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State Research in Chemistry.

IF Prof. G. T. Morgan's presidential address to the Chemistry Section of the British Association, at the recent meeting at Bristol, was not of the kind that provides arresting headlines for the daily Press, the reason is to be sought rather in deliberate choice of treatment than in lack of material, for we live in times—to many of us it still seems strangely novel—when State experiments and chemical research are both regarded as good copy, and fair game for the alliterative caption. The British Association exists primarily for the advancement of science as an element of culture; the addresses are designed to provide a bridge between the minds of two groups of thoughtful people, of whom one group is formed of pioneers engaged in the search for a particular kind of knowledge, whilst the other includes those similarly engaged elsewhere, as well as members of the general public who are interested to know something of the habits of this thing called scientific research which seems to touch their lives at every turn.

Instead of providing a critical survey of selected problems or an account of experimental advance along some well-defined path, Prof. Morgan offered a contribution to the study—in which, from various points of view, every member of his audience could participate—of a certain phenomenon, namely, the application, under the direct control of the State, of centralised and co-ordinated team-work to promote the more rapid advance of a science. Just as in the early stages of an investigation into natural effects it is most appropriate to record observations with accuracy and to determine what relations exist between the new and the old, so in this instance it was appropriate that the director of the Chemical Research Laboratory should avoid prophecy and special advocacy, but should confine his address chiefly to statements of fact and observations. His address forms a valuable basis to which, as time passes, there will be added the results of experience and of thoughtful suggestion and criticism; we of strong faith in the great future which lies in the path of this still new adventure welcome the convincing proof of vitality with its promise of robust growth.

The national value of such research as is being carried on at Teddington is, of course, no longer in question; no longer—in the abstract, at any rate—is it even ignored. Should it be asked how distinctively *national* in its significance is the technical work performed there, the reply might quote an example of the highest importance offered by the

studies on low temperature tar. The abatement of the smoke nuisance has long been a matter of popular discussion, but complaints have for the most part 'ended in smoke', so indissolubly wedded is the Briton to the coal fire which turns his house into a home. The new process of low temperature carbonisation of coal has at length given him a fuel which, while preserving his domestic amenities, contributes in no small measure to a solution of the problem of diminishing atmospheric pollution. If the price of this smokeless fuel could be made more attractive, there is no doubt that its use would quickly become widespread, and in time perhaps universal, to the great content of the guardians of the public health and to the convenience of aeronauts and astronomers. The price of the fuel depends not only on the output but also on the opportunities which exist for the exploitation of the by-products—aqueous liquor and tar. Now this tar differs markedly in its composition and characteristics from that hitherto produced, and its exhaustive examination, necessarily the first step in its exploitation, is pioneering work of first importance. It is self-evident that such an investigation is not only one which will be lengthy and will demand co-operative effort in a high degree, but also one which when developed along industrial lines can scarcely fail to lead to definite economic advantage, no less than to noteworthy contributions to chemical and possibly geological science.

It would be difficult at the present stage to estimate the full extent of the advantage to be anticipated from the development of low temperature carbonisation; it is sufficient to indicate that a general stimulation of industry following the return of coal to its former economic status is not to be excluded from view. Apart, however, from such mundane, if vital, considerations, is the impetus which the work will give to the world-wide advance of organic chemistry by providing (as did that on its elder brother, 'coal tar') starting-points for synthesis and relationships for elucidation. Already the presence of a substantial proportion of pyrocatechol has been demonstrated, a coloured hydrocarbon has been separated, and it has been observed that, speaking generally, the products tend to be the methyl derivatives of their high temperature tar analogues.

Surely no better example of the unreality of division of chemistry into 'pure' and 'applied' sciences is needed. Application can never precede discovery but often promotes it; and leaders of the chemical profession, whether their outlook be from a chair or from a board room, see the same fundamental knowledge supporting their endeavours and the same fundamental difficulties obstructing them. Work of this calibre can be represented in the museum of the laboratory only by a few shelves of bottles and specimens; their neighbours are no less significant in their relation to the development of a science, for they are early examples of pure substances which have been prepared by simplified processes rendered possible by the application of moderate pressure, whilst the series of primary alcohols (including ethyl), aldehydes, and acids derived from the catalytic interaction of carbon monoxide and hydrogen, offers both an intriguing contribution to the study of catalysis and a material success capable of industrial expansion. Each glass case that is opened discloses the steady progress of pioneering exploration—where practice has outrun perception, as with synthetic resins; where the engineer has solved problems of a new technique (our thoughts return to the first air-pump and its contribution to chemical advance); in the new iatro-chemistry, where therapy and the 'architecture of molecules' move forward with mutual aid, not disdaining to strew their path with substances of curious behaviour and with incidental contributions to the study of valency. So essentially practical a matter as the corrosion of metals is not without its surprises and its puzzles; who would have thought that the green patina on copper roofs is not verdigris but basic copper sulphate eventually corresponding in composition with the mineral brochantite? And why does iron not rust so quickly when confined in a muslin cage as when not so confined?

This is the type of work which engages the attention of a staff of twenty-five chemists and thirty-two others, housed in a building adjacent to the National Physical Laboratory, and it is fully worthy of the attention of a State organisation. Like the German Reichsanstalt, the Chemical Research Laboratory owes its parentage to conditions evolved from war, although the former institution has now arrived at years of maturity. Neither can the Laboratory claim seniority in Great Britain as a public institution devoted to the prosecution of scientific research and its application to industrial needs, for its immediate neighbour has during the past thirty years discharged that duty. An essential difference in the nature of the work undertaken by the two institutions is to be found in the fact that whilst that of the Chemical Research Laboratory consists exclusively of original research, that of the National Physical Laboratory

includes testing, and hence provides substantial opportunities for fee-earning. That this should be so does not, of course, detract *ipso facto* in any way from the quality of the research carried on concurrently with the routine testing, which constitutes an essential public service. Nevertheless, it was doubtless wise not to burden a chemical laboratory, created specifically for exploration, with duties of a like nature. Should the usual facilities for obtaining such service prove inadequate or non-existent, there would presumably be little technical difficulty associated with a modification of the present policy.

We have already remarked that the Chemical Research Laboratory is the home of centralised and co-ordinated team-work. The unit is not the individual worker, whose efforts are likely to be discounted—not always by his own fault—through lack of adequate co-operation with others, but the 'working party'. As a coherent team the working party receives from the director its mandate to operate in a certain field; as a team it collects information and gathers experience. Not least among the national services rendered by the Laboratory must be counted the training, both in method and in spirit, of leaders in chemical research, particularly of those who will carry the habit of co-operation with them into the industrial world. It must not be forgotten that such 'key' problems as have been entrusted to the Laboratory require for their solution not only skill, knowledge, and strategy of a high order, but also substantial resources, expanding facilities, and the application of sustained forces.

Prof. Morgan refers to the undertaking as "a State experiment"; it is from one point of view an experiment, but not one of the result of which there need be much doubt. When Francis Bacon gave his opinion that States should not try experiments, he added the qualification "except the necessity be urgent or the utility evident", advising that it would be "well to beware that it be the reformation that draweth on the change, and not the desire of change that pretendeth the reformation". Reformation in our national attitude towards research (particularly chemical research, in which the material returns are often subject to but little delay) and towards chemical industry there has indeed been, and changes in our institutions have occurred in consequence—all too slowly and timidly, as some think who should be in a position to judge. These harbour no doubts concerning the utility or the urgency of the necessity. There may, of course, still be those who regard the 'experiment' as a novelty to be suspect; merely an innovation in tune with modern custom, a fashionable enterprise of which some indefinite good may come. Others, and we may hope the majority, see in it an effective new tool at the service of an industrial nation; some indeed, perhaps those who most clearly read the signs of the times, think of such a development as this in terms of future employment, of the standard of living, and of human happiness and well-being. *Scientia imperii decus et tutamen.*

Kepler's Letters.

Johannes Kepler in seinen Briefen. Herausgegeben von Max Caspar und Walther von Dyck. 2 Bände. Band 1. Pp. xxviii+396. Band 2. Pp. xvi+348. (München und Berlin: R. Oldenbourg, 1930.) 20 gold marks.

THE present year is the three-hundredth anniversary of the death of Kepler. The volumes before us mark the occasion. All that remains of Kepler, and it is a great deal, is already available in Frisch's edition. But Frisch is frankly unreadable. He had all the faults that sometimes accompany German thoroughness. In particular, as the editors of the volumes now before us remark, the letters come off very badly, being cut up and distributed here and there according to the subject treated of.

Max Caspar and Walther von Dyck have prepared a book for German readers which has the intention of bringing the man rather than the scientific ideas of three centuries ago before us; in fact, many of the scientific passages are omitted or compressed. Kepler's life was passed in evil times. A great deal of it was passed in penury and family distress. The counter-Reformation, with the vindictiveness of those who had come back to what they regarded as their own, framed the early part. When he went to the service of the Emperor Rudolph in Austria, an endless war with the Turk surged on the confines of the country and crippled civilised efforts. The Thirty Years' War wrapped the end in spectral gloom—though by that time Kepler himself was very tough. Messrs. von Dyck think that the present times are evil times, too, and that these letters will fortify Germans and do them good. The letters are a selection of those by Kepler and to him. They exist mostly in Latin, and these have been translated and make pretty easy reading, very different from those in the German of his time, where prolixity, long involved sentences, bad spelling, and the exasperating

practice of mixing Latin phrases with his vernacular make heavy going.

The book is a scholarly book and well done, though not intended as a prime authority. It is meant for current reading and has only a brief index. It includes a bibliography of sources where originals may be found, though each letter is not ascribed to its source. It includes also a brief list of dates and facts for all the persons referred to, and a certain number of portraits and other illustrations, well reproduced from interesting originals.

Taking the book, then, as we are meant to take it, what impression do we form of Kepler? Certainly the editors have banished a good deal of fog, but what we see is still not clear. Kepler was not one of those men of genius who can turn each matter that they touch into gold for all time by a single phrase. One reads his letters about religion, and of the refusal of the sacrament to him, and again of how he declines the proposal of his friend the Jesuit Guldin that he should join the Church of Rome, only to be led deeper and deeper into details that are long since dead and better forgotten. The same is true of the letters dealing with the case when some spiteful neighbour prosecuted his mother for witchcraft, and although the charge seems to have been entirely baseless, actually succeeded in spinning it out from year to year and incarcerating the old lady and threatening her with torture, in spite of Kepler's many letters to the Grand Duke of Württemberg urging that it should be brought to an issue. Perhaps of necessity they are detail, detail, detail.

Be that as it may, it is to be feared that Kepler, before he discovered Kepler's Laws and became famous, must have seemed, to those of his contemporaries who had enough contrivance to dodge the lesser troubles of this world, a formidable bore, always in poverty and domestic embarrassment, an able man without a spark of humour, writing immense letters about himself or any other subject, ticking off each with level emphasis and immense prolixity of detail. He had an unhappy life. Perhaps he expected people to have unhappy lives. He mentions the burning of Giordano Bruno, and that he was said to have shown a firm face in his trials, but expresses no horror of the deed. One of the portraits of him shows a face of fearful intensity, and energy, and frustration. It was not his fault that the world ill-treated him. The Emperor Rudolph II. wrote a rescript to his treasury to pay his pension, and the treasury did not pay it. His wife's relatives disapproved of his marriage and did not pay. Still, what have we to do with all that? He is dead long since, and we have our own bothers, of which he knew nothing.

