.M.G., K.C.I.E., C.B., and C.I.E. He served as president of the Royal Geographical Society from 1916 to 1918, and he was the oldest holder of the Society's gold medal. He was the author of several works, notably "The Indian Borderland", "The Countries of the King's Award", and "The Gates of India". H. L. C.

REV. CAMILLO MELZI D' ERIL.

FATHER CAMILLO MELZI D' ERIL, who died on Mar. 10 last, was born on Jan. 6, 1851, and thus at the time of his death was one of our oldest seismologists. He was educated at the Carlo Alberto College, Moncalieri, and later was admitted to the Barnabite Order. In 1873 he joined the teaching

staff of the Collegio alla Querce at Florence. Here he was a colleague of Father T. Bertelli, the founder of microseismology. For many years he was director of the geodynamic observatory belonging to the college. Following in Bertelli's footsteps, Melzi made a special study of microseismic motions, concluding that their frequency increased with a low barometric pressure, but that it was independent of the velocity of the wind. On the death of Bertelli, he contributed a valuable account of his life and work to the *Bollettino* of the Italian Seismological Society (vol. 10, pp. 179-196; 1904).

C. D.

WE regret to announce the following deaths:

Sir Sainthill Eardley-Wilmot, K.C.I.E., from 1903 until 1906 Inspector-General of Forests in India, on Nov. 13, aged seventy-seven years.

Dr. Ninian McIntire Falkiner, for about twenty years Medical Superintendent of Statistics for Ireland, on Oct. 30, aged seventy-four years.

Mr. G. B. Francis, formerly a director of British Drug Houses, Ltd., who was an original member of the Society of Chemical Industry and for many years an honorary auditor of the Pharmaceutical Society, on Nov. 6, aged seventy-nine years.

Prof. G. A. Goodenough, since 1910 professor of thermodynamics at the University of Illinois, known for work on the properties of saturated and superheated vapours, on Sept. 30, aged sixty-one years.

Dr. James Cosmo Melvill, who was elected a fellow of the Linnean Society so long ago as 1870 and was also a past president of the Conchological Society, on Nov. 4, aged eighty-four years.

Sir Archdall Reid, K.B.E., author of works on heredity in man and allied subjects, on Nov. 18, aged sixty-nine years.

Dr. Samuel Rideal, president in 1918 of the Society of Public Analysts, who was well known for his work on sewage purification, on Nov. 13, aged sixty-six years.

Dr. Harold W. T. Wager, F.R.S., formerly H.M. Staff Inspector of Schools, Secondary Branch, Board of Education, who was president of Section K (Botany) of the British Association at the South Africa meeting in 1905, on Nov. 17, aged sixty-seven years.

News and Views.

THE debate in the House of Commons on Nov. 20 on Empire timber resources was largely confined to a reiteration of the view that the world will be faced with a famine in softwood coniferous supplies in some thirty years' time. The debate originated from a resolution moved by Sir George Courthope to the effect "that the threatened shortage of commercial softwood timber demands the serious attention of His Majesty's Government". Sir George said that foresters regard the position with grave alarm. This, however, is stating but half the case, for many timber merchants agree with the foresters. On the other hand, there is a body of opinion comprising both foresters and timber merchants who do not acquiesce in this alarmist view. They hold that as the supplies of the commodity in question become less abundant prices will rise, other materials will replace, to some extent, the softwood timbers; and that, with the ingenuity and adaptive faculty of the various trades, matters will readjust themselves. The arguments concerning the exhaustion of Canadian supplies in thirty years, the competition of the United States with the British Empire, and the scanty supplies which would by then be left in Northern Europe, have all been alluded to in our columns on previous occasions. It is not, however, apparent upon what source of information Sir George Courthope bases his statement that "in Russia, certainly within twenty-five or thirty years, production will be forced down to a limit which does not exceed their own requirements, and the capacity to export timber will have ceased". This is very far from being in agreement with opinions held by some continental experts, who are probably in a far better position to know the true position than most in Great Britain.

AFTER an appreciative allusion to the ten years' work of the Forestry Commission, which has planted 140,000 acres of softwoods and 6000 acres of hardwoods, and has rendered assistance to local authorities and private enterprise to deal with some 50,000 acres more, Sir George Courthope said that the Commission would shortly be planting 40,000 acres a year. He suggested that a good deal could be done in encouraging the replanting and conservation of existing woods, that there is very definite scope for research, and that the laboratory at Princes Risborough will be so extended as to enable it to deal with forest products from all parts of the Empire. In the debate which followed, in which the replanting of areas felled during the War and since, was strongly stressed, Mr. Buxton stated that the late Government announced last spring a programme of £5,500,000 for the next decade's work with a planting programme of 237,000 acres and 1500 small-holdings attached. The plan adopted by the present Government involves a sum of £9,000,000, an area of 350,000 acres, and the provision of 3000 small-holdings, and it is hoped that this big programme will have a really useful effect on the rural economy in many districts and help to retain the rural population.

THE cause of the preservation of the wild fauna of the British Empire cannot but benefit from the publicity given to it in the debate in the House of Lords on Nov. 21. No political partisanship is shown in this matter, for every speaker spoke with abhorrence of the slaughter which has been carried out under the name of 'sport'. Two widely different aspects of the question of killing wild animals cropped up in the course of the discussion. There is the new development of the running down and shooting of antelopes and the like by means of motor-cars, an inexcusable travesty of the sporting idea, which is not only condemned on all hands, but, as Lord Passfield pointed out, is also definitely illegal. The difficulty in Tanganyika is just that which confronts the animal protectionist, whether he is dealing with legal shooting grounds or great animal reserves, namely, that the law is bound to be ineffective in

face of the criminally disposed hunter, if the area is not under thorough surveillance by a large staff of wardens. This is an expensive business unless, as some of the colonies have contrived, the cost of supervision is borne by the profits made from the necessary reduction of surplus wild stock. The Legislative Council and the Governor of Tanganyika are doing their best to prevent illegal and excessive shooting, and the debate should encourage them in their efforts.

THE second aspect is the slaughter of wild animals by natives in their own territory. This question cannot reasonably be confined, as the Earl of Onslow suggested, to the protection of crops against depredations or of human beings against dangerous foes. From time immemorial the natives have depended on their own wild animals for food, and to deprive them of this right would seem to be a hardship. The difficulty is that in recent years there has been a tendency in some parts to slaughter for the sake of killing, irrespective of actual food requirements. We have been assured by African travellers that this development is directly due to the inordinate killing caused by sporting expeditions, the native, less passive than he would seem, saying to himself that since the whites are killing out the animals, he may as well kill them also. Here the cure would seem to be the setting of a good example rather than penalties which must give the impression of unjust differentiation. But where a real danger of extermination looms on the horizon, every effort must be made to protect the threatened creatures from anyone whomsoever. It strikes us as curious and inconsistent that while all this strong and unanimous discussion concerns itself with the wild creatures in wild country, where the danger of extermination is on the whole far off, men may still kill the last remnants of some of the interesting relics of the British fauna, to their own considerable profit, and without running the risk of the slightest penalty, for except in the case of the grey seal there has been no attempt on the part of the British legislature to protect British mammals.

SUBJECT to the approval of the Charity Commissioners, an agreement has been reached between the Radcliffe Trustees and Sir William Morris, Bart., president of the Radcliffe Infirmary, by which the Trustees will sell to Sir William (on behalf of the Infirmary and the University Medical School) the whole of the Observatory grounds, which extend to more than nine acres, and the Trustees will take a lease of the Observatory buildings and part of the grounds for a period of five years, to enable the completion of the observational programme on which the Observatory has for some years been engaged, the determination of the proper motions of some 30,000 stars in the Kapteyn Areas. The Radcliffe Observatory will then be moved to South Africa. Its new site has not yet been finally selected, but it will be somewhere on the high central plateau, where the atmospheric conditions for astronomical work are second to none in the world.

LIKE the Radcliffe Library and the Radcliffe Infirmary, the Observatory was formed by the trustees of the estate of the famous physician, John Radcliffe (1650–1714), the first Radcliffe Observer being Thomas Hornsby (1733–1810), who was appointed in 1772 and under whose direction the observatory was erected and equipped at a cost of £28,000. The original instruments included two quadrants and a transit instrument, a zenith sector, an equatorial and a Dollond achromatic refractor, to which later on a Newtonian reflector by Herschel was added. Hornsby had succeeded Bradley as Savilian professor in 1763, and on the erection of the Observatory commenced a regular series of transit observations. At present the Observatory is the second oldest in the British Isles, and it has been the scene of the labours of many notable astronomers. Radcliffe was a fellow of Lincoln College, Oxford, and graduated as a bachelor of medicine in 1675. After practising for some years in the University, he removed to London and soon rose to the head of his profession, occupying much the same position that Sydenham did before him. Of strong common sense and independent views, he was very outspoken and sometimes rough, but of great liberality. He died at Carshalton, Surrey—according to his earliest biographer " a victim to the ingratitude of a thankless world and the fury of the gout "—but he was buried on Nov. 27, 1714, with much ceremony at St. Mary's, Oxford.

HEARTY congratulations were due this week to the veteran Sir James Crichton Browne, who, on Thursday last, celebrated his eighty-ninth birthday; and also to Prof. Horace Lamb, who, on Wednesday last, attained his eightieth birthday. Sir James Crichton Browne was educated at Dumfries Academy, graduating thence, in the medical faculty, at the University of Edinburgh. For forty-seven years he was Lord Chancellor's Visitor in Lunacy. For many years he was treasurer of the Royal Institution. Despite his great age, his interest in the Royal Institution is maintained; at the ensuing general meeting of members on Dec. 2, he will attend and make a presentation to a retiring officer of the staff whose services have covered half a century. Sir James Crichton Browne was elected into the Royal Society in 1883.

FOR upwards of forty-five years, Prof. Lamb has been recognised as the most prominent and successful worker in applied mathematics in Great Britain. In hydrodynamics he is a world-known authority. In the mathematical questions involved in the discussion of forces in aircraft, the action of screw-propellers, and stresses in aeroplane structure generally, his assistance has proved of high value. Awarded the Royal Society's Royal medal in 1902 for mathematical investigations, this was confirmed in ampler measure in 1923 by the allotment of the Copley medal. President of the British Association at the Southampton meeting of 1925, Prof. Lamb gave an address dealing in the main with geophysics. But some remarks of his on that occasion may be recalled as bearing on certain recent aspects of officialism in the State. "The habit", he said, " of sober and accurate analysis which scientific pursuits tend to promote is not always favourable to social and economic theories, which rest mainly on an emotional, if very national basis. There is, I think,

a certain dumb hostility, which, without venturing on open attack, looks coldly on scientific work except so far as it is directed to purposes of obvious and immediate practical utility." Prof. Lamb was elected into the Royal Society in 1884.

IT is satisfactory to learn that the structural alterations lately decided upon at the Royal Institution are going forward with a minimum of delay, so that the amenities enjoyed in normal times by the general body of members are within reasonable distance of renewal. Further, that these alterations are so designed that the aspects and qualities of the historic rooms and of the theatre are being carefully preserved. We trust, as do many who hold the Royal Institution in deep regard, that in the end that old-time atmosphere, that flavour of great personal traditions which here appeals so strongly, will be found not entirely disconnected with the efforts of rehabilitation. If any doubt existed as to the advisability of reconstructing the theatre, it has been removed during the dismantling of the structure by the disclosure of the dangerous condition of the woodwork. In the course of a century, dry-rot had obtained a hold in many parts.

THE financial problems arising from the various alterations to the Royal Institution are, of course, extremely onerous. Although those whom we may perhaps call the friends of the Royal Institution have generously responded to a first financial call entailed by the scheme, a balance of about £17,000 is still required. The Royal Institution with its laboratory, fine library, and rota of experimental and philosophical lectures, is something beyond a mere London society of persons interested in the movements and progress of science. In effect it is a bequeathment to posterity by Rumford, Davy, Faraday, Dewar, the repercussions of which are international. Accordingly strong hopes are entertained that the necessary sum will be forthcoming. Apart from physical science it is worth recalling that the Royal Institution in early days took a hand in the promotion of geology and mineralogy. By the year 1804 a museum of more than 3000 mineral specimens and fossils had been brought together, including a special collection of minerals formed by Davy. During the years 1805–7 Davy lectured occasionally on geology as well as chemistry, and he was one of those present at the meeting in Freemason's Tavern, Great Queen Street, on Nov. 13, 1807, when it was resolved to institute a Geological Society. Faraday became a member of the Geological Society in 1824.