There are, however, other personal features in Kepler's story that one would read these letters very ill if one did not see. There was no subtlety in Kepler. Fate bludgeoned him, but he did not bow his head. *Hier steh' ich, ich kann nicht anders*, might have been said by him, if he had had any instinct for a vital phrase. He sent Galileo his book "Mysterium Cosmographicum", and Galileo replied politely with guarded words—this was thirteen years before he used a telescope—that perhaps he believed the Copernican theory more than circumstances allowed him to say. Kepler answered with the insistence of a man who sees one truth and sees it only. He had the kind of courage that a bull has—he made straight for his object. Besides that, he had a warm and generous heart. He cherished his old and true friends, and he had some, though they were not able to help him much. The great event of his life was his meeting with Tycho Brahe. Tycho, when established under the protection of Rudolph, after his exile from Denmark, asked Kepler to be his guest. Kepler went, and stayed with him for six months; and Tycho, like the great gentleman he was, placed his castle and family and servants, as well as his scientific stores, at Kepler's service. In the end something went wrong, and Kepler lost his temper and behaved outrageously; and there is a letter, full of noble remorse, to Tycho, taking all the blame. Tycho again behaved like a great gentleman and bore no grudge; and from that association we have the planetary laws, and how much more that is later history.

Kepler's scientific ideas do not really enter into these volumes, but they cannot be kept out. If the essence of mathematics is form, he had no mathematical genius. Number was what interested him. He had an intense conviction that the secret relations of things would be found in the relations of number. It led him elaborately astray twice—in relating the musical intervals with the distances of the planets, and in relating the latter with the dimensions of the five regular solids. Only later was his persistence in calculating rewarded in finding the planetary laws.

Great pains and labour must have gone in producing this book, and the editors have made the circle that is interested in such things their debtors by rendering the material so available. It is to be hoped that that circle will not be a small one.

R. A. S.

The South Atlantic Islands.

British Museum (Natural History). Report on the Geological Collections made during the Voyage of the Quest *on the Shackleton-Rowett Expedition to the South Atlantic and Weddell Sea in 1921–1922.* Pp. ix + 161 + 3 plates. (London: British Museum (Natural History), 1930.) 12*s.* 6*d.*

THE voyage of the *Quest* in 1921–22, in spite of the change of plans after the tragic death of Sir Ernest Shackleton, has thrown important light on the geology of the South Atlantic islands owing to the energy of the geologist, Mr. G. Vibert Douglas, and the use that has been made of his collections by Mr. Campbell Smith. The specimens were presented by Mr. Rowett to the Mineral Department of the British Museum (Natural History), and an authoritative account of them, with several new analyses, has been prepared by Mr. Campbell Smith and other experts.

The volume includes twelve reports, including descriptions by Mr. Vibert Douglas of South Georgia and Tristan da Cunha and an account, in conjunction with Mr. Campbell Smith, of the rocks of Zavodovskii Island and of rock fragments, sedimentary, metamorphic, and plutonic, dredged from the Weddell Sea. Mr. Campbell Smith, the editor of the volume, describes the petrography of Tristan da Cunha, Gough Island, St. Helena, and Ascension; Dr. G. W. Tyrrell, the geology and petrography of South Georgia; Mr. G. H. Part, the rocks of St. Vincent; Dr. H. S. Washington, those of the St. Paul's Rocks; Dr. C. E. Tilley, the basalts of Elephant Island, South Shetlands; Miss A. Vibert Douglas, the deep-sea deposits, and Prof. Gordon, fossil wood from South Georgia.

The contributions which throw most light on the history of the South Atlantic are those on South Georgia, regarding which there are two theories. Suess interpreted the island as a fragment of an arc that once connected the main Andean chain with its extension in Grahamland. This view is supported by the claims that South Georgia consists of a series of overfolded and faulted Mesozoic rocks and that its igneous rocks are represented in the Andes of the Argentine. According to the alternative view, which is based mainly on the observations and collections of Mr. D. Ferguson, South Georgia is a remnant of an old South Atlantic land and the connexion of the Andes and Grahamland passed to the west of it. This view rests on the conclusions that South Georgia consists of three series of rocks, of which one is Lower Palæozoic, the second Mesozoic, and the third includes igneous rocks of the Atlantic type, which are also found in the pre-Andean foundation of Argentina, while the typical Andean igneous rocks are unknown in South Georgia.

The new evidence is consistent with the latter theory. The only new fossil found is a piece of fossil wood; it is referred to that indefinite genus *Dadoxylon* (*Araucarioxylon*), by Prof. Gordon, who regards its age as more likely to be Mesozoic than Palæozoic. This identification is consistent with the age assigned to the Upper and Middle parts of the Cumberland Bay Series. The claim that the whole of the sedimentary rocks belong to one Mesozoic series is not supported either by Mr. Douglas, who argues in favour of the separation of the two sedimentary series by an unconformity, or by Dr. Tyrrell, who points out the difference in composition between the older and newer sediments. The main change that seems not unlikely in Ferguson's classification is that the beds which yielded his older fossils may be more closely associated with the underlying Cape George Harbour series than with the Cumberland Bay series as now restricted by Dr. Tyrrell.

The structure and relations of South Georgia can only be settled by the collection of more fossils, which will establish horizons which are at present provisional. Fortunately, further fossils have been discovered by Dr. Holtedahl and are being investigated by Prof. Wilckens. It is to be hoped that these fossils will solve the South Georgia problem.

The contribution to the petrography of the St. Paul's Rocks, by Dr. H. S. Washington, has also an important bearing upon the history of the South Atlantic. He shows that the rock is a wehrlite-dunite, which has undergone change by pressure, and includes such characteristic metamorphic mineral species as jadeite and actinolite. Dr. Washington nevertheless hesitated before accepting the rock as non-volcanic because of its geographic position, and he considers the possibility of its being a submarine lava. He concludes, however (p. 134), that "the rock is almost undoubtedly metamorphosed or shows signs of pressure"; also (p. 136) that jadeite "is generally regarded as being characteristically, if not exclusively, of metamorphic origin". He concludes, "if it were not known whence the specimens came, the microtexture, with the mineral and chemical composition, would lead unhesitatingly to the belief that the rock is a somewhat metamorphosed peridotite, and probably of plutonic origin"; and he considers that the St. Paul's Rocks are part of the Atlantic floor that has been upraised to the surface, and that the wehrlite block found by Daly at Ascension indicates that that island also stands on a continental basis. J. W. G.

Dietetics.

(1) *A Laboratory Handbook for Dietetics.* By Prof. Mary Swartz Rose. Third edition. Pp. xiv + 269. (New York: The Macmillan Co., 1929.) 12*s.* 6*d.* net.

(2) *Food Values in Practice: Simple Guidance in Diet Planning and Cookery.* By Ethel M. Dobbs. Pp. xvi + 240. (London: University of London Press, Ltd., 1929.) 4*s.* net.

(3) *Properties of Food: a Practical Text-Book for Teachers of Domestic Science.* By W. M. Clifford and Prof. W. H. Mottram. Pp. 128. (London: University of London Press, Ltd., 1929.). 2*s.* 6*d.*

(4) *Food, Health, Vitamins.* Being a new edition of "Food and Health". By Prof. R. H. A. Plimmer and Violet G. Plimmer. New edition. Pp. viii + 120. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 3*s.*; paper, 2*s.*

THE importance of a proper diet for healthy living is now well realised by medical men and health workers, but is not always appreciated by the general population; even with such knowledge, the devising of a suitable dietary within the means of the more poorly paid members of the community is not always easy. Again, it is essential nowadays that all those responsible for feeding the inmates of institutions, hospitals, schools, etc., should arrange their diets on scientific principles. To supply dieticians and others interested with the requisite knowledge, numbers of manuals have been written, varying from the scientific treatise on nutrition to the primer suitable for the lay reader. Several such works have been published in recent years, covering a part of this possible range in depth of scientific knowledge, and four are now before us.

(1) Dr. Rose's handbook is intended for the dietician and provides the information necessary for the planning of dietaries for people of different ages and either sex. A brief account of the composition and uses of foods is followed by examples of the methods of calculating the food requirements and specimen dietaries. Height-weight-age tables are supplied, and, forming the bulk of the book, tables of the composition, including calorie value, of all the common foodstuffs.

(2) Dr. Dobbs's book covers part of the same ground, but in a more elementary manner; it is intended for the enlightened housewife and health worker rather than the dietician. Simple dietary calculations are included; methods of cooking are described in detail; nearly half the book is devoted to recipes for dishes suitable for the normal household, in fever and convalescence, in pregnancy, and for the constipated, the fat and the thin.

(3) Dr. Clifford and Prof. Mottram have written their little book for teachers of domestic science; simple chemical tests for the different foodstuffs are described, special attention being devoted to the demonstration of the properties of foods with only the minimum of chemical apparatus. Experiments are given to show how food is digested and what happens to it when it is cooked, and a chapter is devoted to the calculation of calorie and other values of food from tables. The chemical tests described show no little ingenuity and can be carried out by anyone possessed of only an elementary knowledge of chemistry.

(4) Prof. and Mrs. Plimmer's book has now reached its fourth edition; its outlook is different from that of those previously referred to, since the necessity for an adequate vitamin intake is especially emphasised. At the same time, the essentials of a complete dietary are fully described and two simple balanced diets at minimum cost are given; an extra chapter on diet in special cases has been added. The fact that four editions have appeared in five years indicates that this small work fulfils a real want; and opportunity is taken to bring the text up-to-date, since the subject dealt with is one in which our knowledge is advancing rapidly in many directions.

Experiments on Atomic Physics.

Electron Physics. By Dr. J. Barton Hoag. Pp. ix + 208. (London: Chapman and Hall, Ltd., 1930.) 15*s.* net.

THIS book is an account of a laboratory course on modern physics which has been developed by the author and Prof. A. J. Dempster at the University of Chicago. The experiments to be performed are twenty-three in number, nine of which illustrate properties of radioactive bodies, and the remainder properties of electrons and ions, and some of their applications. With each group of experiments there is an up-to-date summary of the theory and standard results of that branch of the subject. There are three excellent appendices on vacuum technique, and two on the use of electrometers and electroscopes, a collection of problems, and some tables of atomic constants.

Most of the experiments described are familiar, but several will be new to many teaching laboratories, in particular the determination of the charge of an electron by the oil-drop method, the use of

the photoelectric cell, and two methods for finding the ratio of charge to mass for an electron by magnetic bending of cathode rays. The general standard is such that the book could also quite well have contained the measurement of e/m for an electron by the Zeeman effect, the use of an X-ray spectrometer, and the photography of trails of ionising particles with a Wilson cloud chamber.

In a sense, however, the actual contents are only of secondary importance. The publication of a book of this type is in itself effectively a statement that it is just as desirable, and possible, for students to carry out a connected set of experiments on the properties of atoms and electrons, as it is for them to do experiments in sound, or heat, or geometrical optics, or in any of the better established branches of physics. After all, to advance no other arguments, this newer work bears very closely on everyday life, and the equipment required to teach it is not in the end more elaborate than much in current use. The main difficulty comes in deciding what is to be thrown out to make room for it in a course necessarily limited to, say, three years.

On one important point the judgment of the author may be challenged. He states in his preface that "The book has been prepared for the student who has had one year of college physics or its equivalent". Experience in English laboratories suggests that work of this type might not be appreciated by a student in his second year, and that he would quite possibly fail to grasp the significance of what he was doing; in his final year, however, it would be of the utmost value. K. G. E.

History of Determinants.

Contributions to the History of Determinants, 1900–1920. By Sir Thomas Muir. Pp. xxiv+408. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 30*s*. net.

IT is almost exactly half a century since a forty-page "List of Writings on Determinants", compiled by Thomas Muir, was published in the *Quarterly Journal of Mathematics*, marking the inception of an attempt to provide a complete history of determinants, up to 1900 if possible. How the attempt was crowned with success forty-two years later, by the publication of vol. 4 in 1923, is common knowledge. The work we now review goes beyond the original intention; when supplemented by several extraneous articles cited, in the *Proc. Roy. Soc. Edin.* and the *Trans. Roy. Soc. S. Africa*, it constitutes vol. 5 and brings the history up to yesterday.

In a characteristically unassuming preface Sir Thomas briefly alludes to the vicissitudes his self-imposed 'contract' underwent, and it needs but slight imagination to amplify his modest understatements and to conceive the real seriousness of the hindrances encountered: the absorption in administrative educational work in South Africa, the remoteness of European reference libraries, the perturbations of two wars. By 1915 the work had been brought only as far as vol. 2, and retirement at that date from the position of Superintendent-General of Education meant for the author, at seventy years of age, no tranquil retrospect but rather intensified activity. The achievement of the last fifteen years, with its fruit, vols. 3, 4, and 5, indicates a sustained vitality which evokes astonished admiration.

The present book is not so large as vol. 4, since eight chapters, each self-complete, are excluded and referred to separately, as we have mentioned. The sources quoted for these are, of course, readily accessible to all workers; and the restriction brings the book down to a convenient size for handling. The printing, on smooth white paper, is beautiful; and a scrutiny of hundreds of formulæ failed to disclose a single fault.

Concerning the arrangement, subjects, and style, little can be said which has not already been handsomely said by reviewers of earlier volumes. The various heads—determinants in general, axisymmetric, alternant, compound, and so on—fall under review in the self-contained chapters and sequence we now expect. The style has Roman qualities of solidity, clarity, and conciseness, and the comments are as impartial and as illuminating as ever; a typical example is the summary (pp. 187-190) of a paper by Giambelli. The extent of the author's own personal contributions during the period may be gauged by the number of papers against his name in the index, 109, as compared with 108 in vol. 4.

A feature of outstanding value is the concluding 36-page subject-index of all five volumes. The inclusion of this cannot be too highly commended. With such wealth of reference as this provides, it is no longer, surely, a venial offence for writers to publish rediscoveries, as has so often happened before.

Nothing remains but to congratulate the distinguished author on these latest rewards of his long tenacity. The work is classic; if there exists anywhere a more detailed and comprehensive history of any branch of theoretical knowledge, one would be interested to hear of it. Yet one hesitates to use phrases like "the culmination of the work of a lifetime"; the energetic author is only eighty-six, and may yet bring it up to 1930! A. C. A.

Our Bookshelf.

The Scientific Achievements of Sir Humphry Davy. By Joshua C. Gregory. Pp. viii + 144. (London: Oxford University Press, 1930.) 6*s*. net.

IT is always interesting to attempt to trace the origin of scientific work, and although the results are liable to error, they provide a key to much that otherwise would be obscure. In this book Mr. Gregory has tried to show how many of Davy's researches and speculations may have had some relation to the scientific knowledge of his day, and in this way the progress of Davy's work is seen to follow a course which makes it more intelligible to us at the present time. The book is more concerned with the scientific achievements than with the personal character of the great chemist, and although Mr. Gregory writes sympathetically, he has not raised some of the questions which have perhaps received too much attention in the past. Davy suffered by too much success on his own part and from too much sensitiveness on the part of others.

Apart from giving an excellent and clear account of Davy's researches, the book provides a useful picture of the state of chemistry in general at the beginning of the nineteenth century, when the theory of phlogiston still lingered in the minds of chemists even after they had been forced by experimental facts to abandon it as a working hypothesis. The new instrument of research, the voltaic pile, had just come into being, and in Davy's hands it opened a splendid chapter in the great story of chemistry. The relations between Davy and Dalton are discussed in an interesting manner, and the strange reluctance of Davy to use the hypothesis of atoms, a reluctance shared to the full by Faraday, is mentioned. At the same time, Davy was able to arrive at the correct formula for water, H_2O, whilst Dalton remained faithful to the simple HO which served chemists for so many years afterwards.

Mr. Gregory's book is one which can be recommended. It is not too long, but it contains a large amount of interesting materials. It is a pity that the appearance of the text has often been spoiled by the use of large capitals in the equations.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 4: *Hydro- und Aero-Dynamik.* Teil 3: *Technische Anwendungen.* Herausgegeben von Ludwig Schiller. Bearbeitet von O. v. Eberhard, R. Emden, O. Flachsbart, W. Gaede, L. Hopf, F. Horn, W. Klemperer, W. Spannhake. Pp. x + 557. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 55 gold marks.

IN this survey of the technique of hydro- and aero-dynamics, the editor has succeeded in attracting to his service a strong body of experts, who bring to it a long and intensive experience of their subject. The section on model ship tests is written by F. Horn, balloons by R. Emden, airship tests by W. Klemperer of the United States, experimental full scale flight by L. Hopf, turbines by W. Spannhake, air screws by O. Flachsbart, air pumps by W. Gaede, and ballistics by O. v. Eberhard, all well-known names in their respective fields.

The general plan that has been adopted in each section appears to be to give a critically connected non-mathematical account of the subject, with exceedingly useful and up-to-date details of experiments that have been conducted to test out the various crucial points. Diagrams indicate very clearly the lay-out of the experimental plant and the type of apparatus in use in the research institutions in different countries of the world.

As is to be expected from a work of this nature produced almost entirely by German writers, the sections deal very largely with the researches conducted in that country. It is a tribute, however, to workers in Great Britain that several of the sections enter very fully into the details of experiments conducted in British institutions, notably at the Royal Aircraft Establishment and at Teddington. The work is exceedingly rich in references. Incidentally, it is interesting to note the tendency in all countries for the centres of research activity to concentrate in the State-supported institutions.

The Subject Index to Periodicals, 1928. Issued by the Library Association. Pp. viii + 326. (London: The Library Association, 1930.) 70*s*. net.

WE congratulate the Library Association on the publication of the "Subject Index to Periodicals" for the year 1928. The first volume of this valuable series was for the year 1915, so that these subject indexes now enter upon the sixteenth year of their existence. It has, however, not yet been found possible to issue the volumes for 1923, 1924, and 1925, although these volumes are in preparation.

The present volume, like its predecessors for 1926 and 1927, is arranged alphabetically by subjects, the headings being chosen from the alphabetical subject headings of the Library of Congress, with modifications and additions to suit British practice. When the titles of articles do not sufficiently indicate their contents, brief annotations are given. Under each heading the articles are arranged alphabetically by the author's name.

The subjects indexed cover a wide field, but magazine verse and fiction are not included.

The periodicals indexed are, for the most part, those published in the English language, but a certain number of journals in the French, German, Dutch, and Italian languages are included. The general editor, E. E. G. Tucker, has been ably assisted by the librarians of the chief public libraries in Great Britain.

Although the subjects indexed are by no means confined to science, yet science is so well represented among the headings that this subject index will be found to be a very useful work of reference in any scientific library. Important papers sometimes appear in periodicals where they stand a chance of being quite overlooked unless they are traced by reference to a "Subject Index to Periodicals".

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.*]

Anticipation of Wegener's Hypothesis.

THE question of the bodily displacement of continental masses on the earth's surface has been the subject of considerable discussion among geologists and geophysicists in recent years.

When first I heard this referred to as 'Wegener's Hypothesis', my memory went back to my schooldays and to a popular book on science which I then possessed entitled "The Playbook of Metals", by J. H. Pepper, the inventor of the optical illusion known as 'Pepper's Ghost'. The subject having recently come up again in the course of conversation, I took the opportunity of consulting the Library of the University of Cambridge, where I was fortunate enough to find a copy of this work, dated 1861. In it are to be found two diagrams, photographic reproductions of which were kindly made for me by Mr. W. H. Hayles, of the Cavendish Laboratory (Figs. 1 and 2). Pepper states that these diagrams are from a book entitled "La Création et ses mystères dévoilés", by A. Snider. It was necessary for me to go to the British Museum Library to find a copy of this latter work, the date of which I ascertained to be 1858.

It is interesting to compare these dates with those given by Prof. Wegener in his book, "Die Entstehung der Kontinente und Ozeane", where the following passage occurs (see p. 3):

"Die erste Idee der Kontinentalverschiebungen kam mir im Jahre 1910 bei der Betrachtung der Weltkarte unter dem unmittelbaren Eindruck von der Kongruenz der atlantischen Küsten, ich liess sie aber zunächst unbeachtet, weil ich sie für unwahrscheinlich hielt. Im Herbst 1911 wurde ich mit den mir bisher unbekannten paläontologischen Ergebnissen über die frühere Landverbindung zwischen Brasilien und Afrika durch ein Sammelreferat bekannt, das mir durch Zufall in die Hände fiel. Dies veranlasste mich, eine zunächst flüchtige Durchmusterung der für die Frage in Betracht kommenden Forschungsergebnisse auf geologischen und paläontologischem Gebiet vorzunehmen, wobei sich sogleich so wichtige Bestätigungen ergaben, dass die Überzeugung von der grundsätzlichen Richtigkeit bei mir Wurzel schlug. Am 6. Januar 1912 trat ich zum erstenmal mit der Idee in einem Vortrag in der Geologischen Vereinigung in Frankfurt a. M. hervor, der betitelt war 'Die Herausbildung der Grossformen der Erdrinde (Kontinente und Ozeane) auf geophysikalischer Grundlage'. Diesem Vortrag folgte am 10. Januar ein zweiter über 'Horizontalverschiebungen der Kontinente' in der Ges. z. Beförd. d. gesamten Naturwiss. zu Marburg. Im gleichen Jahre 1912 folgten auch die beiden ersten Veröffentlichungen."

We thus see that the hypothesis of continental displacement had been put forward a full half-century before it first occurred to Prof. Wegener.

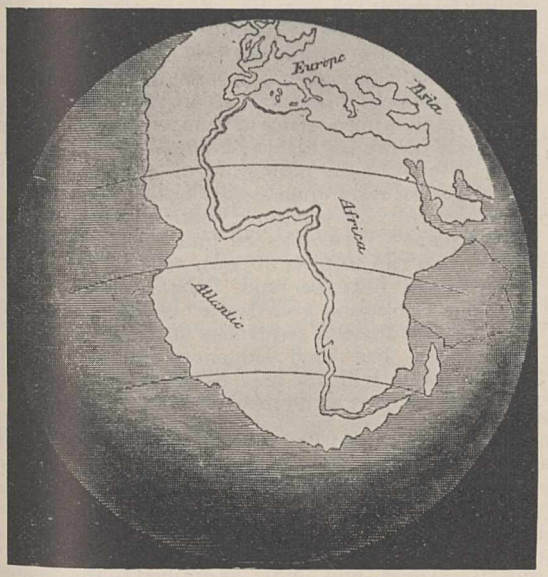

FIG. 1.—The earth before the separation (Snider's diagram).

FIG. 2.—The earth after the separation (Snider's diagram).

On comparison of Snider's diagrams with those of Prof. Wegener, the essential similarity will at once be apparent; the main difference in detail being that Snider puts the junction of Australia with Africa somewhat farther north than does Prof. Wegener.

From the fact that it should have been mentioned in a popular book on science like Pepper's "Playbook of Metals", one would infer that the hypothesis must have been well known about this period, and it is highly probable that the pros and cons of it were pretty well discussed by scientific men.

I freely admit, from what I have seen of Snider's book, that I do not think it would be treated very seriously as a whole by men of science nowadays; but I need scarcely point out that a question of fact is quite distinct from any explanation thereof which may be put forward, and it seems quite clear that the hypothesis of continental displacement (be it true or false) dates at least so far back as 1858, if, indeed, it may not be possible to trace it still further. As regards evidence in favour, or otherwise, of the hypothesis (by whatever name it be called), we must still, of course, turn to the work of Prof. Wegener and other writers who have studied the subject in its various aspects.

ALFRED A. ROBB.

Cambridge, Oct. 24.

Polarisation of Electrons.