IN his Croonian Lecture on "The Developmental History of the Primates", delivered to the Royal Society on Nov. 21, Prof. J. P. Hill gave an illuminating summary of his investigations, extending over many years, on the evolution of the placenta and the early phases of the embryo in the Primates. The results of this difficult and exacting work emerge from the complexities, which are so bewildering to all except a few specialists, as a lucid statement defining a series of facts of observation easily susceptible of confirmation. Hence the evidence provided by Prof. Hill's laborious researches should establish once for all the true relationships of the four groups into which he subdivides the Primates. Man and the anthropoid apes are included in the same group, which was derived from the stage revealed in monkeys, both of the Old and the New World. This Pithecoid stage is clearly an advance on the Tarsioid type of placentation, which is displayed in the solitary survivor of the group, the spectral tarsier. It is equally certain that the Tarsioid placentation was derived from a primitive Lemuroid type, which can be inferred from the common denominator of the diversely specialised forms found in the living lemurs, galagos, lorises, and indrisines. Prof. Hill has demonstrated that the Lemuroidea certainly belong to the order Primates, and that man is nearly related to the anthropoid apes, the common ancestors of which must have passed successively through both Tarsioid and Pithecoid stages in their descent from some pre-Tertiary Lemuroid. The evolutionary process of adaptive specialisation involves a speeding-up and an abbreviation of the developmental processes.

THE Huxley Memorial Lecture of the Royal Anthropological Institute was delivered by Baron Erland Nordenskiöld in the lecture theatre of the Royal Society, Burlington House, on Nov. 26. Baron Nordenskiöld chose as the subject of the address "The American Indian as Inventor", a subject on which his prolonged study of American technology and his journeys of anthropological exploration in Central and South America have made him peculiarly competent to speak. In his lecture he dealt with the question as to the extent to which we may suppose that the American Indians have independently invented many things entirely uninfluenced by the Old World. He gave numerous examples of inventions and discoveries that must necessarily be of original Indian conception, seeing that they were unknown in the Old World prior to the discovery of America. Among such he mentioned the use of poisonous manioc for food, tobacco and tobacco pipes, the rubber ball, rubber syringe, and the hammock; quinine, curare, and other poisons; the use of cayenne pepper in the preparation of a poison gas employed in siege warfare; the welding of copper; various kinds of musical instruments; calculating by means of knotted strings by the decimal system, and so forth. He asked whether it may not reasonably be supposed, seeing that the Indians discovered so much that was unknown in the Old World, with its variegated culture, that they may also have discovered various things that were known there. In the course of the lecture it was repeatedly emphasised that what was said did not constitute any conclusive evidence that there might not have been some pre-Columbian intercourse between the cultures of the Old and the New World. Even if there had been intercourse, it does not constitute proof that everything of common possession must necessarily derive from a common origin. At the close of the lecture the Huxley Memorial Medal of the Royal Anthropological Institute was presented to Baron Nordenskiöld by Prof. J. L. Myres, president of the Institute.

THE November issue of the *Realist* contains a stimulating article by Mr. J. B. S. Haldane upon the

place of science in western civilisation. Mr. Haldane's forceful style is always attractive, but when it is exercised upon so fruitful a topic as the present it shows to particular advantage. The main thesis of the article is that western civilisation has completely failed to integrate into its intellectual structure the scientific ideas that furnished its material structure. There are thus two alternatives before it. In the first place, scientific ideas may not be accepted by the ruling class, in which event Mr. Haldane foresees further wars, spiritual decay, and a drying-up of the flow of real invention. The second alternative is that a serious attempt will be made to incorporate scientific ideas, as well as scientific inventions, in our national and international life. If this attempt were made, and succeeded, it would do much to fill the emotional gap which is left " by the collapse of the religious picture of the universe ", for the scientific point of view is lofty enough to satisfy any of the aspirations of the human spirit. According to Mr. Haldane, Soviet Russia has chosen the second alternative. He says that there is " any amount " of research being done in Russia, and that there is an intense general interest in science. The children in the towns of Russia, he avers, learn a great deal more science than the corresponding children in England, and the scientific workers are relatively, though not absolutely, much better off than they are in Great Britain. While we agree with Mr. Haldane that western civilisation has far to go before it properly appreciates the true value of science, we cannot help contrasting his roseate account of Soviet Russia with the diametrically opposite estimate given by Mr. Lancelot Lawton a few pages further on in the same issue of the *Realist*.

DR. CHARLES SINGER also has an article in the November *Realist*, on the " Dark Age of Science ". After observing that science is a process and, like most processes, can be reversed, he states that, so far as science is concerned, the whole course of history presents no clearer division than that between the earlier Middle Ages or ' Dark Age ' and the later Middle Ages or ' Scholastic Age '. The critical event is the arrival of Arabian influence in the twelfth and thirteenth centuries. When in contact with a new medieval document, the first question that the historian of science asks himself is whether he can discern Arabian influence in it. If he can, the document is placed in the scholastic category ; if he cannot, in the Dark Age category. Dr. Singer exemplifies the characteristics of Dark Age ' science ' by reference to the " Handboc " of the monk Byrhtferth of the monastery at Ramsey. This was written half a century before the Norman conquest of England, and has recently been edited, with a translation, by Mr. S. J. Crawford. Byrhtferth was a good average Dark Age writer, and Dr. Singer condemns him and his contemporaries, referring to " the sophisticated childishness, the inane learning, and the humourless edificatory imbecility of the men of those times". His book is worth perusal by those who dwell in the light that science has since shed. The charge against the Church of having destroyed ancient science is, in Dr. Singer's opinion, unfounded, for there was practically nothing to destroy. When, in the sixteenth and seventeenth centuries, she did oppose independent thought, it was because the discoveries and theories of Copernicus, Giordano Bruno, and Galileo threatened to overthrow the doctrine—fundamental from the Church's point of view—of a finite universe.

THE relationship between biological phenomena and weather is of profound interest to the naturalist, and the " Report of the Phenological Observations in the British Isles from December 1927 to November 1928 ", published by the Royal Meteorological Society, supplies a wonderful assortment of data for consideration and speculation. The labour of collecting and tabulating the notes from the 467 stations now in being must be enormous, and were it not that generalised results are shown, the tables and individual records are not such as the general reader can peruse with any satisfaction to himself. A comparison of the excellent charts brings out some interesting results. The lines throughout the British Isles (migrant isophenes) interpreting the equal arrival dates of twenty selected migrant birds, show that the earliest arrivals occur on the south-east coast of England, that coastal arrivals precede inland arrivals, the coastal dates up to the Wash-Mersey line being some three days later than the south coast dates, to the Tyne-Solway line six days later, and to the north of Aberdeenshire nine to twelve days later. It is a striking fact that there appears to be some correlation between the floral isophenes and the migrant isophenes, and this, since it connects local conditions of flowering and the appearance of birds which have set out from distant places, seems to indicate the influence of very far-reaching weather conditions.

DURING the four weeks ending Oct. 17 there has been a remarkable increase of seismic activity in the island of Hawaii. The numbers of earthquakes registered at the Kilauea Observatory suddenly rose from 9 during the week ending Sept. 18 to 221, 244, 129, and 97 during the succeeding weeks, the origins of the shocks being concentrated below the Hualalai Volcano, a mountain 8269 feet high on the west side of Hawaii. Two strong earthquakes of intensity 9 (Rossi-Forel scale) occurred on Sept. 25 and Oct. 5. Though, after the latter date, there was a marked decrease in strength and frequency, the occurrence of this tremor-storm suggests that the Mauna Loa lava column, which has sent out its flows from the south-west rift of the mountain during the last twenty-five years, is now moving underground towards Hualalai. The decline in activity may imply that the mountain fissures are more open and the lava outburst near at hand.

IN telephony many attempts have been made to increase the speed of communication between automatic exchanges and manual exchanges, and specially between subscribers having automatic telephones and those connected with rural exchanges. It is stated in a recent issue of the *Times* (Nov. 9), that the Bell Telephone Laboratories have made a considerable step in this direction and have given a public demonstration of their new method. They use talking films to

assist in the operation of automatic telephones. The device consists of ten films, one for each number from zero to nine. These are recorded by an operator specially selected for her telephone voice. The films are wound on drums installed in the exchange. The dialling by the subscriber of the number required automatically releases the films, which revolve and call out the number required to the exchange operator. It is expected that many of these film-calling devices will be in practical use in a few weeks' time. A demonstration was also given by the Bell Laboratories of an improved means for ensuring the secrecy of radio-telephonic conversations. The method adopted is to 'scramble' the words of the message. In the course of the transmission the high frequencies are changed to low frequencies and vice versa. The frequencies are then inverted and the conversation becomes intelligible. Before the retranslation, the sounds are completely unintelligible.

AT the Institution of Electrical Engineers, on Nov. 21, three papers were read dealing with the low temperature carbonisation of coal with special reference to its combination with the production of electricity. One of the papers described English practice, another American practice, and the third German practice. Whilst most other countries have hydro-electric power to fall back upon, the amount of power available from this source in Britain is never likely to provide more than about one-twentieth of our total power requirements. It is suggested that the power plant of the future will take in coal as its raw material, but will deliver, in addition to electricity, motor spirit, fuel oil, creosote, pitch, and other derivatives of coal tar. The present coal distillation plant at Dunston-on-Tyne produces from one ton of Northumberland small coal, 16 gallons of tar oils, and $\frac{3}{4}$ ton of semi-coke. It is stated that a wide and promising field of research in this direction has not yet been explored, although the first step has been taken. It is most important that coal, the valuable national asset of Britain, should be fully utilised.

IN America great interest is taken in the carbonisation of fuel, and the trend of progress is towards the co-operation of the electric companies with public service companies supplying gas for domestic and industrial purposes. Germany's coal industry is characterised by the competition between pit coal and brown coal. The pit coal is similar to that used in England, whilst the brown coal is of very inferior value until it has undergone suitable treatment. The production of brown coal, of which there is an almost unlimited supply, already amounts to 170 million tons a year. The cost of pit coal, however, will probably increase owing to the increasing depths of the pits. A large combination steam and brown coal carbonisation plant is now in operation. Germany is looking forward to the combining of carbonisation plants, power stations, and gas works.

A NUMBER of spectacular experiments involving the use of sound-films, photoelectric cells, and reproducing apparatus were demonstrated by Mr. J. B. Taylor, of the General Electric Co., Schenectady, in a lecture given on Nov. 6 to the New York Electrical Society. An image of the sound track of the film after projection on to the screen was used to actuate a loud speaker through the medium of a photo-electric cell. Various distortions of reproduced speech were then demonstrated by running the film at speeds up to three times the normal, by running the film in the reverse direction, and by increasing or decreasing the width and position of the slit, thus allowing selected and restricted portions of the sound track to act on the cell. The rapid fluctuations in intensity of apparently constant sources of light were also demonstrated as sounds by allowing them to illuminate the photoelectric cell of the sound reproducing apparatus.

IT is well known that the principles governing successful communication over long distances on land and sea have their origin in optical, acoustic, and mechanical methods which were used in primitive times. Through revolutions, wars, and reformations the art of signalling by these means can be traced to the beginning of the nineteenth century, when it attained its highest perfection under Claude Chappe, the first administrative telegraph engineer in France. Mr. Rollo Appleyard, in *Electrical Communication* for October, rightly includes him in his biographies of the pioneers of electric signalling. Chappe, who was born in 1763 and died in 1805, endeavoured to replace acoustic signals by electric signals. At that time, however, the insuperable difficulty was how to insulate the wire. Chappe was educated for the Church, but when the Revolution came he devoted himself to the Republic. From 1793 to the end of his life he did valuable public service, semaphore lines operating on his method and with his code connecting Paris with many towns in France.

CHAPPE'S only recompense as an inventor was the satisfaction of having served his country. He did not escape cruel annoyance by those who claimed to have anticipated his successful devices. In 1804, Napoleon demanded the immediate establishment of a telegraph service between Paris and Milan through Lyons. The work proved too heavy for him and shortened his life. Ultimately there were 58 semaphore stations between Paris and Lyons. Trees which interfered with the line of vision were cut down and their owners indemnified. Chappe was fully aware of the extent to which the general principles of his devices had been praised by the ancients. The value of his work lay in the adaptation of these principles to the needs of his time. His mechanism was designed to secure the greatest visibility, strength, lightness, durability, and ease of operation, and his successful methods were a great boon to several European countries until the invention of the electric telegraph by Wheatstone in 1837 made some of them antiquated.

AT a meeting of the Newcomen Society held on Nov. 20, Mr. Rhys Jenkins read a paper on "The Art of Water Drawing", the title being taken from a work published in 1660 apparently written by one R. D'Acres, whose name is attached to the preface. The book is extremely rare, and in view of the interest-

ing way the author treated his subject, the Society proposes to reprint it as one of its "Extra Publications". A striking feature of the book is the systematic way in which the pumping machine is analysed into prime mover, transmitting mechanism, and operating member, while D'Acres gives evidence that he understands the action of the pressure of the atmosphere in forcing water into a vessel containing a partial vacuum. He goes on to suggest, indeed, the use of fire for the raising of water, and describes an apparatus into which water can be drawn through the cooling of hot gases within it. Whether he made such an apparatus is not known. Mr. Jenkins gave some interesting information regarding the use of bucket gins, that is, the chain of buckets or chain of pots once in common use in Great Britain, suction pumps, force pumps, and other appliances of Tudor and Stuart times, and referred to some of the earliest examples. According to the "Oxford English Dictionary", no trace of the name 'pump' occurs before the fifteenth century, for though remains of Roman pumps have been found, such things went out of use with the coming of the Saxons. During the meeting, it was announced that Mr. L. St. L. Pendred has consented to continue as president for a second year, and that the Society now has 248 individual members, besides 57 institutions which subscribe as members.

MR. ERIC MACLAGAN, director and secretary of the Victoria and Albert Museum, South Kensington, has been elected an honorary member of the Yorkshire Philosophical Society.

FURTHER correspondence concerning the appearance of the comma butterfly in England has reached us (see also NATURE, Oct. 26, p. 653, and Nov. 16, p. 770). Mr. E. J. Machin records its capture at Tettenhall, South Staffordshire, on Oct. 18 last, and Mr. R. L. Williams states that a specimen was taken in the grounds of the Biological Field Station of the Imperial College of Science, Slough, Bucks, on Sept. 24.

THE Principal Trustees of the British Museum have appointed Mr. J. Ramsbottom, at present deputy keeper in the Department of Botany, to be keeper of the Department on the retirement of Dr. A. B. Rendle on Jan. 19 next. Mr. G. J. Arrow has been appointed deputy keeper in the Department of Entomology.

AT the annual general meeting held on Nov. 14 of the London Mathematical Society, the following officers were elected:—*President*: Prof. S. Chapman; *Vice-Presidents*: Prof. W. E. H. Berwick, Prof. P. J. Daniell, and Prof. E. H. Neville; *Treasurer*: Dr. A. E. Western; *Librarian*: Prof. H. Hilton; *Secretaries*: Prof. G. N. Watson and Mr. F. P. White; *New Members of Council*: Mr. T. W. Chaundy, Prof. G. H. Hardy, Prof. H. Levy, and Prof. L. J. Mordell.

THE Williams Prize of the Iron and Steel Institute, of the value of 100 guineas, has this year been awarded by the Council to Mr. William E. Simons, assistant blast-furnace manager at the Cardiff Works of Messrs. Guest, Keen, and Nettlefolds, Ltd., in consideration of his paper on "The A.I.B. Sinter Plant at the Works of Guest, Keen, and Nettlefolds, Limited," which he presented at the last annual meeting of the Institute in London.

AT the annual general meeting of the University of Durham Philosophical Society, held on Oct. 31, the following officers were elected:—*President*: The Hon. Sir Charles A. Parsons; *Vice-Presidents*: Prof. Masson, Mr. Wilfred Hall, Sir William Marris, Dr. Morrow, Dr. Smythe, Prof. Harrison; *Hon. Secretary*: Mr. W. M. Madgin, Armstrong College, Newcastle-upon-Tyne; *Hon. Treasurer*: J. W. Bullerwell, Armstrong College, Newcastle-upon-Tyne.

ON Oct. 1, Sir Frederic G. Kenyon opened at Hull the Mortimer Collection of Prehistoric Antiquities, which was presented to the Corporation by Col. G. H. Clarke, and has now been given a permanent home in the Old Art Gallery of the City Hall. There are few museums, Sir Frederic said, which put the people so closely in touch with prehistoric man as the Mortimer Museum. The objects are clearly recorded and admirably displayed. Some idea of the extent and scientific value of the collection may be gathered from the fact that Mr. Mortimer excavated about 350 burial mounds, from the Bronze Age to Roman and Saxon times, and preserved every object found in them. In addition, there are many Neolithic objects found unassociated with burials in various parts of the world.

THE Department of Zoology of the British Museum (Natural History) has recently received a fine example of the common porcupine (*Hystrix cristata*) mounted in a defensive attitude with its spines erected, from the trustees of the Rowland Ward Bequest; while Mr. C. D. Soar has presented to the Department a collection of nearly 600 slides of microscopic preparations of water-mites, forming the material described in the standard monograph, "British Hydracarina", by Mr. Soar and Mr. Williamson, published by the Ray Society (1925–29, 3 vols.). Through the generosity of Mrs. M. E. Eaton, the Department of Entomology has received the collection of Psychodidæ (moth-flies) formed by her late husband, the Rev. A. E. Eaton, and including more than 1800 pinned specimens and about 200 microscope slides. It is probable that the Eaton collection is the largest and most important in existence, including as it does, in addition to a complete series of the known British species, much material from Switzerland, Algeria, Madeira, the Canary Islands, and elsewhere. It is hoped that it may be possible to publish some parts of Mr. Eaton's manuscript notes on the group. A recent addition to the Department of Geology is a cast and enlarged model of the tooth of the fossil man *Sinanthropus pekinensis* from the Pleistocene of China. Many specimens of minerals and rocks recently collected in Northern Rhodesia and South-west Africa have been added to the mineral collection.

A CATALOGUE (No. 10) of some 500 second-hand books relating to botany and zoology has been received from Mr. J. H. Knowles, 92 Solon Road, S.W.2.

WE have received from Messrs. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2, a copy of their

latest catalogue of books relating to medicine and allied sciences.

MESSRS. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, have added to their interesting series of catalogues No. 519, consisting of nearly 600 titles of books, maps, views, and MSS. concerning the West Indies.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A demonstrator in civil and mechanical engineering in the Department of Engineering of the University of Leeds—The Registrar, The University, Leeds (Dec. 2). A clinical assistant in the Department of Physio-Therapy of St. George's Hospital—The Dean of the Medical School, St. George's Hospital, S.W.1 (Dec. 7). A lecturer in physics at the Northampton Polytechnic Institute—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1 (Dec. 10). A woman lecturer in geography at the Leeds Training College—The Principal, Training College, Leeds (Dec. 10). A principal of the Norwich Technical College—The Secretary of Education, 41 St. Giles Street, Norwich (Dec. 10). A director of the Marine Trades School, Suez, under the Egyptian Ministry of Education—The Under Secretary of State, Ministry of Education, Cairo (Dec. 10). A glass blower in the Department of Chemistry of the University of Cape Town—The Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Dec. 11). A petroleum technologist to the Government of Trinidad—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, S.W.1 (Dec. 20). A professor of social biology at the London School of Economics—The Academic Registrar, University of London, South Kensington, S.W.7 (Jan. 23). A Martin White professor of sociology at the London School of Economics—The Academic Registrar, University of London, S.W.7 (Jan. 24). A head of the Department of Mechanical and Structural Engineering and Building of the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A lecturer in mathematics and geography at St. Gabriel's Training College for Women—Miss K. T. Stephenson, St. Gabriel's College, Cormont Road, Camberwell, S.E.5. A laboratory assistant in the soil chemistry laboratories of the Agricultural Research Station, Amani, Tanganyika Territory—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1797). A lecturer in botany in the University of Reading—The Registrar, The University, Reading. Heads of the pathological and botany divisions of the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2/4 Idol Lane, Eastcheap, E.C.3.

Our Astronomical Column.

Changes on Jupiter.—The planet Jupiter will be in opposition to the sun on Dec. 3, and promises to exhibit some very interesting phenomena to observers. Mr. A. Stanley Williams, Rev. T. E. R. Phillips, and others have reported the appearance of a long stream of dark spots in the region immediately south of the north temperate belt of the planet. On Nov. 16 the spots extended over about half the circumference, for Mr. Phillips found that they occupied 5 hours in crossing the central meridian. This outburst of spots has appeared in the same latitude and presents a similar aspect to that shown by a remarkable train of spots which attracted much attention in October and November 1880. The latter objects gave a rotation period of $9^h\ 48^m$ and formed a new dusky belt on the planet in 32 days. They were among the swiftest markings ever detected on the Jovian surface. The present revival of similar details is very suggestive of repetition, for the spots at present visible are travelling with great rapidity of movement and complete a rotation in about $9^h\ 49^m$. They are being attentively watched in order to determine whether or not they become transformed into a new belt as occurred with the markings of 1880.

The Binary Star 70 Ophiuchi.—It has long been known that the discordances between theory and observation in the distances and position angles of this star are of a somewhat systematic nature ; some of the orbit computers have considered that there was evidence of a third unseen component disturbing the motion of the others ; an alternative explanation was that the discordances arose from systematic errors in the observations, depending on the inclination to the vertical of the line joining the stars. It is known that some observers have personal errors of this nature, and R. Tschilschke examines in *Astr. Nach.*, No. 5664, whether the discordances can be explained in this way. He concludes in favour of the existence of a third mass from the fact that the discordances have a different period from the period of revolution of the visible pair ; he finds 89·09 years for this, but about 64 years for the discordance. He concludes also that the node shows a yearly change of some 2°, indicating that the third body moves in a plane different from that of the visible system.

The Star-cloud in Scutum.—*Lick Bulletin*, No. 416, consists of an examination by C. J. Krieger of the distance and depth in the line of sight of the galactic star-cloud in Scutum (now generally included in Aquila). The centre of the cloud is at about R.A. $18^h\ 43^m$, S. Decl. 7·6° (equinox of 1900). The spectral types of the brighter stars were obtained by slitless spectrograms ; the photographic magnitudes by comparisons with the north polar sequence ; the colour indices by photographs with colour filters. The cloud is approximately 6° by 8° in angular area ; its mean distance is determined as 2800 parsecs, which makes its mean diameter in a direction perpendicular to the line of sight 350 parsecs ; the depth in the line of sight appears to be greater, being between 500 and 1000 parsecs. The relative luminosities of the different spectral types are the same as in the neighbourhood of the sun, but the density of distribution of dwarf stars is considerably greater. There is concluded to be a region of low star density between the solar cluster and the Scutum Cloud. Other estimates of the distance of the cloud are : Seares, 7000 parsecs ; Shapley, 4000 to 6000 parsecs ; Kreiken, 1500 parsecs ; Malmquist, 3400 parsecs. The mean is 4200 parsecs, or 1·5 times Krieger's estimate. The study of the distance of these galactic condensations is of interest for comparison between them and the condensations in the spiral nebulæ.

Research Items.

Mice and Evolution.—Following a summary of recent results of the irradiation of animals by X-rays and its effect upon inheritance of characters, N. Dobrovolskaïa-Zavadskaïa has discussed his own experiments upon 35 breeding mice (*Biol. Rev. and Biol. Proc. Cambridge Phil. Soc.*, vol. 4, October 1929, p. 327). In a progeny numbering about 3000, only two mutations were discovered, and these, having already been found apart from irradiation, are regarded as manifestations of pre-existing latent states brought to light under the influence of the rays. The rays can scarcely, therefore, be looked upon as a real cause of mutations, as has been alleged. On the results of these relatively few experiments, the author has the temerity to base a theory of evolution, a hypothesis of stable species with single changeable individuals, which are the source of new forms. This hypothesis conceives evolution to be based on three foundations: (1) Stability of existing species as the expression of the conservative principle of life; (2) variability of single individuals as the manifestation of the creative power in Nature; and (3) natural selection as the sifting out of the adapted species. We cannot comment on these conclusions in this note, but on general grounds we deprecate the building up of wide theories upon artificial experiments without any reference to the course of events in Nature. Although species are of the essence of the theory, the species of mouse experimented with here is not even named.

Catgut and its Sterilisation.—With the exception of antiseptic treatment, probably no procedure has advanced the practice of surgery more than the use of the ligature for tying the blood-vessels and controlling hæmorrhage. Many substances have been employed for the purpose, but catgut is usually the material to be preferred. Catgut for surgical use should be sterile in the sense of being free from any bacterial contamination, yet flexible, strong, and absorbable in the tissues. The practical problems involved in producing such a material are the subject of a report by W. Bulloch, L. H. Lampitt, and J. H. Bushill, issued by the Medical Research Council (*Special Report Series*, No. 138; London: H.M. Stationery Office, 4*s*. net). Prof. Bulloch contributes what must be the most complete modern account of the history and literature of the whole subject, as well as the results of thousands of sterility tests and experiments on methods of sterilising. Dr. Lampitt and Mr. Bushill deal with the physical and chemical properties of the sheep's intestine (from which 'catgut' is made) and its manufacture into sterile ligatures for surgical use. Prof. Bulloch finds that much commercial surgical catgut is not sterile, and that many of the sterilising processes recommended are inefficient. It is of interest that the last method devised by Lord Lister, who studied the subject for forty years, which consists in the use of chromium sulphate and mercuric chloride, yields a sterile product. Prof. Bulloch finds that a 1 per cent aqueous solution of iodine and potassium iodide will infallibly sterilise the most contaminated catgut if applied for not less than eight days, and is the best agent to employ on a commercial scale. Messrs. Lampitt and Bushill show that the iodine process yields a satisfactory ligature provided certain conditions are observed and precautions taken during manufacture.