DR. RUPP [1] finds that if electrons of 80 kilovolts energy are reflected in succession from two gold surfaces at an angle of about one-third of a degree, there is a twelve per cent difference in the intensity of the twice reflected beam according as the two deviations are in the same or opposite directions. I have attempted to repeat this result for electrons scattered in succession through two thin gold films. The films were thin enough to give good ring patterns and the method is to measure photometrically the diffraction pattern formed by the twice scattered beam. The result is negative. Eight plates were taken, each with two exposures; the mean difference between the two sides for seven of these plates was 1 per cent. Of the individual pairs of readings, half differed by less than 5 per cent on the two sides, which corresponds to about 2 per cent probable error on the mean of the seven plates. The eighth plate gave a mean effect of 20 per cent in the reverse direction to that found by Rupp. I am unable to account for this plate, and as I have left Aberdeen, where the experimental work was done, I cannot attempt to repeat it. It is possibly due to uneven development.

In some cases the rays selected for the second scattering formed part of one of the diffraction rings formed by the scattering in the first film. In other cases they came from the part of this pattern between the rings. Since the regularly diffracted electrons are always in a minority, the polarisation might be greater than suggested by the above figures if it were limited to these electrons, but there is no sign of such an effect. The angles of scattering were of the order of 2°; the mean energy of the electrons was 65 kilovolts. The experiment is in agreement with the view that the detection of polarisation by such means is only possible with large angles of scattering. Since making the experiment I have seen a paper by Kirchner,[2] in which he mentions that he has satisfied himself that the effect, if any, is less than 10 per cent.

G. P. THOMSON.

Imperial College of Science,
London, S.W.7, Nov. 29.

[1] *Zeit. für Phys.*, **61**, p. 158.
[2] *Phys. Zeit.*, **31**, p. 772.

Heredity and Predestination.

SOME of us are wont to ascribe a super-papal infallibility to the editorial notes in NATURE, and it is, therefore, with much diffidence that I suggest a certain misunderstanding in the issue of Nov. 15, p. 781, as to my Lloyd Roberts Lecture. The place of moral values in modern arguments for theism is so fundamental that possibly space can be found for a few sentences which may stimulate biological experts to consider afresh the relation of evil to the evolutionary process.

Mutations, I stated, appear to be the raw material of evolution: and they seem to be devoid of any ethical character whatever. Changes in the genes—call them simply inheritance factors if their localisation in the chromosomes is doubted—are as near as we can at present get to creative activity: but in such changes we can discover no moral quality. Good and evil, as judged by our standards, are equally likely to arise in the variations associated with heredity.

The note in NATURE says that the 'evil and good' of my argument "are simply adjustment or mal-adjustment to environment". I would that it were so, for then the theologian's difficulties would be at an end. All that is good would flourish because adapted to its environment. The evil would disappear under the operation of natural selection. We could then, indeed, affirm with Pippa, "God's in His heaven: all's right with the world". Huxley's war between man and the cosmic process would be unnecessary.

Unfortunately, however, the loathsome parasite is a result of the integration of mutations: it is both an exquisite example of adaptation to environment and ethically revolting. Civilised nations, as I emphasised, have of late been creating an environment to which the mental deficient can happily adapt himself: humane principles and social degeneration are thus conjoined. None the less—and here is the puzzle over which I ask biologists to ponder—out of the evolutionary process has come the progress which has led to man with his spiritual consciousness and moral loyalties. I reached the perplexing conclusion that, if we accept the moral argument for ethical theism, we must find Divine activity, albeit elusively, in the environment and not in the genetic changes through which apparently the creative process works. But, as I told my Manchester hearers, I was thinking aloud. My conclusion cannot claim the merit (or demerit) of orthodoxy; and I am willing to be converted to any other explanation for which better arguments can be adduced.

May I add, though it is a subsidiary matter, that I do not personally accept the notion that mutations "are causeless in the sense of being entirely fortuitous". It is part of my faith that the universe is rational for man. Belief in the possibility of successful scientific investigation rests upon such a faith. That faith has its difficulties: as we know, there are those who hold that science will always be limited to regions upon which man can impose his own sense of order. But, if the larger faith be true, the progress of research should in due course give us the 'causes' of mutations or, more accurately, sequences of which they are the end terms. But such sequences, as Hume pointed out long ago, will not lead us to efficient causation. For that we need some metaphysical postulate.

E. W. BIRMINGHAM.

Bishop's Croft, Birmingham,
Nov. 15.

THE letter of Dr. Barnes raises two difficulties in our mind. 'Good' and 'evil', as applied to the organisms which in his lecture he grouped as "animals and insects", and on which he relies for his genetic data, can only mean relative adjustment or mal-adjustment to environment, for the biological end of a creature is to multiply its kind. A parasite is biologically evil because it has renounced the power of initiative, replacing it by dependence upon the success of its host, and because the more successful the parasite is, the more precarious its existence as a species becomes. The 'good and evil' of humanity, in so far as they are conventions sanctioned by custom or law, are acquired characters and have nothing to do, if Dr. Barnes is right about the non-heritability of acquired characters, with inheritance factors, but biologically conventions may be good or evil, as they encourage or discourage the best continuance of the race.

Feeble-mindedness is a mal-adjustment which in Nature would meet its own fate, and the morality which protects and encourages feeble-mindedness is also a mal-adjustment which also will meet its fate.

The second difficulty is Dr. Barnes's firm belief in the 'non-morality' or fortuitousness of mutations. It is an uncertain hypothesis, unacceptable to many biologists, yet on it the argument of the Lloyd Roberts Lecture was based. Our notion is that environment may be more than a mere eliminator, but any further power it may exercise must depend upon the response of the organism. THE WRITER OF THE NOTE.

Agricultural Field Experiments.

IN the article with the above title which appears in NATURE of Oct. 25, p. 667, it is stated:

"Beaven's half drill strip method is described, but without pointing out its two serious but remediable defects: that the continued use of one half of the drill for one variety, and of the other half for the variety with which it is to be compared, may introduce a constant difference the magnitude of which cannot be estimated; and that the regular alternation of strips of the two varieties does not permit of a valid estimate of experimental error."

I submit that these defects are more theoretical than practical, and that any modification of practice in the application of the method, such as changing over seed boxes, would be a retrograde step.

To take the first, there are three possible ways in which one half of a drill may differ from the other:

(1) It may cover a wider breadth of ground; this would doubtless have an appreciable effect, but it would be detected and allowed for by the routine measurements taken across the stubble.

(2) The coulters may be less evenly spaced than those of the other, and

(3) Less seed may be drilled from it than from the other.

Now, cereal crops are wonderfully independent of the amount of seed sown. I have in mind two chess-board experiments, in one of which half the area was sown with seed 1 in. apart instead of the usual 2 in., and in the other, the rows in half the experiment were 3 in. apart instead of 6 in. In each case the heavier seeding only resulted in a gain of about 3 per cent, and it is not to be expected that such slight irregularities as occur between the two halves of a drill would have any measurable effect.

The second defect, owing to the peculiar shape of the half-drill strip, would only exist if the experiment were to be sited so that some periodic variation existed across the breadth of the drills: otherwise randomness is supplied by the soil. By taking care that the experiment is drilled across ploughman's 'lands', if they exist, and by bearing in mind the history of the last few crops, this danger can be avoided.

The pairs of strips fall naturally into two sets according as one or other variety is on the right hand, and in an analysis of the variance of the difference between varieties, one degree of freedom is taken up by these two sets. The estimate of the experimental error arrived at in this way is perfectly valid, provided the above precautions have been taken in siting the experiment.

It would be a pity to interfere unnecessarily with the simplicity of this very efficient method of conducting field trials.

STUDENT.

I FEEL that 'Student' under-estimates the importance of differences in the two halves of a seed-drill. I have repeatedly found significant differences between adjacent rows in respect of such characters as plant-height, number of tillers per unit length of row, and, finally, yield per unit length of row. This is sufficiently marked to make it definitely an advantage, for precise observations, to divide the observational unit of a metre-length of row into two half-metres, end to end but on adjoining rows. I suspect that depth of sowing (a factor which 'Student' does not mention) and amount per unit length play the important part in determining this individuality of the row. The results of a small-plot experiment which I examined recently showed that the yield of wheat per unit area was unaffected by changes in spacing, but was considerably lessened by increased depth of sowing, as also by decreased amount of seed per unit length of row. The number of rows in a 'half-drill strip' is small, so that a considerable difference may result from these causes, even with random distribution amongst the coulters of depth and amount of delivery. There is likely, however, to be a steady gradation in depth of delivery as one passes from one side of the drill to the other, and this would more certainly constitute a 'serious defect' in the half-drill strip method.

'Student' is satisfied with the validity of the estimate of error, provided care is taken to drill across ploughman's 'lands'. There was an interesting series of uniformity trials carried out at the Danish station at Aaslev, in which an apparently uniform field revealed a periodicity in yield, of half-wave-length almost coincident with the width of the plots. Had this been a varietal trial, and had the half-drill strip method been used, the experimenters might have been sadly misled!

The method loses only slightly in simplicity and gains considerably in value if modified in one of the following two ways, as R. A. Fisher has pointed out. If there is any possibility of a steady fertility gradient at right angles to the length of the strips, the arrangement should be a set of 'sandwiches', but it should be decided at random for each whether variety *A* or variety *B* should occupy the two middle strips: if it is certain that no such gradient exists, then the more satisfactory arrangement is to take *pairs* of strips, deciding, again at random, whether *A* shall be on the left-hand or the right-hand strip. The former arrangement gives as many degrees of freedom as there are sandwiches; and, for the same number of strips, the latter gives twice as many degrees of freedom. The strips should all be drilled with the same half-drill.

THE WRITER OF THE ARTICLE.

Relationship of the Oat Smuts.

Two species of smuts—*Ustilago avenæ* and *U. levis*—occur commonly on cultivated oats. They differ from one another in the character of their spores and in the appearance of the spore masses produced on their host plants. The spores of *U. avenæ* are minutely echinulate; those of *U. levis* smooth. *U. avenæ* usually destroys the florets of the host plant, giving them a blackish, powdery appearance; *U. levis* causes less injury to the inflorescence and at maturity its spores may be entirely concealed by the glumes.

During the past year we have been investigating experimentally the relationship between the two species. Spores of the loose and covered smuts have been germinated singly in hanging drops, and their sporidia removed one by one and cultured separately on artificial media.

Young oat seedlings were inoculated with the following cultures or combinations of cultures: (1) Monosporidial cultures of *U. avenæ* used singly and in pairs. (2) Monosporidial cultures of *U. levis* used singly and in pairs. (3) Pairs of cultures, each one made by mixing together a monosporidial culture of *U. avenæ* with one of *U. levis*.

The seedlings were grown to maturity in the greenhouse, and observations were made as to the appearance of the smutted heads and the kind of spores borne in them. The results of the inoculations are of considerable interest and may be summarised briefly as follows:

(1) Plants inoculated with a single monosporidial culture of *U. avenæ* or *U. levis* did not produce smutted heads.

(2) Plants inoculated with two monosporidial cultures of opposite sex produced smutted heads. If the two cultures were of *U. avenæ* the infected

heads were 'loose' in appearance and their spores echinulate; if of *U. levis* the heads were 'covered' in appearance and their spores smooth; if one of the cultures was of *U. avenæ* and the other of *U. levis* the infected heads were somewhat variable in appearance, but upon close examination they proved to be of the 'loose' type, and their spores were echinulate.

(3) The sporidia of *U. avenæ*, like those of *U. levis*, are of two kinds, (+) and (−); the sporidia of one species mate without difficulty with sexually opposite sporidia of the other species.

These results indicate that *U. avenæ* and *U. levis* are genetically distinct with respect to the characters by which they are differentiated, but the ease with which crosses can be made between them suggests that they are closely related species.

A full report of the investigation is being prepared for publication.

W. F. Hanna.
W. Popp.

Dominion Rust Research Laboratory,
Winnipeg, Canada, Oct. 21.

Synthesis of a Methoxyketose.

A 5-methoxyketose has been prepared by the condensation of dioxyacetone, $CH_2OH.CO.CH_2OH$, and α-methoxyglyceric aldehyde, $CH_2OH.CH(OCH_3).CHO$. The method of synthesis is proof of the position of the methoxyl group and such a structure cannot form a furan ring.

Pure dioxyacetone was obtained from nitromethane by the method of Henry and Piloty. Neither α-methoxy-glyceric aldehyde nor its acetal had been prepared but the latter was obtained by methylating α-chlor-β-oxypropiondiethylacetal with sodium methylate, α-chlor-β-oxypropionacetal being formed from acrolein through the intermediary of β-chlorpropionacetal and acroleinacetal by a modification of the methods described by Wöhl and Witzemann. The required acetal was obtained as a colourless liquid distilling at 100°-102° C./6mm. This was readily hydrolised by dilute mineral acids and the aldehyde produced was converted into the bromphenylhydrazone derivative and into the condensation product with phloroglucinol. The preparation of these derivatives and the analysis of the acetal proved the identity of the aldehyde.

The conditions used by Fischer in his synthesis of α-acrose were modified to suit the condensation of dioxyacetone and α-methoxyglyceric aldehyde and the optimum results were obtained by allowing a 5 per cent aqueous solution containing 0·25 per cent of barium hydroxide to stand at room temperature for a period of three weeks.

Dioxyacetone is in equilibrium in aqueous solution with glyceric aldehyde, and hence, theoretically, it should be possible to obtain as a result of this condensation four inactive 5-monomethoxyketoses, the corresponding eight inactive 5-monomethoxyaldoses, and the twelve racemic forms of the non-methylated hexoses. The number of possible osazones is only eight and it was not considered likely that the non-methylated osazones would be formed in any quantity. Further, from analogy with the work of Fischer and Schmidt it was expected that the bulk of the product would consist of a single racemic form. These expectations were realised, but it may be noted that for the purpose in hand the actual identity of the substance produced was immaterial, the aim being to synthesise a ketose which could not possess a furan structure.

Treatment of the reaction mixture with phenylhydrazine under the usual conditions gave an impure, crystalline substance and a tarry mass. The former proved to be acetylphenylhydrazine, whilst from the latter a mixture of osazones was isolated with considerable difficulty. Repeated fractional crystallisations from ethyl acetate gave two main fractions of osazones, a larger fraction melting at 183° C. and a smaller fraction melting at 130° C. These gave analytical figures corresponding to a pure monomethoxyhexosazone. From analogy with the work of Fischer on α-acrose and on a consideration of the melting points of the known methylated and non-methylated osazones the former product was considered to be inactive 5-monomethoxyfructosazone and the latter inactive 5-monomethoxysorbosazone.

The monomethoxyhexosazone (m.p. 183°), of which 35 grams were obtained (from 5600 grams of acrolein), was converted through the osone into the corresponding monomethoxyketose by a modification of Fischer's method. Five grams of a crystalline material melting at 80°-85° C. were obtained which gave analytical figures corresponding to a pure monomethoxyhexose. Treatment at room temperature with methyl alcohol containing 1 per cent HCl showed that fructoside formation was complete only after 48 hours. This was evidence in favour of a sugar which cannot exist in the γ-form since the formation of γ-methylfructoside is complete after one hour. The monomethoxymethylhexoside was methylated by treatment with methyl sulphate followed by two successive methylations with Purdie's reagents. Towards alkaline permanganate this tetramethoxymethylhexoside behaved as a normal sugar derivative and the rate of hydrolysis also corresponded to that of normal tetramethoxymethylfructoside. Hydrolysis of the synthesised hexoside was complete on refluxing with 3 per cent aqueous HCl for three hours and the product was isolated as a syrup in the usual way. From this syrup tabular crystals were obtained by extraction with light petroleum which, after repeated crystallisations, melted at 95°-96° C. There was no depression of melting point on mixing with an authentic specimen of normal tetramethoxyfructose.

Nitric acid oxidation gave a trimethyl-lactol acid which on further oxidation with alkaline permanganate yielded a trimethylarabonolactone. The curve of apparent specific conductivity plotted against time obtained by observations during the hydrolysis of the lactone derived from the synthesised tetramethoxyhexose was almost identical with the curve given under similar conditions by the lactone derived from normal tetramethoxyfructose but was sharply differentiated from that given by the lactone corresponding to tetramethoxy-γ-fructose.

From these experiments it is shown that the synthesised 5-methoxyhexose and its derivatives have exactly similar properties to those of the methylated derivatives of normal fructose, and that the synthesised hexose was in fact the racemic form of 5-monomethoxyfructose. Since the methoxyhexose produced by condensation could not possess a 5-atom ring, and of the other possible ring structures the pyranose is considered to be the most likely, this evidence, obtained from a field hitherto unexploited, proves conclusively that normal fructose and its derivatives cannot possess a furanose structure and lends support to the accepted pyranose constitution.

A parallel experiment is in progress with the object of synthesising a 6-methoxyhexose.

Eric Frank Hersant.
Wilfred H. Linnell.

Chemical Research Laboratories,
School of Pharmacy of the
Pharmaceutical Society of Great Britain,
University of London,
17 Bloomsbury Square, London, W.C.1,
Nov. 4.

Double Refracting Structure of 'Corex' Glass.

SOME years ago I found that silica glass showed a doubly refracting structure (*Proc. Roy. Soc.*, A, vol. 98, p. 284; 1920. Also *Proc. Optical Convention*, Part 1, p. 41; 1926). This structure is quite distinct from any due to bad annealing, and seems kindred to the 'liquid crystals' of Lehmann. Nothing of the kind could be found in the ordinary glasses consisting of silica with metallic oxides.

I now find that the ultra-violet transmitting 'Corex' glass of the Corning Co. shows a similar structure. This glass is said to consist in the main of calcium phosphate, though I have not seen an analysis. The subject evidently requires detailed examination, which I hope to make as opportunity allows.

RAYLEIGH.

Terling Place, Chelmsford,
Nov. 14.

Energy Levels of Atoms in an Electric Field.

ISHIDA has recently given clear experimental evidence that Stark levels with equal m values do not intersect (*Sci. Pap., I.P.C.R.*, Tokyo, No. 260; 1930). With increasing field, the levels approach to a limiting separation and then recede. This feature of the investigation was limited to levels with equal m but different n values.

I now notice on a plate which has been published (Neon; Foster and Rowles, *Proc. Roy. Soc.*, vol. 123, p. 80; 1929) a good illustration of this point for the case where the levels have the same principal quantum number. The diffuse line $2p_9 - 7d'_4$ approaches the sharp line $2p_9 - 7s_5$ as the electric field increases (Fig. 1). When the separation (25 cm.$^{-1}$) is but a

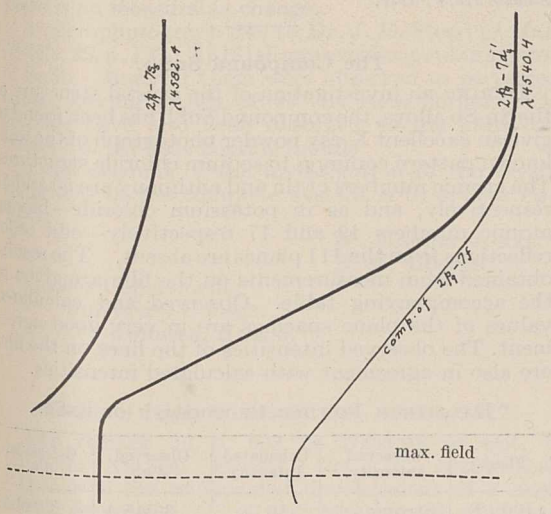

FIG. 1.

fraction of the almost constant separation observed for the other components with (initial) $m_l = 0$, it turns abruptly and retains constant displacement up to the maximum external field.

In the paper referred to, Ishida reproduces some remarkably fine plates which give strong support to the theory of the Stark effect in helium (Foster, *Proc. Roy. Soc.*, vol. 117, p. 137; 1927). On two points, however, his interpretations lead him to very striking conclusions at variance with the theory and with earlier experiments (Foster, *Proc. Roy. Soc.*, vol. 114, p. 47; 1927). I should like to suggest views which (if correct) will place the new results in harmony with previous work.

The conclusions reached by Ishida are (1) that the selection rule $\Delta m = 0, \pm 1$ is broken, and (2) that hitherto unknown series lines have been discovered in the helium spectrum. The selection rule is apparently broken by the appearance of a few weak π components having the same wave-length as corresponding members of the strongest group of σ components ($m = 2$ in initial state). This is not an effect due to the larger fields he employs, since in his photographs it persists in moderate fields. On any one plate it is found only where the corresponding σ component has extraordinary strength, yet it fails to appear on the plate showing the intense yellow line λ5876. This irregularity attracts one to the possible view that an imperfect adjustment of the double-image prism with reference to the axis of the Lo Surdo tube may account for all that has been observed, and allow the selection rule to apply here as elsewhere. But even with this adjustment correctly made, this phenomenon has been observed, and attributed to an occasional confusion of the fields in a Lo Surdo source (Foster, *Astrophys. Jour.*, vol. 62, p. 235; 1925).

The second point is concerned with π components which vanish or become very weak as they pass under the zero field position of the $P - P$ combination line (or $S - S$ or $p - p$ or $s - s$, as the case may be) of the group to which they belong. This phenomenon has been observed in many experiments (Foster, *Phys. Rev.*, vol. 23, p. 667; 1924; *Jour. Frank. Inst.*, vol. 209, p. 585; 1930). Nevertheless, Ishida regards the lines as entirely new at the point of reappearance. One can understand that the sloping lines are cut off vertically, and doubtless appear to point to zero field positions near those of the $P - P$ lines. But as Ishida observes, there are no terms in the well-known normal helium spectrum which can account for such origins. It is doubly difficult, therefore, to deny the theory which on this point has already received adequate experimental support.

J. S. FOSTER.

McGill University, Montreal,
Oct. 15.

Determination of the Abundance Ratios of Isotopes from Band Spectra.

I RECENTLY reported an intensity anomaly in the isotopic bands of boron monoxide (NATURE, Aug. 9, p. 203), which showed that the intensity ratio of isotopic bands does not always give directly the relative abundance of the isotopes. The following is an account of the determination of the correction to be made in order to obtain the relative abundance from the intensity ratio, and is an abstract from a dissertation presented to the University of Utrecht.

The intensities of the heads of all the bands of the $B^{11}O$ β-system which appear on plates with exposures of four hours have been measured; variations of plate sensitivity were corrected for by comparison with a lamp the spectral energy distribution of which was known. The intensity of each band was then divided by ν^4, ν being the frequency of the band in question, in order to obtain the square of the amplitude of the virtual oscillators, since it is the latter quantity which is additive. By adding up the values of I/ν^4 for all the bands having a common v', a figure was obtained which gave a measure of the number of $B^{11}O$ molecules in the v' state. This was done for the different v'' progressions, and so the number of molecules in the different v' states was determined. The graph (Fig. 1) shows $f(E'_v)$, the number of $B^{11}O$ molecules in these states, plotted as a function of the vibrational energy E'_v.