Development of Mosquito Larvæ.—Dr. Malcolm E. MacGregor (*Parasitology*, vol. 21, 1929) has described observations on the significance of the hydrogen ion concentration in the development of mosquito larvæ, especially those of *Ædes argenteus*. By gradually eliminating one and another of the interacting factors he has been able to demonstrate (*a*) that if the *p*H of the normal environment is changed the development of the larvæ is adversely affected; (*b*) that under bacteriologically sterile conditions the foregoing statement is no longer true; and (*c*) that consequently the acid or alkaline reaction of the medium, within ordinary limits, has no direct effect upon the development of the larvæ. An alteration in the *p*H often brings about a change in the biological group associations and the abnormal dominance of factors unfavourable to a particular species of larvæ. The larvæ of certain species show a restriction to waters exhibiting a *p*H index within a definite short range, and hence the *p*H index is often a trustworthy indication as to whether the chemical and biological group associations will favour or preclude successful development of such larvæ. The author states that of the different artificial food stuffs nothing has been found to suit the larvæ of *Ædes argenteus* so well as bread, and he describes the technique for the production of successful cultures of larvæ and pupæ under bacteriologically sterile conditions. The phase of 'suspended development' of the larvæ of many species of mosquitoes is found to have its probable explanation in the temporary or complete disappearance of micro-organisms on which the conversion of the organic materials of the environment to a suitable larvæ diet depends.

Parasitic Roundworms in Sheep.—The Ministry of Agriculture and Fisheries has recently issued two clearly written leaflets on parasitic roundworms in sheep. The first (No. 75) gives an account of the twisted wire worm (*Hæmonchus contortus*) which occurs in the fourth stomach of the sheep, and the second (No. 304) deals with the common lung worms of cattle, sheep, and goats, causing 'husk' or 'hoose'. The life-history of the respective worms so far as it is known is concisely described, and will undoubtedly "assist the direction of intelligent effort towards suitable measures of control". These measures and curative treatment are briefly described.

Trypanorhynchid Cestodes from Ceylon and India.—The first part of a monograph by Dr. T. Southwell on Cestodes of the order Trypanorhyncha from Ceylon and India is published in *Spolia Zeylanica*, vol. 15, part 3, 1929. An extensive historical survey of the literature of the order is followed by the author's proposed classification into three families with six certain genera and one of uncertain position, and by a description of each of the species. A list is given of the species—about three dozen—recorded from India and Ceylon and of their respective hosts. A note is added on larval cestodes collected in large numbers from the umbrella of a rhizostomous medusa in the Chilha Lake. At the anterior extremity of the larva is a deep pit the base of which—where the head or scolex would later develop—is thickened. These are plerocercoid larvæ but are not identifiable further. Dr. Southwell states that no cestode larvæ have been previously recorded from medusæ.

A Four-Rayed Clypeaster.—Mr. Iwao Taki describes an unusual abnormality in this specimen of *Clypeaster japonicus* ("Note on a 4-rayed Specimen of *Clypeaster japonicus* Döderlein". *Memoirs of the College of Science*, Kyoto Imperial University, Series B, vol. 4, No. 2, article 6, 1929.) It was found on the shore close to the Seto Marine Biological Laboratory, Seto, Prov. Kii, after a heavy storm. Several normal

individuals were obtained at the same time. Compared with these latter the abnormal specimen, which is immature, has a much rounder outline, the test is higher, the number of ambulacral pore-pairs smaller, and the outline of the petals oval with an obtuse distal part. The four rays are repeated in the madreporite, which is nearly square with only four genital pores, situated at the four corners. One of the petals is open showing it to be the anterior. The remaining three, therefore, represent the other four rays of a normal specimen. From the number of pore-pairs it is deduced that one of the posterior petals is missing, and that the tetramerism is brought about by the abortion of the right posterior ambulacrum and adjacent interambulacra.

Nets for Plankton Research.—In a recent publication by the International Council for the Exploration of the Sea ("Vergleich der Fangfähigkeit verschiedener Modelle von Plankton-netzen". *Rapports et Procès-Verbaux des Réunions*, vol. 69, September 1929 (København: Andr. Fred. Høst et Fils) Cl. Künne gives the results of some quantitative tests which have been made with three types of nets, Hensen's egg-net, the Nansen net, and the standard net of the International Council. He finds that while the Nansen net and the Hensen net are rather similar in their catching powers, the former catching about 90 per cent as much as the latter, the standard net, on the other hand, falls far short in efficiency, catching only one-tenth of the material that the Hensen net does. Moreover, this is not due so much to the lesser dimensions of the opening of the standard net, but rather to its construction. It seems probable that the netting inserted at the front tends to constrict the virtual opening of the net where it joins the silk, and the throttling rope may also help in this at times. The question is an important one and should be settled now that there is a tendency more and more to standardisation of method in order that results may be comparable. The author favours the Hensen net for its convenience in sea work, in spite of its cumbrous size.

Nitrogen Metabolism of Virus Diseased Plants.—The nitrogen metabolism of healthy and spiked sandal leaves has been studied by N. Narasimhamurthy and M. Sreenivasaya, and their results have been published as Part 6 of the "Contributions to the Study of Spike-disease of Sandal (*Santalum album* Linn.) in Vol. 12 A, Part 10, of the *Journal of the Indian Institute of Science*, pp. 153-163. They report a greater content of total nitrogen (on a dry weight basis) in spiked leaves than in healthy leaves where a leguminous host is absent, whilst little difference can be detected when the latter symbiont is present. There is, however, in all cases an increase in total water-soluble nitrogen, basic nitrogen, and total amino nitrogen, and a decrease in the nitrate nitrogen in the diseased leaves, when compared with healthy leaves, relative to either dry weight or to total nitrogen. Comparisons are drawn with the nitrogen contents of several plants attacked with virus diseases which usually show no decrease in total nitrogen content as a result of the disease.

Industrial Development of Saskatchewan.—The province of Saskatchewan in the Dominion of Canada is chiefly known as a great wheat-producing area, but the development of its natural resources in other directions is proceeding apace, and it is apparent that before very long there will be an industrial activity corresponding in many respects to that of the provinces of eastern Canada. A report issued by the Natural Resources Division of the Saskatchewan Department of Railways, Labour, and Industries, for the fiscal year ended April 30, 1929, shows that during the past twelve months much attention has been given to the establishment of the lignite briquetting industry near Estevan, and to mineral development in that large area of Saskatchewan which lies within the boundary of the two million square mile Pre-Cambrian Shield. Mention is made in the report of the exploitation of the Province's non-metallic mineral resources, etc., its clays, sodium sulphate deposits, and volcanic ash, special attention being given to the marketing of sodium sulphate, the importance of which to the Canadian pulp and paper industry is considerable.

The Eruptions of Mayon Volcano.—In *The Philippine Journal of Science* for September last, L. A. Faustino describes Mayon Volcano and its eruptions, with special reference to the great outburst that took place last year. The volcano is a cinder cone with venticular lava-flows, and its profile follows very closely the hyperbolic sine curve discussed many years ago by Becker. Surface indications point to only one orifice, and if there have in the past been subordinate openings, they have since been hidden. None appeared in 1928. The original vent broke through a Tertiary basement in late Tertiary or early Quaternary time, and Mayon is to-day the most active cone in the Philippines. The ejected materials are of porphyritic basaltic composition and they have repeatedly smoothed the irregularities caused by erosion and weathering, thus maintaining the almost perfect symmetry and form of the cone. Since the destructive eruption of 1814, twenty-eight well-defined eruptions have been recorded, the longest period of relative quiescence being from 1900 to 1928. The eruptions can be described in terms of the sequence recognised by Perret in his well-known description of the Vesuvius eruption of 1906. In the case of Mayon, the luminous, *liquid lava* phase is of shorter duration than at Vesuvius; the intermediate, *gas* phase, characterised by vapours and gases with but little ash, is longer; and the dark, *ash* phase is marked as usual by a preponderance of ejected ashes.

Late Cretaceous and Tertiary of New Zealand.—In his presidential address to the Geological Section of the Fourth Science Congress of New Zealand, Dr. J. Henderson gave a detailed series of correlations of the Tertiary and late Cretaceous deposits for seven characteristic areas of New Zealand (*Trans. and Proc. N.Z. Inst.*, **60**, pp. 271-299; 1929). The strata are divided into three groups on diastrophic grounds. The first, following the Hokanui deformations, when New Zealand was more extensive than now and diversified with a great chain of mountains of which the present axial highlands are the roots, extended from the Albian to the close of the Eocene. Widespread movements then occurred, and basic rocks were erupted in many districts. The resulting elevation, however, was not great, and base-levelling reached its climax during the succeeding Ototaran or Oligocene period. In the Miocene, the andesitic lavas of Auckland and Hauraki were poured out. These seem to have relieved the crustal stresses in part, for the post-Ototaran movements are found to be more pronounced in the South Island, where volcanic outbursts were less active. During the Pliocene, the Kaikoura movements reached their climacteric. Since then the Castlecliff beds and their correlatives have been laid down, and the basaltic vents of Whangaroa have continued intermittently. The paroxysmal rhyolitic outbursts of the Rotorua-Taupo region began a little later than the first emissions of basalt. The published address contains valuable correlation tables and a full bibliography.

Crystal Structure of Ice.—An elaborate investigation of the crystal structure of ice, now of importance in many connexions, is described by Dr. W. H. Barnes in the November number of the *Proceedings of the Royal Society* (pp. 670-693). The older data for this are conflicting, and even now the possibility cannot be ruled out that, quite apart from high pressure modifications, different forms may exist under slightly different conditions. Dr. Barnes's results, however, which are based upon the interpretation of X-ray diffraction photographs taken by various methods at the Davy-Faraday Research Laboratory, show that the space group in the specimens studied by him was one of the two known as D_{6h}^4 (dihexagonal bipyramidal) and D_{3h}^4 (ditrigonal bipyramidal), with the probability in favour of the former. Photographs taken by the powder method also failed to reveal any change in structure between the temperatures of standard melting ice and of liquid air. Four molecules go to build up each unit cell, and it is probable that the lattice is ionic.

Melting-point of Palladium.—The highest standard point in the thermometric scale which can be measured conveniently with the gas thermometer is the melting-point of gold, 1063° C. Above this, recourse is usually made to radiation thermometry, with for technical purposes an agreed value for the radiation constant (c_2). It is, however, useful to have other higher fixed points, and of these the most important is the melting-point of palladium. One determination of this was reported in the *Bureau of Standards Journal of Research* for May of this year, yielding the value 1554°. A second determination, made at the National Physical Laboratory by F. H. Schofield, is described in the *Proceedings of the Royal Society* for October, and gives the temperature as 1555°. Older determinations, made at the Physikalisch-Technische Reichsanstalt in 1919 (1556°), and at the Nela Laboratories in 1920 (1557°), are also in remarkably good agreement with the new numbers, and it thus seems probable that the agreed value of 1555° which has been taken as the melting-point for the purposes of the International Temperature Scale cannot be in error by more than 2°. It is an interesting fact that Prof. Callendar obtained a value only five degrees below this in 1899, working with a resistance thermometer of platinum, and extrapolating from the boiling-point of sulphur.

Measurement of Radioactivity.—The new electrical counter for α-particles and β-particles which was described by Prof. Geiger and Dr. W. Müller last year is so extremely sensitive to weak radiation that it could be used immediately to demonstrate the radioactivity of potassium, and has since been applied to the study of the cosmic rays. An investigation of its utility in the measurement of radium preparations has now been made at Prof. Geiger's instigation, and is described by H. Neufeldt in the issue of the *Physikalische Zeitschrift* for Aug. 15. The counter employed was of special design, and could, if desired, hold the radioactive preparation internally, the strength of the latter being measured by the secondary β-rays produced in the counter by the γ-radiation. Quantities of radioactive material equivalent to 10^{-6} mgm. radium could be measured in this way, as compared with about 10^{-3} mgm. with the most refined of the older methods. The precision of the measurements was about ten per cent, and the only important disadvantage inherent in the use of the instrument appears to be the long time—of the order of several hours—required to obtain sufficient auxiliary data to allow for the large number of particles of uncontrollable origin which are recorded by it, due very largely to the cosmic rays and the radioactivity of the material of the counter itself.

Viscosity of Solutions.—Although much experimental work on the effect of concentration on the viscosity of solutions has been carried out, it has been found difficult to represent the results by means of equations. In the October number of the *Journal of the American Chemical Society*, G. Jones and M. Dole describe some very accurate measurements of the viscosities of barium chloride solutions at 25° over a range of concentration of 0·005 to 1·0 molal. They find that the fluidity (1/viscosity) can be represented by an equation of the form $\phi = 1 + A\sqrt{c} + Bc$, which also fits other data with proper values of A and B. The term in $\sqrt{c}$ was suggested by the Debye and Hückel formula for electrolytes, and since A is always negative for electrolytes it is suggested that it represents the 'stiffening effect' on the solution of the electric forces of the ion atmosphere. For non-electrolytes A is zero. The value of B may be positive or negative.

The Active Principles of Pyrethrum Flowers.—The use of pyrethrum flowers, or an extract in the form of liquid insecticides, has increased considerably during the last five years, and some method of determining the amount of active principles in them has been required. In 1916, Staudinger and Ruzicka found that the two active principles of pyrethrum flowers were pyrethrin-I and pyrethrin-II, which were shown to be esters of a ketone-alcohol, pyrethrolon, with two acids, chrysanthemum monocarboxylic acid and chrysanthemum dicarboxylic acid methyl ester, to which they were able to attribute structural formulæ. In the October number of the *Journal of the American Chemical Society*, Gnadinger and Corl describe the isolation of pure pyrethrin-I and -II from Japanese pyrethrum flowers. They then worked out a method for the determination of these principles in the flowers by means of the reducing action on alkaline copper solution as compared with that of dextrose, and in this way were able to use much smaller quantities of material than were required in previous methods. The percentages found ranged from 0·40 to 1·21.

A Novel Evaporating Plant.—In the *Chemiker-Zeitung* for Oct. 16 is described a novel form of evaporating plant for which many advantages over other types are claimed. The principle involved is the distribution of the liquid into extremely thin layers, which are allowed to flow over funnel-shaped heating surfaces. The time required for the vaporisation of a given bulk of liquid is thus enormously reduced and the vapours can be removed rapidly without encountering the resistance of a column of liquid. The process is continuous, and since the liquid is also kept constantly in motion, there is no danger of superheating, foaming, or bumping. The heating units can be built up into columns of varying heights according to the degree of concentration of liquid required, and by means of separate steam-pipes they may be heated to different temperatures, so that when the evaporator is used for the distillation of oils a preliminary separation into fractions is effected. Fractionation may be completed by combining the evaporator with suitable dephlegmators and condensers. The apparatus is also well adapted for the concentration of solutions in which prolonged heating is apt to induce chemical decomposition; when once regulated for a particular operation, very little supervision is needed. The efficiency of the evaporator may be judged from the fact that 80-90 kilograms of water can be evaporated per square metre of heating surface in one hour without using a vacuum pump. The apparatus is patented and manufactured by Messrs. Zahn and Co., Ltd., of Berlin.

Fuel Research.[1]

THE Report of the Fuel Research Board for the year ended Mar. 31, 1929, is remarkable for its range of subject matter, and it is only by selective treatment that a short notice like this can be made anything more than an enumeration of its contents.

The first part of the report, by Sir Richard Threlfall, the chairman, does not limit itself to an account of the activities of the Board, but deals also with other happenings in the world of fuel which may be regarded as relevant. The opening sentence states a wholesome truth which cannot be too strongly emphasised in these days, when the pursuit of what is known as rationalisation may lead to over-centralisation if it is not carried out with care, discrimination, and sober judgment. The sentence proclaims the difficulty (and might have said impossibility) of one research organisation dealing adequately with the many and complicated problems involved in the study of the coal resources of Britain and their utilisation, and welcomes the increasing attention given to fuel research, both by individual firms and by industrial organisations. Notice is also given to a particular recommendation by the National Fuel and Power Committee, which is not content with the prosecution of research alone, but insists upon the necessity for the application of the results of research and the consequent necessity of employment on the executive side of industry of more men trained as fuel technologists.

Another recommendation of the National Fuel and Power Committee is noted, that the thermal system of charging for gas (introduced by the Gas Regulation Act of 1920, on the recommendation of the Fuel Research Board) should be regarded as having proved its value, and be made compulsory, except for very small undertakings. This recommendation has been embodied in the Gas Undertakings Act, 1929.

The physical and chemical survey of the national coal resources is reported upon as having progressed steadily, and with the appointing of a committee to deal with the South Wales area, the organisation now covers coalfields producing 85 per cent of the coal raised in Great Britain. There is so much that might be done on such a survey, with its many possible ramifications indicated in the report, that a wide vista of usefulness is opened out for the Fuel Research Board, if it is to deal adequately with this part of its work. The survey once begun leads naturally to the operations of other committees (such as the Coke Research Committee, formed at the instigation of the National Federation of Iron and Steel Manufacturers), which deals with the properties of coal mined in certain areas for various industrial uses.

All this has led to a realisation of how comparatively little is known even to-day on many of the most fundamental and elementary things connected with coal and its carbonisation; and the Fuel Research Board is assisting workers at the universities in their endeavours to extend and strengthen the scientific foundations on which the structure of the fuel industries must be based.

Quite topical is the reference to the use of pulverised fuel, both ashore and afloat, and to work which the Fuel Research Board is itself carrying out on the interesting subject of burner design for this purpose, on the principle of so relating the movements of air and the solid particles of fuel that maximum efficiency of contact and rapidity of combustion can be secured. It is to be hoped that the Board will be able to turn its attention to the problem of dust emission from plants using pulverised coal, which promises to become very serious as this method of use is extended in scale.

The largest section of the report is contributed by Dr. C. H. Lander, the Director of Fuel Research. He deals with many subjects, but probably the one to which the most general interest will attach is that of low temperature carbonisation. If one were to choose the branch of work in which the Fuel Research Board has been of the greatest public service, it would surely be either this, or the formulation of the recommendations on which the Gas Regulation Act of 1920 was based. Low temperature carbonisation should, however, take first place, since the Fuel Research Board has not only interested itself in the subject by the examination and testing of quite a number of proposed processes embodying different ideas and types of construction, but also has carried out useful research work and informative experiments by its own staff at the experimental station at Greenwich. The time has now arrived when a limited number of the numerous processes and plants projected for carrying out low temperature carbonisation have reached the stage of full scale technical working and commercial trial. Some of these engage the attention of Dr. Lander in this report, particularly the setting of vertical cast-iron retorts at the Richmond Gas Works, erected by the Gas Light and Coke Company to the general design developed earlier at the Fuel Research Station.

Dr. Lander undertakes a two-page review of the general position of low temperature carbonisation as deduced from the experiments and observations of the Board. It is a summing up, characterised by knowledge, fair-mindedness, and caution, and is neither condemnatory nor eulogistic of any particular process or of the low temperature system as a whole.

So far as the summary can itself be summarised, it points to the necessity for considering every individual undertaking on its merits with due regard on one hand to the nature of the coal it is proposed to treat and the available supply, and on the other to the outlets for the coke, tar, and gas. Of equal importance are the questions of maintenance and depreciation of the plant, which must take a considerable time to ascertain unless the life is short and replacement expenses heavy. Then again come the factors which govern the prices of different classes of coal and the saturation point in the markets for the products. It seems likely that there are situations where low temperature carbonisation of coal can be made to pay, but the incidence of the factors mentioned above has to be considered carefully in choosing a plant and a locality for its installation.

Some experiments are described on the hydrogenation of coal. They are too few in number to allow definite deductions at this stage, but are undoubtedly promising and very interesting from their possible bearing on the constitution of coal. It is reported that by the action of hydrogen under pressure on the Bergius principle, but not carried so far, "a non-caking coal has been converted into solid products with strong caking power, and further experience has shown that carbonaceous materials ranging from cellulose and wood to anthracite, and including all types of coal and lignite, can, by controlled treatment with hydrogen under pressure, be converted into material which on carbonisation, yields a strong coherent coke".

[1] Department of Scientific and Industrial Research. Report of the Fuel Research Board for the year ended 31st March 1929; with Report of the Director of Fuel Research. Pp. viii+127. (London: H.M. Stationery Office, 1929.) 2s. net.

In high temperature carbonisation, the principal work of the year has been a study of the effect of size of coal on the working of horizontal and vertical gas retorts, being a continuation on a larger scale of work already carried out at the University of Leeds for the Gas Investigation Committee of the Institution of Gas Engineers. "The general result of the investigation is to confirm that the influence of size of the coal charged is greater with vertical than with horizontal retorts, and that with vertical retorts those variations offer a means of controlling, to some extent, the yields and qualities of the products to suit the needs of particular circumstances. In particular the increased yields of tar may be important."

Among other subjects receiving notice may be mentioned the composition of low temperature tars, combustibility, 'shatter' tests, and reactivity of coke, the effect of oxidation on the coking properties of coal, briquetting, the water gas process, the use of coke for domestic purposes, the heating requirements of a house, an interesting method of expressing fuel consumption in internal combustion engines, and various methods for sampling and analysis. JOHN W. COBB.

The Atlantic Earthquake of Nov. 18, 1929.

AN earthquake that could break a dozen deep-sea cables, that could give rise to destructive sea-waves on the Newfoundland shores, and to a shock felt along 940 miles of the American coast, must clearly have been one of unusual strength.

In Nova Scotia, the shock was felt severely in Halifax, Yarmouth, and other places. In Windsor, chimneys were thrown down. At St. John's (N.F.) the shock was slight, but all along the New England coast, as far as Boston, it was distinctly felt. At the time of the earthquake the White Star liner *Olympic* was about 300 miles from the spot at which cables were broken. The captain reported that, at 3.30 P.M. on Nov. 18, he felt the vessel suddenly quiver, as though she had cast off a propeller blade, and this movement was followed by vibrations lasting for two minutes. The ship was found to be undamaged and there was no wreckage in its wake.

Two and a half hours after the shock was felt, sea-waves flowed up the southern shores of Newfoundland. In Long Harbour, which lies at the head of a narrowing inlet, fishing-booms and stages were damaged by the sea-waves, and 75 yards of roadway were destroyed. A wave, 15 feet in height, swept away several houses in the town of Burin and all the buildings on the water-front. Nine lives were thus lost in Burin and seventeen others at Lord's Cove and Lamalin. In the open ocean the waves must have been much lower, but it might be worth while to examine the mareograms obtained at the western ports of Great Britain for any traces of their passage.

A remarkable effect of the earthquake was the fracture of a large number of telegraph cables. Of the twenty-two cables that traverse the central district, twelve were damaged, and ten of these cross the Atlantic. The probable site of the breakages is said to be in Lat. 44° N., Long. 57° W. The fractures, however, were not concentrated in one spot, for two of the Western Union cables were severed at a depth of 90 fathoms off the coast of Nova Scotia, while a third, belonging to the same company, broke at a depth of 900 fathoms. The exact positions of the fractures will throw light on the origin of the earthquake. It may be that all twelve sites will be found to lie along a straight line, as happened in 1884 with three cables on the south-eastern slope of the Newfoundland Bank. At the same time, it seems quite possible that the earthquake may have had a multiple origin and that a displacement not far from land was responsible for the strong shock felt in Nova Scotia. It is difficult otherwise to account for the damage at Windsor, slight as it was, this town being more than 300 miles from the spot assigned to the fractures. On the other hand, that the sea-waves originated at a distance from land of this order of magnitude seems to be indicated by the long interval that elapsed between the earthquake and the arrival of the waves.

That the disturbed area was one of great size is clear from the length of coast shaken. As Boston is 700 miles from the spot above mentioned, it is possible that the disturbed area may have contained so much as 1½ million square miles, an area that has seldom been exceeded in earthquakes of the last fifty years. C. DAVISON.

Oil-Pools and Fault-Zones.

THE effect of faulting on oil accumulation, equally on oil dispersion, has always been a matter of added interest in working out subsurface conditions, probably because each new case studied presents some peculiar feature worthy of close investigation. So many circumstances enter into the consideration of fault-fields, that were a classification of these alone attempted it would result in a tabular scheme almost, if not quite, as large as those already in existence for other structures, and, moreover, just about as useless. Accumulations dominated by normal fault systems, as at Luling, Texas; by reversed faults, as at Whittier, California; by overthrust faults, as at the well-known McKittrick field, California; by the high factor of porosity in many fault-belt shatter-zones where adequately sealed; by the buffer action of solid bitumen resulting from inspissation of heavy oil along planes of dislocation: these are a few of the many possible expressions of fault-structure capable of influencing storage.