If it be now assumed that the same function holds for $B^{10}O$, then the ordinates drawn through the energy values of the vibrational states of $B^{10}O$ will give the number of these molecules in the various v' states;

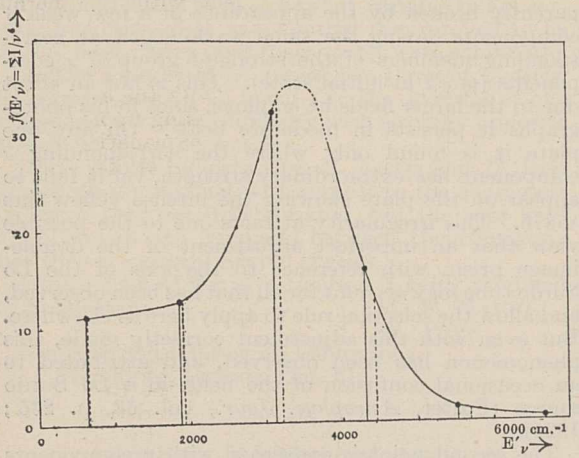

FIG. 1.

these states are shown by the dotted lines. It is evident that the isotope intensity ratio for bands from the $v'=3$ state will be considerably higher than that for the bands from lower v' states. The table

Band.		0-3.	1-4.	1-5.	2-5.	2-6.	3-7.
Intensity ratio of isotopic bands	a	..	..	..	3·34	3·50	..
	a	..	..	..	3·22	3·17	4·30
	a	..	..	..	3·49	3·45	4·38
a = from lines		..	3·49	3·41	3·42	3·49	4·05
b = from heads	b	3·56	3·20	3·53	..	..	..
Average . .		3·56	3·35	3·47	3·37	3·40	4·24
Corrected for plate sensitivity . .		3·63	3·44	3·56	3·48	3·50	4·37
$f(E'_v)/f(E'^i_v)$.		1	0·985	0·985	0·95	0·95	1·21
Isotope ratio .		3·63	3·50	3·61	3·66	3·68	3·61

Mean Isotope Ratio = 3·63 ± 0·02.
Corresponding Atomic Weight (correcting for O^{17} and O^{18}) = 10·794.

shows the corrections $f(E'_v)/f(E'^i_v)$ obtained from this curve by which the measured intensity ratios must be divided in order to obtain the real relative abundance of the isotopes. More complete data (which refer to Chilian boron) are given than were contained in the previous communication, and a correction for change in plate sensitivity with wave-length has been made. The very good agreement of the corrected isotope abundances determined from different bands may be pointed out.

In a recent letter (NATURE, Oct. 25, p. 649), Stenvinkel has given an explanation of the high ratio for the 3-7 band, based on the supposition that Boltzmann distribution holds for the lower electronic level, and that the $v'=3$ level is fed chiefly by molecules from the $v''=1$ level, according to the Franck-Condon principle. It may be pointed out, however, that the number of molecules in the $v''=1$ state, calculated from the Boltzmann law at a temperature of 470° A. (found from intensity measurements on the rotation lines of BO), is 1/370 that of the number in the $v''=0$ state. It is therefore difficult to imagine that the $v''=1$ level plays any important part in determining the distribution in the upper electronic state. Further, the assumption that the Franck-Condon principle applies to transitions caused by active nitrogen is open to question.

A. ELLIOTT.

Physical Laboratory,
University of Utrecht,
Oct. 30.

The Red Coronal Line in Oxygen.

IN looking over my spectrum plates of oxygen I find some which show not only the nebular lines λ6300 and λ6364,[1] which had not been produced in the laboratory before, but also a strong line λ6374·29. The wave-length of this line seems to be identical with that of the strong, red coronal line λ6374·2.[2] Although this oxygen line is well known, I do not think that the above remarkable coincidence has been previously pointed out. This coincidence in the wave-lengths of the oxygen and the coronal line, and also the fact that the line occurs in an isolated position in the oxygen spectrum when only lines of O I were present, would seem to indicate their identity, and is strong evidence of the presence of oxygen in the sun's corona.

This oxygen coronal line is still unclassified and its Zeeman pattern has not been observed. Possibly it represents a forbidden transition between terms still unknown. Such a study would be very interesting in throwing light on the spectroscopic nature of its end-terms and in helping to explain the nature of the solar corona.

JOHN J. HOPFIELD.

University of California,
Berkeley, California,
Oct. 30.

[1] Paschen: *Die Naturwissenschaften*, **34**, 752; 1930.
[2] Campbell and Moore: Publications of the Lick Observatory, *Bulletin* 318, 8; 1918.

The Compound SnSb.

DURING an investigation of the crystal structure of the Sn-Sb alloys, the compound SnSb has been found to give an excellent X-ray powder photograph of the well-known pattern common to sodium chloride structures. The atomic numbers of tin and antimony are 50 and 51 respectively, and as in potassium chloride—having atomic numbers 19 and 17 respectively—odd order reflections from the 111 planes are absent. The results obtained from measurements on the film are given in the accompanying table. Observed and calculated values of the plane spacings are in very good agreement. The observed intensities of the lines on the film are also in agreement with calculated intensities.

DATA FROM POWDER PHOTOGRAPH OF SnSb.

Plane.	Observed Intensity.	Calculated Intensity	Observed d/n.	Calculated d/n.
100 (2)	Strong	10	3·045 A.	3·046 A.
110 (2)	Strong	8·9	2·154	2·154
111 (2)	Medium	3·7	1·759	1·759
100 (4)	Weak	2·0	1·525	1·523
120 (2)	Medium	6·0	1·362	1·362
121 (2)	Medium	5·0	1·243	1·244
110 (4)	Very weak	1·7	1·076	1·077
100 (6) / 122 (2)	Medium	3·8	1·016	1·015
103 (2)	Medium	2·7	0·964	0·963
113 (2)	Medium	2·4	0·918	0·918
111 (4)	Very weak	1·7	0·878	0·879
203 (2)	Very weak	2·0	0·845	0·845

Structure: NaCl Type.
Dimensions of Unit Cell: $a_0 = 6·092$ A.

The density of the compound is 6·94 gm./c.c.,

giving four molecules of SnSb per unit cell as required by a sodium chloride lattice.

The arrangement of atoms into a sodium chloride type lattice would indicate that the compound is ionic in character. This requires the tin to be trivalent. From formulæ given by Pauling (*J. Amer. Chem. Soc.*, 49, p. 765; 1927) the calculated ionic radii for Sn^{+3} and Sb^{-3} are respectively 0·75 and 2·45 A., which when built up into a sodium chloride structure, gives a lattice constant 6·40 A., in poor agreement with the observed value. However, the atomic radii for tin and antimony for co-ordination number 8 are 1·53 and 1·56 respectively (Goldschmidt; *Trans. Faraday Soc.*, 25, p. 253; 1929), and for co-ordination number 6, these are reduced to 1·484 and 1·513 A. Such radii would give a lattice constant of 5·99, in good agreement with the experimental value 6·092 A.

The structure of SnSb is found to persist over the range 46 to 60 per cent tin with some change of lattice constant, showing that both tin and antimony are soluble in it. This agrees with the equilibrium diagram given by Broniewski and Sliwowski (*Comptes rendus*, 186, p. 1615; 1928), although they thought a compound Sn_3Sb_2 existed at the end of this range—at 60 per cent tin. Our X-ray analysis, however, shows that the compound is definitely SnSb with a range of solid solution on either side. The solution of tin and antimony by the compound can be readily understood, since both metals have acidic and basic properties. In addition, their atomic numbers and atomic dimensions are practically the same, so that one atom of tin could be replaced by one of antimony, and vice versa. The solution of antimony up to 4 per cent causes a change of lattice constant from 6·092 to 6·106 A. Before annealing, the solution of 10 per cent tin causes a definite expansion to 6·124 A., but after annealing there is no measurable change.

A microphotograph due to Dr. J. E. Stead (*J. Inst. Metals*, 22, p. 127; 1919) shows excellent cubic crystals of SnSb. Many of them were observed to be perfect cubes, having angles of 90° at each corner. The crystals have also been observed as the hard constituent of tin-base bearing metals.

A full account of the investigation of the crystal structures of the complete system is to appear elsewhere.

W. MORRIS JONES.
E. G. BOWEN.

Physics Department,
University College,
Swansea, Nov. 5.

Cause of High Winds of Oct. 19–20, 1917.

THE remark on p. 633 of NATURE of Oct. 18 (Historic Natural Events, Oct. 19, 1920) that, "Owing to the unexpected development of a barometric depression . . . a very strong cold north-east wind sprang up at some height above the ground", does not state the facts correctly and gives a misleading impression of the cause of the high winds at an altitude of 10,000–20,000 ft. on the occasion in question.

The winds at those heights over south-east England and northern France on Oct. 19–20, 1917, were northerly and not north-easterly. These winds occurred over a region where the horizontal gradient of pressure was insignificant at sea-level. This insignificant gradient, however, became a steep west to east gradient at great heights owing to the fact that there was a steep horizontal gradient of temperature in the upper air also from west to east. The strong northerly wind was simply a thermal wind. Generally, the actual wind is compounded of the thermal wind and the wind arising from the horizontal gradient of pressure at sea-level. On this occasion, as the latter was practically nil, the actual wind was practically coincident with the thermal wind.

A reasonably complete account of the conditions at the time is given in Vol. 4 of Shaw's "Manual of Meteorology", p. 112, along with the explanation of the phenomenon. I find on looking up my records that I gave the facts and the explanation to the General Staff at G.H.Q., France, on Oct. 23, 1917.

E. GOLD.

8 Hurst Close, London, N.W.11,
Oct. 24.

COL. GOLD is no doubt fundamentally correct as to the cause of the high winds of Oct. 19–20, 1917. My version agrees with that in McAdie's book, "Man and Weather", p. 12, which runs: "But a depression developed in the Atlantic, west of the British Isles, and the light variable winds, characteristic of settled fair weather, were routed quickly by cold north or north-east winds of 20 metres or more per second. The airships from midnight until 7 A.M. were carried south and somewhat east, at a speed of fifty miles an hour." A closer examination of the facts, however, shows that this view of the mechanism is too superficial.

THE WRITER OF THE NOTE.

Scientific Inexactitude.

IN NATURE of Nov. 8, p. 725, Mr. Darling criticises a certain sentence in a recent book on "Sound". The sentence in question, "A clamped steel bar electrically maintained is sometimes employed as a rough standard of frequency", is described as 'unfortunate' and 'incorrect', and is given as an example of a tendency towards scientific slang.

Mr. Darling is, in effect, suggesting that all statements must be *explicit* in every detail, nothing must be implied. The sentence to which he refers is taken from a section entitled "Transverse vibrations of elastic bars" and from a sub-section commencing (24 lines away) "Electromagnetic methods of maintenance of the vibrations". One might reasonably expect, therefore, that even "a reader not conversant with the subject" would understand that the words "in vibration" are implied after the word "maintained" in the sentence quoted. I consider his alternatives "operated" or "driven" no better than the word actually used.

If all statements were explicit and nothing implied, a scientific book, or any other class of book, would make very dull reading. Mr. Darling's method applied to such well-known expressions as 'an oscillating circuit', 'a reversing switch', 'a projector screen', and so on, would lead to extremely laboured and amusing English. Abbreviation is essential to progress, provided that it is not carried beyond the intellectual limits of the reader, and I consider that the abbreviation in the sentence Mr. Darling quotes is entirely justified.

Applying his views to the opening sentence of his letter, what does Mr. Darling mean exactly when he says "a reader . . . may be completely fogged"? Presumably he does not really mean the *reader* is fogged any more than the sentence quoted means that the *tuning fork* is maintained? Again, what is an "unfortunate sentence"? The English language is based on such 'slang'.

A. B. WOOD.

"Beaumont", Hampton Hill,
Nov. 13.

The Lochaber Hydro-Electric Power Undertaking.

By Dr. BRYSSON CUNNINGHAM.

THE remarkable engineering enterprise known as the Lochaber Hydro-Electric Power Undertaking, the first and main portion of which was brought to a successful completion early in the present year, embodies a number of novel and interesting features which justify a more extended notice than could be given in the brief paragraph in NATURE of Aug. 9, p. 213, describing the visit of H.R.H. the Duke of York to the works of the Lochaber Water Power Company. The scheme, which is one of the most remarkable of its kind and certainly unique in importance in Great Britain, was promoted by the British Aluminium Co., Ltd., under the direction of Mr. Murray Morrison, director and general manager, who, with the late Mr. C. S. Meik, realised the latent possibilities of water power contained in Loch Treig and Loch Laggan, and devised a plan for their exploitation for the production of aluminium in a factory at Fort William. The work has been executed to the designs and under the supervision of Messrs. Meik and Halcrow, civil engineers, of Westminster.