Probably the most difficult cases to elucidate, if not the most important from an economic point of view, are those pools either determined or to some extent controlled by low-angle overthrusting, with its concomitant network of subsidiary 'blatts', or by those thrust-faults in which curvature of the planes, when pronounced, complicates definition except under the most favourable conditions of full well-data. As illustrative of the latter, Mr. Frank Reeves' survey of the Highwood Mountain oil-areas, Montana (*Bulletin* 806-E, 1929, United States Geological Survey), is worthy of note. The type of overthrust most commonly displayed in this region is that in which the surface-trace has a high angle of hade (or low dip) and flattens out in depth by mergence with the stratigraphic planes, so that it becomes, in fact, an almost horizontal thrust at some particular horizon in the area concerned.

Altogether an interesting contribution, although in this region the author concludes that the structures are not favourable to the ultimate location of oil and gas pools.

University and Educational Intelligence.

CAMBRIDGE.—The Vice-Chancellor has appointed Sir James Jeans to be Rede Lecturer for the year 1930.

Dr. R. A. Webb, Peterhouse, has been appointed University lecturer in pathology.

The Raymond Horton-Smith Prize for the year 1928–29 has been awarded to Dr. W. Shaw of St. John's College.

At Pembroke College Mr. J. M. Whittaker has been elected into a fellowship and appointed lecturer and director of mathematical studies. Mr. Whittaker obtained a first class in Part 2 of the Mathematical Tripos in 1927 and was awarded a Smith's prize this year.

LONDON.—Dr. G. A. Harrison has been appointed as from Oct. 1 last to the University readership in chemical pathology tenable at St. Bartholomew's Hospital Medical College. In 1919–24 Dr. Harrison was biochemist to King's College Hospital and lecturer on medical chemistry to the Medical School. For the next two years he was biochemist at the Hospital for Sick Children, Gt. Ormond Street, and since 1926 has been chemical pathologist to St. Bartholomew's Hospital and lecturer on this subject in the Medical College.

The following doctorates have been conferred: D.Sc. in chemistry on Mr. Harry Baines, for a thesis entitled "New Methods for the Analysis of Photographic Products and Raw Materials", and other papers; D.Sc. in physics on Mr. A. C. G. Menzies, for a thesis entitled "The Spectra of Fuses in the Ultra-violet and Schumann Regions", and another paper.

The Right Hon. the Earl Beauchamp was installed as Chancellor of the University on Nov. 22.

H.R.H. PRINCESS MARY has graciously consented to open the new wing of the Battersea Polytechnic on Wednesday, Dec. 11, at 6.15 P.M. The additional accommodation provided will include a physical chemistry laboratory, a bacteriology laboratory, and two lecture rooms.

THE Institution of Chemical Engineers, Abbey House, Westminster, S.W.1, announces that application forms and particulars of its associate membership examination for 1930, together with the memorandum on "The Training of a Chemical Engineer", are obtainable from the Honorary Registrar at the address given. Completed forms must be returned by Dec. 23.

THE Chelsea Polytechnic directs special attention in its prospectus for the current session to its provision for the study of the scientific bases of some modern developments of industrial processes: in the department of physics, for example, technical acoustics and electricity for students of domestic science and demonstrations of electrical domestic appliances; in chemistry, preparation of compounds by industrial methods, technical analysis, including gas analysis, and the chemistry and microscopy of food and drugs; in natural science, the study of plant diseases, genetics, and industrial bacteriology. Its College of Science and Technology embraces mathematics, surveying, physics, chemistry, pharmaceutics, metallurgy, botany, geology, geography, mineralogy, zoology, anatomy, physiology, and hygiene.

Calendar of Patent Records.

December 1, 1671.—On Dec. 1, 1671, Prince Rupert was granted a patent for his new invention of "converting into steel all manner of edged tools, files, etc., forged and formed in soft iron, or any part of the said tools, after they are set, forged, and framed". The patent was to run from May 6, the date of an earlier grant which had been surrendered. In connexion with the patent, Prince Rupert was authorised in the following January to administer an oath to "the several workmen, artificers, and persons concerned in the said arts, neither directly nor indirectly to divulge or make known to any person whatsoever, except his Majesty . . . the said arts or how they are used or with what instruments or materialls the same are made".

December 1, 1898.—The telegraphone, an instrument which utilises the action of magnetism on a magnetisable wire for the recording and reproducing of sounds, was the invention of Valdemar Poulsen, the Danish engineer, who was granted a patent for the invention in Denmark, dated Dec. 1, 1898. The apparatus has the advantage that the recording is not easily interfered with by subsidiary noises, and that the record can be 'wiped out' to enable the same wire to be used again by the simple process of demagnetising the wire. Communications telephoned in the absence of the subscriber at the receiving station are recorded directly by the apparatus and may be given out by it to the subscriber whenever required. The apparatus was also used for the simultaneous transmission of speech to a number of subscribers.

December 2, 1856.—Frederick Siemens' British patent for his regenerative furnace is dated Dec. 2, 1856, and though utilising ideas proposed by Robert Stirling in 1816, is one of the most important in the history of the steel industry. The open-hearth method of making steel by the Martin-Siemens process, rendered possible by this invention, accounts for by far the larger proportion of steel made in the world to-day.

December 2, 1893.—The pince-nez with pivoted nose-grips which can be expanded by the thumb and finger and allow the glasses to be placed easily on the nose with one hand was the invention of the French spectacle maker Jules Collet, and was first patented on Dec. 2, 1893, in Great Britain in the name of A. W. Newbold. The eyeglasses were originally sold under the name of 'Movillette' by Joseph Raphael, opticians, of London.

December 3, 1901.—The United States patent for the Gillette safety razor was applied for on Dec. 3, 1901, and granted in November 1904.

December 4, 1806.—The camera lucida, "an instrument whereby any person may draw in perspective or may copy or reduce any print or drawing", was the invention of William Hyde Wollaston, secretary of the Royal Society, and was patented by him on Dec. 4, 1806.

December 6, 1679.—To John Bellingham is due the introduction of the crown glass industry into England from France. A patent was granted to him and Nicholas Hubin on Dec. 6, 1679, "they having been at great expences in bringing to perfection the manufacture of makeing Normandy window-glass in this kingdom which hath never yet been made here", and manufacture was started probably the same year at Bellingham's glass-house at Vauxhall. A second patent for window-glass was granted to Bellingham in 1685, and by the end of the century crown glass was superior to Normandy glass and fetched a higher price than any foreign window-glass.

Societies and Academies.

LONDON.

Physical Society, Oct. 25.—**E. G. Richardson** and **E. Tyler**: The transverse velocity gradient near the mouths of pipes in which an alternating or continuous flow of air is established. A comparison is made of the alternating and direct flow of air near the mouths of tubes of various sections, by traversal of a hot-wire anemometer across the tube. In the alternating flow, a peak of high average velocity is found near the walls of the pipe, but in one-way flow this annular peak is absent, the velocity falling continuously from the centre of the tube to within a short distance of the walls. The existence of a layer of laminar flow close to the walls, when the main body of air is in turbulent motion, is demonstrated.—**B. K. Johnson**: Resolving-power tests on microscope objectives used with ultra-violet radiation. An object of known regular structure and of variable interval is produced by projecting in the object-plane of the lens under test a reduced image of grating, the apparent line separation of which is varied by rotation of the latter; thus the line interval can be determined when resolution just ceases. The results show that the fused quartz monochromatic object-glass of numerical aperture 0·35, computed for and used with radiation of wave-length 0·275 μ, gives nearly twice the resolving power of a lens of similar aperture computed for and used with light of wave-length 0·51 μ; while the fused quartz monochromatic lens of numerical aperture 1·2 has a resolving power 70 per cent higher than that of a well-corrected object-glass of the same numerical aperture when used with light of wave-length 0·51 μ.

Geological Society, Nov. 6.—**H. Bolton**: Fossil insects of the South Wales Coalfield. A collection of nineteen fossil wings from the South Wales Coal Measures. Several are too fragmentary for determination of genus or species, or both; the remainder are referable to the Palæodictyoptera and Blattoidea. Palæontologically, the insect fauna of South Wales now shows relationships with the insect faunas of the Midland and Northern coalfields, and a close approximation to forms already known from the Coal Measures of Coalbrookdale (Shropshire), the Forest of Dean, and those of Kent, while several of the Hemimylacridian forms are identical with species described by Prof. Pierre Pruvost from the Coal Measures of Pas-de-Calais (Northern France).—**A. R. Dwerryhouse** and **A. Austin Miller**: On the glaciation of Clun Forest, Radnor Forest, and some adjoining districts. The ice, derived originally from the highlands of Central Wales, filled first the depression now occupied by the valleys of the Rivers Ithon and Irfon to the west of the great line of escarpment extending from Kerry Hill on the north, by Radnor Forest and Aberedw Hill, to Mynydd Epynt on the south side of the Wye Gorge. As the ice accumulated, it first found escape by the valleys of the Severn and the Mule on the north, and by the Wye Gorge on the south. Gradually the level of the ice rose, until it overtopped the escarpment throughout its whole length, with, perhaps, the exception of the highest parts of Radnor Forest. The courses of the various glaciers thus formed are traced, and their effects on the drainage of the area are discussed.

Royal Meteorological Society, Nov. 20.—**M. G. Bennett**: The physical conditions controlling visibility through the atmosphere. Visibility of any (large) object is a function of its brightness, and its contrast with the background. When dispersed matter is introduced between the observer and object, the apparent values of these variables are modified, and thus the visibility is altered. The modification is due to: (1) Screening or absorption; (2) glare or superposition of scattered light; (3) diffusion or reduction of definition. It was deduced from this that the obscuring power of a cloud of opaque (carbon) particles was mainly due to screening, whilst that due to water drops was due to diffusion. This should result in a certain difference between the falling off of visibility as an observer recedes from an object in a dry dusty atmosphere, as compared with a humid clean atmosphere. This difference was satisfactorily verified.—**L. F. Richardson**: The reflectivity of woodland, fields, and suburbs between London and St. Albans. A record of measurements made from aeroplanes, using a white-wedge photometer.—**Thora C. Marwick**: The electric charge on rain. Thunderstorm rain showed a high positive charge per cubic centimetre. Of the total quantity observed, 94·6 per cent was positively charged. Non-thunderstorm rain showed a lower charge per cubic centimetre and a lower percentage of positively charged rain, 79·5 per cent. Hail and rain mixed showed a large excess of negatively charged drops, only 39·4 per cent of the total quantity being positive. The charge per cubic centimetre was approximately the same as for non-thunderstorm rain.

PARIS.

Academy of Sciences, Oct. 21.—**E. Fournier**: The magnetic guidance of ships. Description of some improvements in apparatus for guiding ships electrically into a port, due to W. Loth.—**A. Cotton**: The action of polarised light on certain photographic plates prepared with solutions of colloidal silver. Experimental studies on the Weigert phenomenon. Possible explanations are discussed: the hypothesis of a photoelectric effect is examined and rejected.—**E. L. Bouvier**: The classification and geographical distribution of the hemileucidian Saturnioidæ, sub-family Automeris.—**E. Mathias**: Contribution to the study of fulminating matter. The lowering of the surface tension by impurities.—**Charles Dhéré**: An arrangement permitting the compensation of the variations of the luminous intensity resulting, in the spectrum, from the mode of dispersion by the prisms.—**Eugène Slutsky**: The mean quadratic error of the coefficient of correlation in the case of series of non-independent proofs.—**E. Bompiani**: The tetrahedra invariant by projective applicability attached to the points of a surface.—**Chevalley**: The theory of ideals in infinite algebraic bodies.—**Jacques Chokhate**: The integrals of Stieltjes.—**Krawtchouk**: A generalisation of the polynomials of Hermite.—**Georges Valiron**: Meromorph algebroid functions of the second degree.—**Henri Cartan**: The differential with respect to log r of the growth function $T(r; f)$.—**Podtiaguine**: The regularity of functions with very rapid and very slow growth.—**D. Riabouchinsky**: The determination of a surface from the data that it bears.—**A. Lapresle**: A new principle for setting up large aerodynamical wind chambers.—**D. Rosenthal**: Verification of the resistance of soldered joints by an extensometric method without destruction of the coupling.—**Pauthenier** and **Mallard**: Contribution to the study of the cylindrical field in ionised air at the ordinary pressure.—**A. Kling** and **A. Lassieur**: The hydrogen exponent of water. In earlier work the authors have found a value of 5·8 for the pH of pure water: this is now confirmed by an entirely different method.—**Auguste Le Thomas**: The influence of the structure of the casting on the alterations undergone at high temperatures. The structure of cast iron has a distinct effect on the formation of graphite.—**P. Job** and **Liou Oui Tao**: The cobaltiaquopentammonic and diaquo-

tetrammonic sulphates.—**Ch. Bedel**: The catalysis of the solution of silicon in hydrofluoric acid and the influence of tempering. The presence of certain substances which may be present as impurities in silicon increase the solubility of this element in hydrofluoric acid. On the other hand, this solubility is unaffected by the change into the β and γ varieties of silicon described by Koenigsberger and Schilling.—**L. Bert and M. Anglade**: A new method of synthesis of propylbenzene, of propenylbenzene and of their homologues. The synthetic method is general and is based on an unusual reaction, that of sodium and alcohol on compounds of the type $R \cdot CH = CH - CH_2 - O - R'$, in which R is an aryl group. Instead of the reduction product expected, a mixture of the hydrocarbons $R \cdot CH_2 \cdot CH_2 \cdot CH_3$ and $R \cdot CH = CH - CH_3$ is obtained in good yield. Details are given of two examples.—**Maurice Fontaine**: The action of high pressures on the respiration of the algæ. The consumption of oxygen by the alga diminishes as the pressure is raised, a result exactly opposite to that obtained with animals.—**Aug. Chevalier**: The invasion of the mouths of the Rivers Adour and Bidassoa by *Spartina glabra*.—**Raymond-Hamet**: Sparteine and hordenine.

ROME.

Royal National Academy of the Lincei: Communications received during the vacation.—**G. Armellini**: Measurements of double stars. The results are given of measurements of 56 double stars made with the Cavignato equatorial of the Royal Campidoglio Observatory (aperture 7 inches, focal length 2·383 metres, magnification about 600 diameters).—**G. Abetti**: Altitude of the chromosphere in 1928 and course of the present solar cycle. Measurements made at Arcetri indicate a general lowering of the chromosphere from 10·3″ in 1927 to 10·2″ in 1928, whereas those made at Madrid give the same value, 10·1″, in each of these years. Favaro and Taffara's observations at Catania show a more marked lowering, namely, from 8·5″ to 7·8″. The altitude is almost constant at all latitudes and it appears that the maximum was reached in 1926, this coinciding with the maximum activity of the protuberances. The total area of the latter, measured in units of protuberance, fell by 298 from 1926 to 1927 and by 53 from 1927 to 1928. Moreover, in 1928, the secondary maximum of the areas of high latitude had quite disappeared, the other maxima being distributed irregularly in both hemispheres. Curves expressing the height of the chromosphere, the area of the protuberances, and the relative number of spots from 1921 to 1928 indicate general concordance between the three magnitudes, except that the number of spots has continued to increase up to 1928.—**Maria Pastori**: The partial derivation of tensors.—**M. Picone**: Particular formula for the solutions of a classical fourth order equation of mathematical physics with partial derivatives.—**R. Caccioppoli**: Indefinite integration.—**A. M. Bedarida**: The theory of ideals of a finite algebraic body.—**B. Segre**: Existence and dimensions of continuous systems of plane algebraic curves with given characters.—**M. Lelli**: A new experimental result on the contraction of liquid veins. An experimental arrangement is described by means of which it is possible, as was anticipated by Levi-Cività's theory, to obtain an efflux of water with a coefficient of contraction less than one-half.—**E. Gugino**: The intrinsic equations of the motion of material systems with linkages independent of the time.—**O. Belluzzi**: The behaviour of elastic segmental arches.—**A. Belluigi**: Fundamental physical characteristics of the Paduan plain.—**P. Dore**: The influence of the elasticity of the support on the duration of oscillation of two pendulums oscillating on it.—**M. Tenani**: Theoretical-experimental considerations on the course of the tides of the Adriatic Sea.—**E. Fermi**: The quantistic theory of interference fringes. On the basis of Dirac's theory of radiation, a theory is evolved of Lippmann's fringes. The method adopted is applicable generally to the treatment of any interference phenomenon, and the result arrived at coincides with that of the classical electromagnetic theory.—**W. Del Regno**: The total emissive power of bismuth.—**R. Fedele**: A comparison between the variations with the magnetic field of the Hall coefficient, the thermo-electric power, and the resistance in ordinary and compressed bismuth. Experiments with bismuth indicate that, even if the magnetic field causes structural modifications in the metal, these have no influence on the variation of the Hall effect, the thermo-electric power, and the resistance. It must, therefore, be concluded that such variations are due exclusively to purely electrodynamic actions, and that the failure of the electronic theories to explain these phenomena is to be numbered among the negative proofs of the theories.—**S. Oberto**: A supposed effect of X-rays in crystal rectifiers. The results of experiments with the Cuprox rectifier, commonly used for charging small accumulators, indicate that sparks establish a more intimate contact between the external electrode and the cuprous oxide of this rectifier, and between the point and the crystal in galena rectifiers. Hence, Jackson's experiments on the effects of ultra-violet and X-rays on the characteristics of crystal rectifiers do not fully prove, in so far as X-rays are concerned, the supposed effect of these rays.—**E. Perucca**: The sensitiveness of electrometers. A conceptual difference in behaviour between quadrant, leaf, and wire electrometers used for the measurement of very small differences of potential by the heterostatic method is pointed out.—**V. Caglioti and L. Malossi**: Double sulphates of bismuth and alkali metals (2). Double sulphates of bismuth and ammonium. Addition to concentrated bismuth nitrate solution acidified with nitric acid, of ammonium sulphate in amounts required for the 1 : 1- and 1 : 3-compound gives at 25° the latter, namely, $(NH_4)_3Bi(SO_4)_3$, in both cases. This double salt is in equilibrium with solutions containing between 25·5 and 40·36 per cent of ammonium sulphate. The compound $NH_4Bi(SO_4)_2$ may be obtained in the anhydrous form by crystallisation from solutions of bismuth nitrate and ammonium sulphate, although Lüddecke prepared it in the octahydrated state.—**G. Charrier**: Polycondensed heteronuclear systems. When applied to 2-N-phenyl-1 : 2-naphtho-1 : 2 : 3-triazolequinone, Bally's synthesis of benzanthrone from anthraquinone, which was extended to phenanthraquinone by Turski and Prabierowa, yields a compound which appears to be the 2-N-phenyltriazole analogue of benzanthrone.—**A. Bianchi**: Petrographical observations in the region of the Aurine Alps and Giant Vedrettes.—**S. Ranzi**: Experimental embryological investigations on the cyclostomes: (1) the malformations observed and the time in which they may be determined. Experiments on the ova of *Petromyzon planeri Bl.* show that, in non-fatal doses, lithium chloride never results in irreversible modification of an organ which is developing at the moment the salt acts, but may only determine modifications of processes which begin some time after the action of the salt commences.—**G. Reverberi**: Results of experiments on the development of the eye in hen's embryos.—**C. Guareschi**: Otocysts of *Anura* considered as a mosaic system. Experimental demonstration.—**R. Margaria**: The reaction-regulating power of sea-water. In view of the interest attaching to sea-water as a physiological liquid, its titration curves with dilute solutions of

alkali and strong acid have been studied. In the acid zone and in the first part of the alkaline zone, sea-water exerts but little resistance to displacement of its reaction, but from *p*H 10-11 onwards, a relatively high addition of sodium hydroxide produces but little change in the hydrogen ion concentration. The latter effect is, however, not a true buffering, but is due to the precipitation of magnesium hydroxide. At *p*H 7·4, the buffering power of sea-water is only 0·0016, whereas that of blood serum is 0·0206.—A. Galamini: Partial inanition of albino rats with olive oil, administered with or without added vitamins.—G. Finzi: Anæsotuberculin in the diagnosis of tuberculosis in comparative pathology.

Official Publications Received.

BRITISH.

Royal Society of Arts. Cantor Lectures on The Treatment of Coal, delivered before the Royal Society of Arts on Jan. 21st, 28th, and Feb. 4th, 1929, by Dr. C. H. Lander. Pp. 49. (London.) 2*s.* 6*d.*

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1249 (Ae. 400): Measurement of Lateral Derivatives on the Whirling Arm. By L. W. Bryant and Dr. A. S. Halliday. (T. 2757.) Pp. 6+10 plates. 6*d.* net. No. 1253 (M. 64): Report on some Properties of Alloys of Aluminium with Thorium and Silicon. By J. G. Grogan and T. H. Schofield. (A. 63.) Pp. 12+11 plates. 1*s.* 6*d.* net. No. 1257 (Ae. 406): Comparison of Calculated and Measured Elasticity of the Wings of an Aircraft, in connection with the Investigation of Wing Flutter. By K. T. Spencer and D. Seed. (Ft. 41.) Pp. 9+2 plates. 9*d.* net. No. 1261 (Ae. 410): Experiments on the Spinning of a Bristol Fighter Aeroplane. By K. V. Wright. (T. 2793.) Pp. 7+2 plates. 6*d.* net. No. 1244 (M. 63): The Influence of Oxygen on Corrosion Fatigue. By A. M. Binnie. (E.F. 213A.) Pp. 3+5 plates. 6*d.* net. No. 1258 (Ae. 407): Notes on the Flutter of Airscrew Blades. By E. Lynam. (Ft. 49.) Pp. 5+6 plates. 6*d.* net. No. 1263 (Ae. 412): Full Scale Determination of the Motion of an Avro Aeroplane when Stalled. By K. W. Clark and W. G. Jennings. (T. 2790.) Pp. 6+5 plates. 9*d.* net. No. 1262 (Ae. 411): The Application of the Servo Principle to Aileron Operation. By A. S. Hartshorn. (T. 2792.) Pp. 16+5 plates. 9*d.* net. (London: H.M. Stationery Office.)

Ordnance Survey. Results of the Magnetic Observations made by the Ordnance Survey in England in 1927, and Preliminary Results (Declination only) of those made in England and Wales in 1928. Pp. 7. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

County Council of the West Riding of Yorkshire. Twenty-fifth Annual Report of the Education Committee, 1928-29. Pp. 99. Handbook of the Education Committee. Part 2: Higher Education. Section 9: Regulations relating to Training of Teachers, 1930. Pp. ii+14. Section 10: Regulations relating to Scholarships and Exhibitions, 1930. Pp. iii+54. (Wakefield.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 16: On Abnormal Teeth in certain Mammals, especially in the Rabbit. By Prof. W. C. M'Intosh. Pp. 333-407. 9*s.* 6*d.* Vol. 56, Part 2, No. 17: The Metamorphic Rocks of Kintyre. By William J. McCallien. Pp. 409-436. 3*s.* 6*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

FOREIGN.

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 13: Land-Grant Colleges and Universities, Year ended June 30, 1928. By Walter J. Greenleaf. Pp. v+81. 15 cents. Bulletin, 1929, No. 25: Trends in Home-Economics Education, 1926-1928. By Emeline S. Whitcomb. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 76, Art. 5: Three New Land Shells of the Genus Oreohelix from Arizona. By William B. Marshall. (No. 2802.) Pp. 3+1 plate. (Washington, D.C.: Government Printing Office.)

Bernice P. Bishop Museum. Bulletin 65: Report of the Director for 1928. By Herbert E. Gregory. Pp. 58+3 plates. (Honolulu.)

Japanese Journal of Botany. Transactions and Abstracts. Vol. 4, No. 4. Pp. v+317-426+81-110. (Tokyo: National Research Council of Japan.)

Division of Fish and Game of California. Fish Bulletin No. 17: Sacramento-San Joaquin Salmon (*Oncorhynchus tschawytscha*) Fishery of California. By G. H. Clark. Pp. 73. (Terminal, Calif.: California State Fisheries Laboratory.)

The Rockefeller Foundation. Annual Report, 1928. Pp. xi+460. (New York City.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 7, Part 2, September. Pp. 193-388+plates 10-30. (Tokyo.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 12, No. 5, September. Pp. 227-274. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.30 yen.

The Science Reports of the Tohoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 4, No. 3. Pp. 473-576+plates 19-25. (Tokyo and Sendai: Maruzen Co., Ltd.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Suppl., Livraison 3, Septembre. Pp. 101-147. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Bulletin of the National Research Council. No. 72: Fellowships and Scholarships for Advanced Work in Science and Technology. Compiled by Callie Hull and Clarence J. West. Second edition. Pp. 154. (Washington, D.C.: National Academy of Sciences.) 1.50 dollars.

CATALOGUES.

The Cambridge Bulletin. No. 64, November. Pp. 24+8 plates. (Cambridge: At the University Press.)

Medicinal Glucose (Pure Dextrose) B.D.H. Pp. 7. (London: The British Drug Houses, Ltd.)

A Christmas Catalogue of Book Bargains. (No. 336.) Pp. 32. (Cambridge: W. Heffer and Sons, Ltd.)

"Carola" Photo-Electric Cells and Vacuum Relays. (List C. 1029.) Pp. 8. (London: Isenthal and Co., Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 29.