Lochs Laggan and Treig are two natural storage basins in the Lochaber district of Inverness-shire, with surface levels some 800 feet above the sea. The former is about seven miles in length, with widths varying from a quarter to five-eighths of a mile; the latter, located seven miles or so from Loch Laggan, has a length of five miles and a width of five-eighths of a mile in its widest part. Both lochs have considerable depths, of the order of three to four hundred feet. The catchment area of the district covers slightly more than three hundred square miles. The average annual rainfall reaches a maximum of 160 in. at the top of Ben Nevis and falls to about 40 in. at Laggan Bridge. The minimum and maximum recorded on the summit of Ben Nevis are 108 in. and 240 in. respectively. In records covering a period of nineteen years, the wettest month produced 48·3 in. and the wettest day 7·3 in.

So far, operations have been confined to the development of that part of the scheme which affects Loch Treig, and they have comprised the driving of a tunnel from the loch to a point just above Fort William, where the aluminium factory is situated, together with the building and equipment of a power house. The tunnel was a remarkable project. It has a length of almost exactly 15 miles, appreciably larger than the Simplon (12¼ miles) or, in fact, any European railway tunnel. In length, it is only exceeded by the Shandaken tunnel for the water supply of New York, which is just over 18 miles long, but this has a smaller cross-section, measuring 10¼ ft. by 11¼ ft. The transverse section of the Lochaber tunnel, though composed of several different segments, may be described as roughly circular with a diameter of 15 ft., the height being 4 in. less than the width. The interior lining is of concrete, faced with carefully smoothed cement, in order to reduce skin friction to a minimum.

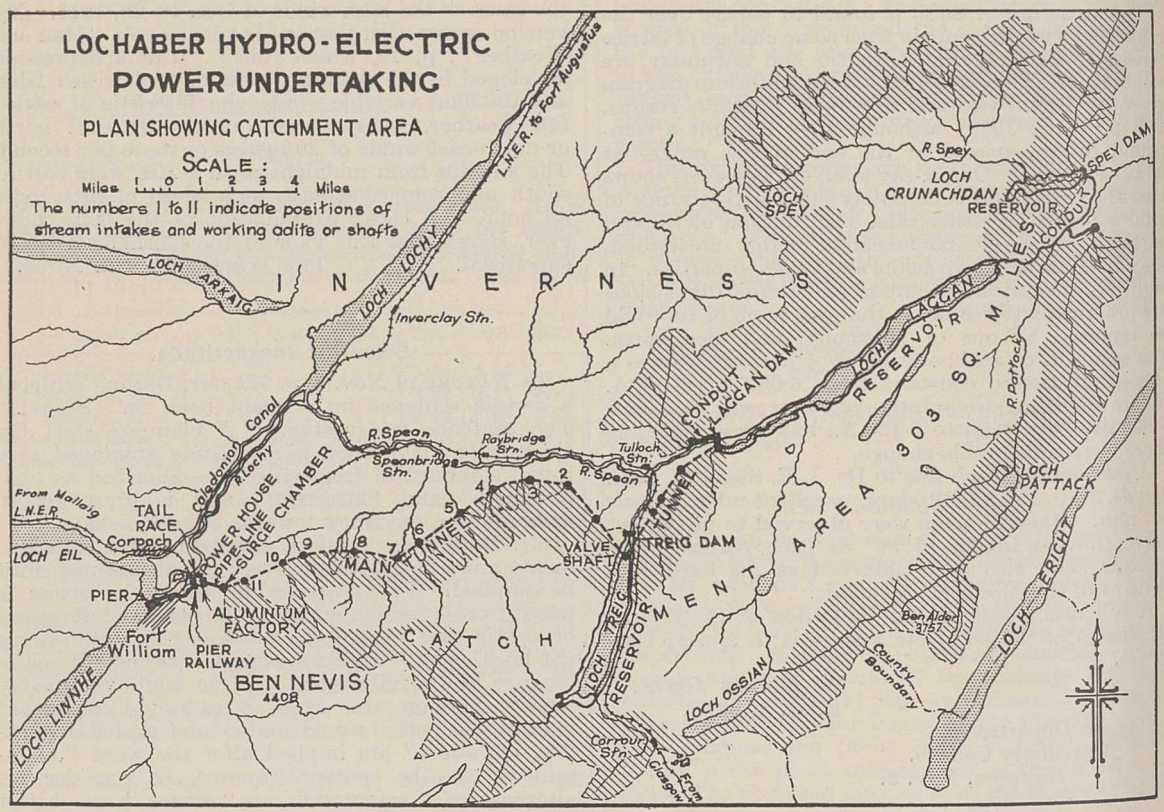

FIG. 1.

The strata along the route of the tunnel varied in character from grey granite of a very hard and compact nature at the Fort William end to schists (mica schist at Loch Treig) and porphyry with intervening layers of red granite, flagstone, etc. Such diverse material rendered drilling operations difficult and arduous, but happily there were no troublesome complications due to the presence of excessive water. Commenced in the summer of 1926, the bore was opened from end to end in February 1929. Driving was done from twenty-two faces : in addition to the end headings, there were seven horizontal adits from the mountain-side and three vertical shafts. The total length of the adits, which ranged individually from 400 ft. to 1440 ft., was 6360 ft. ; and the aggregate depth of the shafts, which ranged from 145 ft. to 356 ft., was 1030 ft.

The tunnel undergoes two successive enlargements in its course for the purpose of receiving, as influents, eleven mountain streams, which are in this way incorporated in the main flow. The streams, or winter torrents, have been intercepted by dams and diverted into artificial conduits, rectangular in section with rounded corners. The water is abstracted over the crest of a weir in each dam, so as to cut off the passage of stones and heavy debris, while the weirs themselves are protected by grids, in order to intercept floating objects, tree branches, etc. The dams are also equipped with valve-controlled flushing pipes for dealing with silt accumulations, and spillways for the surplus flow in times of flood. The shafts by which the water is delivered into the tunnel are lined with concrete and are divided by a partition wall, extending from top to bottom, into two tubes, one of which is the water passageway, and the other, with a vent carried well above the top of the water tube, is a means of escape for the air sucked in by the water.

The pipe lines, 3200 ft. long, leading from the tunnel to the power house at the Fort William end, are to be three in number. For the present, however, only two are in service, the third line being blanked off. The two lines installed are formed of steel plating, from $\frac{1}{2}$ in. to $1\frac{1}{8}$ in. thick, and they vary in diameter from $70\frac{1}{2}$ in. to 65 in. They are in 30 ft. lengths, with lap-welded joints.

The power house on the left bank of the River Lochy is 270 ft. long by 65 ft. wide. Its position, half a mile from the river, has necessitated an exceptionally long tail race of a thousand yards, but the arrangement is justified by the corresponding saving in pipe line. For the present, less than half the generating plant contemplated for the full working of the undertaking is installed. There are five main turbo-generator units, of 10,000 horse-power capacity apiece. Each unit comprises a turbine of the Pelton wheel type, driving two generators on the same bedplate. The generators are direct current machines operating at 300 volts and 250 revs. per min. In addition, there are two subsidiary turbo-generators, each of 1250 kw. capacity, with alternators, triphase, 50 period, 400/440 volts at 600 revs. per min. The gross head available as yet is 764 ft., but when the surface of Loch Treig is raised as intended, the gross head will be increased to 800 ft.

As previously mentioned, the exploitation of Loch Treig is only a part (although as regards constructional difficulties the main part) of the whole scheme, which in its entirety envisages the inclusion of Loch Laggan in the supply service, and moreover proposes by the aid of artificial works to amplify and extend the resources of the whole catchment area. The minimum level of Loch Laggan in times of scanty rainfall is 818 ft. above Ordnance Datum, and by dredging the outlet it will be possible to draw it down to 804 ft. In times of heavy rainfall, however, the surface level rises to 820 ft. above O.D., and it is proposed to maintain it normally at that level by the construction of a dam, not actually at the extremity of the lake, but some distance down the River Spean, which drains the loch into the River Lochy, and so, in turn, into Loch Linnhe and the sea. The dam, which will be 700 ft. long and 130 ft. high, will, therefore, form an additional reservoir, to be known as the Spean Reservoir, which, linked up with Loch Laggan, will afford a combined area of 2440 acres and enable a depth of 16 ft. to be utilised for power purposes.

The surface level of Loch Treig is also to be raised from its present normal level of 783 ft. to 819 ft. above O.D., that is, 1 ft. below the impounded level of Loch Laggan and the Spean Reservoir, with which it will be connected by means of a tunnel 16 ft. in diameter. The tunnel will have a length of nearly three miles and a fall of 41 ft., so that the full available supply from Loch Laggan and the Spean Reservoir will flow into Loch Treig and the whole system be unified.

There are other sources which it is intended to utilise in succeeding stages, including the River Spey and its tributary, the Mashie. By building a weir across the former, its level will be raised during flood time by about 30 ft., resulting in the formation of a reservoir nearly two miles long, attaining a width of just under half a mile at its widest part. The crest level of the weir will be 880 feet above O.D., and in times of flood the excess over the normal flow of the river will be conducted through a conduit, nearly three miles in length, to the River Pattack, one of the influents of Loch Treig. An interesting point about the arrangement is that while the River Spey flows eastward and discharges into the North Sea, by the formation of this reservoir and conduit some of its water will be diverted westward, via Loch Treig, into the Atlantic.

This does not by any means exhaust all the potential sources of supply. There are several other streams the waters of which will be controlled and directed into the general storage reservoir of Loch Treig, which, by reason of its minimum net head of 695 ft., enables one horse-power to be realised for every five gallons of water per minute falling therefrom into the power house at Fort William.

Such in brief outline is the present position and the programme of future development. The completion, in due course, of the undertaking will crown an enterprise which, even in its present stage, is a unique and outstanding achievement in the annals of British water power development.

The Tercentenary of Cinchona in Medicine.

IN the dispensary of the Hospital de Santo Spirito in Rome, there is preserved a quaint fresco which bears the inscription :

Aegrotat Limae coniux Chinconia febrim
Cortice mirando pocula tincta fugant.

It depicts the Countess of Chinchon receiving from the hands of an Indian warrior the rare and wondrous bark which cured her of her fever. Probably the South American Indians knew the virtues of this bark long before the advent of the Spaniards, but apparently they attached little importance to it. Their story is that a native drank from a pool of water into which a cinchona tree had fallen and so was cured of his fever.

In 1630 Juan Lopez Canizares, Spanish *corregidor* of Loja in Ecuador, proved the efficacy of the bark of the fever tree (*Palo de Calenturas*). He is said to have recommended it to the Countess, and his is the first known instance of the use of quinine or cinchona bark in medicine. Quinine has now come to be highly valued and used throughout the world as indispensable for the cure and combat of malarial fever. So the tercentenary of the first use of quinine in medicine is this year being celebrated in Britain, America, and elsewhere, and it is appropriate to recall the outstanding incidents in the history of its utilisation and production.

The Countess of Chinchon, wife of the Viceroy of Peru, returned to Spain from Lima in the year 1640. She brought with her a supply of the precious bark and, soon thereafter, the valuable properties of ' Countess's Powder ' became widely known in Europe. Nine years later, and for the ensuing twenty years, considerable quantities of the bark were sent from Peru to Spain by Jesuit fathers. Their brethren at home were responsible for its distribution throughout their own and neighbouring countries, and thus the powdered bark came to bear the name of ' Jesuits' Powder '. There is evidence to show that by the end of the seventeenth century the use of the bark had spread to France, Italy, and Holland. In England, Robert Talbor used the drug with great effect, and King Charles II., whom he had rid of a quartan fever, honoured him with knighthood.