INSTITUTE OF CHEMISTRY (Belfast and District Section) (at Queen's University, Belfast), at 5.—R. L. Collett: The Professional Aspects of a Career in Chemistry.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—R. H. Parsons and others: Debate on The Registration of Reliable Tests of Power Plant Machinery.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. C. Freeman: Modern Welding Systems and Applications.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.—Dr. J. N. Friend: Science in Antiquity.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates Section) (at 51 West Regent Street, Glasgow), at 8.—J. W. Robertson: Two-stroke Engines: Some Experiments on a New Type.

SATURDAY, NOVEMBER 30.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (Newcastle-upon-Tyne), at 3.—F. Y. Pattern: A Few Notes on Miners' Nystagmus.—Paper open for further discussion:—Machine Mining in Faulted Ground, by A. L. Ford.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

ROYAL IRISH ACADEMY (Dublin).

MONDAY, DECEMBER 2.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Sir Ambrose Fleming: The Garden Tomb at Jerusalem: A Possible Site of the Resurrection.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. V. G. Childe: The Early Colonisation of Northern Scotland as illustrated by the Recent Discoveries in Orkney.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—C. S. Chettoe: Some Points in Reinforced Concrete Bridge Design.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (Annual General Meeting) (at London Day Training College), at 6.—Miss Lucy Fildes: Child Guidance Clinics.

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—Dr. B. P. Haigh: The Relative Safety of Mild and High Tensile Steel under Alternating and Pulsating Stresses.

INSTITUTION OF AUTOMOBILE ENGINEERS (Loughborough Graduates' Branch) (at Loughborough College), at 7.—H. G. Nicoll: Carburettors and Carburation.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—R. A. Chattock: The Modern Use of Pulverised Fuel in Power Stations.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. G. Richardson: Wind Instruments from Musical and Scientific Aspects (Cantor Lectures) (III.).

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—O. M. Tweedy: The Central African Highway.

TUESDAY, DECEMBER 3.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.

LONDON NATURAL HISTORY SOCIETY (Annual General Meeting) (at Winchester House, E.C.), at 6.30.—W. E. Glegg: The Birds of Middlesex since 1866 (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (Informal Meeting) (at North British Station Hotel, Edinburgh), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—F. Judge: The Possibilities of Night Photography.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Branch) (at Broadgate Café, Coventry), at 7.15.—P. Wheeler: Commercial Vehicle Engines.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—M. A. Phillips: British Wild Life.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—J. B. Hoblyn: Aluminium Alloys from the User's Point of View.

TELEVISION SOCIETY (at Engineers' Club), at 8.—E. G. Lewin: Television: Some Suggested Schemes.

ROYAL EMPIRE SOCIETY, at 8.30.—Sir Richard Gregory: Science and the Empire.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—A. L. Armstrong: Report of Excavations in the Cave of Bambata and at the Victoria Falls, South Rhodesia, 1929.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—W. H. Ogilvie, H. Platt, J. Verrall, and others: Discussion on Minor Injuries about the Elbow Joint.

WEDNESDAY, DECEMBER 4.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. E. Greenly: Foliation in its Relation to Folding in the Mona Complex at Rhoscolyn (Anglesey).—H. P. Lewis: The Avonian Succession in the South of the Isle of Man.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—G. Shearing and Capt. J. W. S. Dorling: Naval Wireless Telegraphy Communications.
INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—G. Crift: Coke Carbonisation and Bye-Products.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 29 Hart Street, W.C.1), at 7.—R. C. Ching: Costing Methods for Heating Engineers.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—R. Munton: Pulverised Fuel: Past and Future.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Metropole Hotel, Leeds), at 7.30.—A. Healey: The Pneumatic Tire in Heavy Transport.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Prof. A. P. Laurie: The Methods of Examining Pictures (Lecture).—R. L. Andrew: The Determination of Minute Amounts of Iodine in Soils and Waters.—Dr. S. Glasstone and J. C. Speakman: The Quantitative Analysis of Mixtures of Nickel and Cobalt.
ROYAL SOCIETY OF ARTS, at 8.—H. H. Peach: The Advertiser and the Disfigurement of Town and Countryside: Criticisms and Suggestions.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Pathological Evening.
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Derby Technical College).—Lt.-Col. H. E. O'Brien: Electric Traction.
ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 4.30.—F. L. Arnot: Electron Scattering in Mercury Vapour.—F. A. B. Ward, C. E. Wynn-Williams, and H. M. Cave: The Rate of Emission of Alpha Particles from Radium.—Dr. E. J. Williams and F. R. Terroux: Investigation of the Passage of Fast Beta Particles through Gases.—*To be read in title only*:—E. P. Perman and W. D. Urry: The Compressibility of Aqueous Solutions.—R. J. C. Howland: On the Stresses in the Neighbourhood of a Circular Hole in a Strip under Tension.—G. S. Adair: The Thermodynamic Analysis of the Observed Osmotic Pressures of Protein Salts in Solutions of Finite Concentration.—E. B. R. Prideaux and F. O. Howitt: The Electrophoresis of Protein Sols in the Presence of Gold Sols—Albumen Gelatin and Casein.—S. Bhagavantam: The Magnetic and Optical Properties of the Benzene Ring in Aromatic Compounds.—E. C. Watson and J. A. Van den Akker: Differences in the Directions of Ejection of X-Ray Photo-Electrons from Various Atomic Levels.—Prof. C. R. Goldsbrough and D. C. Colborne: The Tides in Oceans on a Rotating Globe. III.—A. M. Mosharrafa: Wave Mechanics and the Dual Aspect of Matter and Radiation.—Dr. H. T. Flint: On the Determination of the Range of Frequencies within the Group of Mechanical Waves of an Electron.—Dr. H. Spencer-Jones: The Light of the Night Sky: Analysis of Intensity Variations Observed at the Cape, at Canberra, and in England.
LINNEAN SOCIETY OF LONDON, at 5.—Mrs. E. S. Grubb: The Biological Station of Alto da Serra, Sao Paulo, Brazil.—Continuation of the Discussion of the Proposed Introduction of Black Buck into Ceylon.
PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir Israel Gollancz: Problems in the Alliterative Poems.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. C. W. Saleeby: Sunlight and the Child.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. H. Norinder: Surges and Over-Voltage Phenomena on Transmission Lines due to Lightning and Switching Disturbances.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30—J. de la Cierva: Recent Work on the Autogiro.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.30.—H. M. Stanley: Petroleum and Petroleum Gases in Chemical Raw Materials.
CHEMICAL SOCIETY, at 8.—U. R. Evans and J. Stockdale: Passivity of Metals. Part III. The Quantity and Distribution of the Superficial Oxide.—H. Baines: The Argentothiosulphuric Acids and their Derivatives. Part I. The Preparation of the Sodium Salts and the Isolation of Monoargentomonothiosulphuric Acid.—Prof. W. N. Haworth and C. R. Porter: (*a*) Sugar Carbonates. Part IV. The Dicarbonates of Glucose, Fructose, Mannose, Galactose, and Arabinose; (*b*) Isolation of Crystalline α- and β-ethylglucofuranosides (γ-ethylglucosides) and other Crystalline Derivatives of Glucofuranose.
C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—Debate on Birth Control. M. I. Finucane, opposing; Dr. Marie Stopes, defending.

FRIDAY, DECEMBER 6.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—J. P. Davidson: The Manufacture of Tobacco.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne), at 6.—Prof. Dempster Smith: Cutting Capabilities of Lathe Tools.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Section of Institution of Rubber Industry) (at Engineers' Club, Manchester), at 7.—H. C. Young: The Common Factors of Technical and Works Controls in the Rubber and Chemical Industries.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—Dr. C. V. Drysdale: Alternating-Current Potentiometers and their Applications.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—W. A. Tookey and others: Diesel Engine Developments.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Bairstow and others: Discussion on How can the Pictorial Group best help the would-be Pictorialist?
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—A. B. Gowring: The Demolition of Lambeth Bridge.
GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—The Great Barrier Reefs and the Queensland Coast: a Geographical Reconnaissance (Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Hugh Walpole: The Novel and the Creative Spirit.

SATURDAY, DECEMBER 7.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District) (at Exeter), at 3.—Lieut.-Col. E. J. Stead: The Local Government Act, 1929.
GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—W. H. Spreadbury: Some Birds of London's Country.
MINING INSTITUTE OF SCOTLAND (at Glasgow).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 29.

COLLEGE OF MEDICINE (Newcastle-upon-Tyne), at 8.—Prof. A. E. Boycott: The Causes of Cancer (Chadwick Lecture).

SATURDAY, NOVEMBER 30.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Hydra in Fact and Fiction.

MONDAY, DECEMBER 2.

ROYAL COLLEGE OF SURGEONS, at 4.—F. W. Twort: The Relation of Pathogenic to Saprophytic Micro-organisms. (Succeeding Lectures on Dec. 4, 6, 9, and 11.)
LONDON SCHOOL OF ECONOMICS, at 4.30.—E. H. Warmington: The Debt of Medieval Explorers to Ancient Discoverers (3): The Exploration of Eastern Waters to China. Unknown Southern Continents.

TUESDAY, DECEMBER 3.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Prof. A. W. Ashby: Changes in Prices of Farm Produce and their Causes.
UNIVERSITY OF LEEDS, at 8.—Prof. J. W. McLeod: Immunity.
INNER TEMPLE HALL, at 8.15.—Dr. W. A. Robson: Public Health Law and Administration introduced by the Local Government Act, 1929 (Chadwick Lecture).

WEDNESDAY, DECEMBER 4.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. A. C. Jordan: Dress in Relation to Health and Disease.

THURSDAY, DECEMBER 5.

ROYAL SOCIETY OF MEDICINE, at 5.—Prof. H. P. Mosher: The Lower End of the Esophagus at Birth and in the Adult (Semon Lecture).

SATURDAY, DECEMBER 7.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—Prof. H. Levy: Dimensional Theory as a School Subject (Presidential Address).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: British Wild Life off the Beaten Tracks.

EXHIBITION, ETC.

DECEMBER 4, 5, AND 6.

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY (at Central Hall, Westminster).

Wednesday, Dec. 4, at 2.30.—Official opening of Exhibition by The Rt. Hon. Arthur Greenwood.

At 3.15.—Prof. Gösta Forssell: Radiotherapy of Malignant Tumours in Sweden (Mackenzie Davidson Memorial Lecture).

At 8.45 (at 32 Welbeck Street).—Dr. G. B. Batten and others: Discussion on The Requirements of Clinicians from Radiologists and *vice versa*.

Thursday, Dec. 5, 10.30 A.M. to 12.30 P.M.—Discussion on Aspects of Radiation Therapy.

At 2.30.—Prof. F. L. Hopwood and Miss F. E. Smallman: The Use and Abuse of Radium Needles.

At 6.—Prof. A. S. Eddington: X-rays in the Stars (Silvanus Thompson Memorial Lecture).

Friday, Dec. 6, 10.30 A.M. to 12.30 P.M.—W. E. Schall: A Single Valve Plant for Diagnosis and Deep Therapy.—Cuthbert Andrews: A Mobile X-ray Unit.—Dr. Ffrangcon Roberts: Modern Radiological Developments in Germany with Special Reference to the New Institute at Frankfurt.—Dr. A. Orliansky: Output of Transformers under Different Methods of High Tension Rectification.—W. R. Gray: A Hot Cathode Tube with Rotating Anode.—Dr. E. J. H. Roth: The Mekapion, an Ionisation Apparatus for the Absolute Measurement of X-ray Dose.

At 2.30.—Miss S. F. Cox and F. G. Spear: Tissue Culture and its Application to Radiological Problems.—Miss S. F. Cox: The Action of X-rays on Living Cells Cultivated *in vitro*.—Dr. F. G. Spear: The Immediate and Delayed Effects of Radium on Tissues Cultivated *in vitro*.

CONFERENCE.

DECEMBER 5 AND 6.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—Vapour Absorption and Adsorption.

Thursday, Dec. 5, at 10.30 A.M.—Prof. J. C. Philip: The Reversibility of the Adsorption Process and the Thickness of the Adsorption Layer.—Dr. W. R. Ormandy: The Recovery of Acetone Vapours from the Air.

At 2.30.—H. Hollings, Dr. S. Pexton, and Dr. R. Chaplin: The Recovery of Benzol from Coal Gas, with Special Reference to the Use of Activated Carbon.—H. W. Webb: The Absorption of Nitrous Gases.

Friday, Dec. 6, at 10.30 A.M.—A. Hoch: The Recovery of Volatile Solvents (Brégeat Process).—J. S. Morgan: The Continuous Fractionation of Gases by Adsorbents.

At 2.30.—G. W. Himus: Evaporation of Water in Open Pans.—K. Evans and H. F. Pearson: The Industrial Application of Active Carbon.