We owe our first definite knowledge regarding quinine-yielding species and their geographical distribution to various French and Spanish scientific expeditions which visited South America between 1735 and 1852.

Linnæus in 1742 named the genus *Cinchona* in memory of the great service to humanity rendered by the Countess of Chinchon. Misinformed as to her name, he spelt the word *Cinchona*, and unfortunately died before the error was pointed out by the Spanish botanists Ruiz and Pavon.

There are sixty-five species in the genus, but only three are worth consideration from the medical point of view, and these are *Cinchona officinalis*, *C. succirubra*, and *C. Ledgeriana*. The genus is indigenous only in South America and the various species are found scattered through primeval forests in Colombia, Ecuador, Peru, and Bolivia. They are to be found on the slopes of the Andes, in roadless and uninhabited regions at elevations between 2500 ft. and 9000 ft. on the eastern side of the main range. The Loja region in Ecuador is the home of *C. officinalis* and other ' crown barks ', so called because they were reserved for the use of the royal pharmacy at Madrid. *C. succirubra*, the red bark, is found on the western slopes of Mt. Chimborazo, while the seed of *C. Ledgeriana* was obtained from Coroico province in Bolivia.

For many years the collection of bark in the forests was uncontrolled. Ruthless methods of exploitation by which the trees were killed long before they had yielded their full quota of bark made supplies more and more difficult to obtain. By 1847 no good bark was available within a ten days' march of inhabited country. Protests were raised and measures for protection and planting were suggested, but no safeguarding legislation was enforced. Meanwhile, the demand for the bark in Europe had greatly increased, and scientific men in various countries, perturbed by the difficulties of obtaining supplies and the extravagant methods of collection, began to urge their governments to introduce cinchona to their own colonies. Dr. Royle, curator of the Botanic Garden at Saharunpur, recommended that cinchona should be planted in India, and the Dutch botanist, Dr. Blume, made a similar proposal with regard to Java.

The distinguished French botanist, Dr. Weddell, whose monograph, " Histoire naturelle des Quinquinas ", is one of the most important contributions to the literature on this subject, made two expeditions to Bolivia, in 1847 and 1852. He brought seed of *C. Calisaya* to Europe, from which plants were raised both in the Jardin des Plantes in Paris and in the Royal Horticultural Society's Garden in London. Some of these plants eventually reached both India and Java.

For the extensive plantations contemplated, further supplies of plants and seed were necessary, and in 1851 Justus Karl Hasskarl, then superintendent of the Botanic Gardens at Buitenzorg, sailed for Peru. After many adventures he succeeded in reaching Java in 1854 with a number of plants of a species which, unfortunately, turned out to be of very little value and was given the name *C. Pahudiana*.

Sir Clements Markham with his fellow labourers, Dr. Spruce, Mr. Weir, Mr. Cross, Mr. Pritchett, and Mr. Ledger, were successful in introducing cinchona into India, in various consignments of plants and seeds, sent between the years 1861 and 1878.

Markham and Weir set out for the Caravaya forests in the spring of 1860 and reached the valley of the Tambopata River in May. On their return journey they met with considerable opposition, for the local government, fearing the ruination of their monopoly in the supply of bark, did their utmost to prevent the export of cinchona plants.

By following a devious route the explorers arrived at the port of Islay on the coast of Peru in June with a supply of plants which were placed in Wardian cases and shipped to India via Panama and the Red Sea.

Spruce and Cross were successful in collecting seed and plants of *C. succirubra*, the red bark, from the slopes of Mt. Chimborazo, and these were shipped from Guayaquil in January 1861. Cross made several subsequent expeditions; he went to the Sierra de Cajanuma from Loja in the autumn of 1861, bringing back seeds of *C. officinalis*; twice he visited the forests of Pitayo in the extreme south of Colombia to gather seed of *C. pitayensis*; and finally, in 1877, he travelled to the upper reaches of the Caqueta River to obtain the seed of *C. Calisaya* and the soft Colombian barks. Pritchett collected plants and seed of the grey barks, *C. nitida*, *C. micrantha*, and *C. peruviana*, from the Huanuco forests to the north of Lima.

Charles Ledger was engaged on his own account in the bark and alpaca wool trades in Peru. He had made several expeditions to obtain bark, in one of which his partner, Mr. Backhouse, was murdered by the Chuncho Indians and Ledger had only escaped with his life. Knowing the desire of the British and Dutch Governments to obtain seeds of the best species, Ledger sent his old Indian servant Manuel Mamani to the cinchona forests in the region of Coroico. Mamani, faithful to his trust, persevered and at length, after several years of search, delivered seeds from the best (the *roja*) trees to his master. But he had roused the enmity of the Bolivians and soon afterwards was thrown into prison, beaten and half starved. Robbed of all he possessed, he died of the ill-treatment he received. Manuel Mamani deserves to be remembered, for to him we owe the seed of *C. Ledgeriana*. It is this species which in cultivation yields the highest percentage both of quinine and of the other alkaloids, and the productiveness of the plantations both in India and in Java is due mainly to the richness of its bark.

In the introduction of cinchona to India, the Royal Botanic Gardens, Kew, played an important part, not only by raising plants from seed, but also by tending those which arrived from Panama so that they might recuperate ere they faced the perils of their further journey through the Red Sea. Although there were many casualties among the plants which were dispatched from South America, some eventually arrived safely in India. From small beginnings made in 1861 the large plantations in the Nilgiris and in the Darjeeling district of Bengal were gradually established. To Mr. McIvor, of the Government Gardens in Ootacamund, and to Dr. Anderson, of the Royal Botanic Gardens, Calcutta, the task of developing the plantations was entrusted, and Dr. Anderson was succeeded by Mr. C. B. Clarke, Sir George King, and Sir David Prain. We owe to them, too, a debt of gratitude. They have built up a great enterprise. In India we have now under cinchona some 3500 acres, yielding about 40,000 lb. of quinine each year. India, however, is the only country within the Empire in which cinchona is seriously cultivated.

Much has been accomplished, but there is still much to be done. The potential demand for quinine is far in excess of available supplies. India provides only about one-third of the amount of quinine she herself at present consumes. It has been estimated that in order to have any effect upon her malarial problem, she would have to increase her production by eighteen times; and what of the needs of the rest of the Empire and the 800,000,000 people who suffer from malarial fever?

There can be no more fitting manner in which to mark the tercentenary of the first use of quinine than by reviving and renewing our efforts to increase the production of cinchona, the principal agent in the combat of malaria. The problems to be faced are the finding of further areas of suitable land and the application of scientific research to increase the output from existing plantations. May we look forward hopefully to the time when the united efforts of the administrator, the medical officer, the planter, the manufacturer, and of those responsible for distribution and propaganda have brought the scourge of malaria well under control—when Sirius no longer

"O'er the feebler stars exerts his rays;
Terrific glory! for his burning breath
Taints the red air with fevers, plagues, and death."

Obituary.

Col. J. W. Gifford.

COL. JAMES WILLIAM GIFFORD, whose death occurred at his home at Chard, Somerset, on Oct. 27, in his seventy-fourth year, was one of that select band of scientific workers of whom Sir William Spottiswoode, Warren De La Rue, and others were brilliant examples; men who, in addition to their ordinary occupations, found time and opportunity to follow the pursuit of pure science for the love of it. Col. Gifford was by profession a lace manufacturer, and at his death was managing director of the firm of Messrs. Gifford and Fox, of Chard.

The present writer was first brought into touch with Col. Gifford in connexion with an inquiry into the so-called musical properties of some sands that are found on the coasts of Scotland and elsewhere; these sands, when trodden upon, emit a musical note or squeak which becomes fainter and is soon lost altogether if the same specimen is used repeatedly. Col. Gifford found, by the simple operation of rolling the sand down an inclined board several times, that the musical property was restored, evidently by the removal of the fine dust of silica that was produced by the rubbing together of the grains of quartz.

On the discovery of X-rays by Prof. Röntgen in 1895, Col. Gifford entered with enthusiasm upon the new field of research and became an active member of the Röntgen Society, which was founded

by the late Prof. Silvanus P. Thompson, and he soon became an authority on the subject. He gave his services to the members of the medical profession at Chard and made many radiographs for them in the early days of the science.

Col. Gifford's chief activity was, however, in the field of optics, and he was the author of many valuable papers dealing with the construction and improvement of telescopic lenses. He was an active fellow of the Royal Astronomical Society, the Optical, Microscopical, and other kindred Societies, and communicated several important papers to the Royal Society, in the *Proceedings* of which the following are published: "The Refractive Indices of Fluorite, Quartz, and Calcite", "The Refractive Indices of Water and Sea Water", "The Refractive Indices of Benzene and Cyclohexane", and "The Existing Limits of Uniformity in producing Optical Glass".

Col. Gifford was the author of a book on "Lens Computing by Trigonometrical Trace". In a foreword to the book, Prof. F. Cheshire, formerly director of the Technical Optics Department of the Imperial College of Science and Technology, pointed out that "Col. Gifford never relied upon the glass-makers' catalogue for the optical constants of the glasses, but determined these data for himself, and the excellency of the systems that he produced was undoubtedly due to this fact". In the old Volunteer Force he held the position of hon. colonel of the Fifth Somersets; and when the War broke out he took an active part in military matters. He was sent to the front by the War Office to report upon the proposed introduction of giant periscopes for use in the trenches, and later on produced a convenient short high-power telescope for the use of officers.

Taking an active part in local affairs in Chard, Col. Gifford was chairman of the Board of Governors at Chard School, of which he was an old boy; and for many years he maintained at his own expense a nurse for the district. He will be greatly missed there by all who knew him. In 1883 he married Emma, daughter of Mr. Ernest Rossiter, of Taunton, to whose assistance in his scientific work he pays grateful tribute in many of his papers. He had one son and four daughters, all of whom survive him.

J. H. GARDINER.

WE regret to announce the following deaths:

Dr. J. W. Evans, C.B.E., F.R.S., a past president of the Geological Society and of Section C (Geology) of the British Association, on Nov. 16, aged seventy-three years.

Dr. E. R. Frazer, a distinguished pathologist and benefactor of the University of Oxford, on Nov. 17, aged sixty-three years.

Dr. G. H. K. Macalister, formerly principal of the Singapore Medical College and editor of the *Malaya Medical Journal*, on Nov. 2, aged fifty-one years.

Dame Mary Scharlieb, D.B.E., a pioneer in medical education for women, on Nov. 21, aged eighty-five years.

Prof. J. H. Teacher, St. Mungo (Notman) professor of pathology at Glasgow University, on Nov. 21, aged sixty-one years.

News and Views.

DISSATISFACTION with the Government's decision to allow the Dyestuffs (Import Regulation) Act to expire on Jan. 15 next is not confined to circles associated with an industry of exceptional national importance; it is shared by all those who have a care for chemical education and research in Great Britain. The intimate relation which connects the existence of a flourishing dyestuffs industry on one hand with the acquisition and application of knowledge in many other branches of organic chemical science and on the other hand with the supply and facilities for training of competent organic chemists has already been pointed out in the columns of NATURE. This relation is patent to members of the scientific community, and it should not be difficult of appreciation by those responsible for the oversight of our economic and educational destinies. It is not our desire to enter into the polemics of the political aspect of the matter, although it would indeed appear from reports of Mr. Graham's answers and Sir P. Cunliffe-Lister's question in the House of Commons on Nov. 19 that prejudice to the dye-user could easily be avoided. The substance of our protest is rather that, so far as the evidence at present available appears to indicate, the decision rests entirely on political opinions and ignores facts which relate both to the progress of science and to the maintenance of British scientific standing. Until scientific education is more widespread than at present, it would be unreasonable to expect our political leaders themselves always to exercise appropriate judgment in scientific matters, but they are not thereby absolved from the duty of basing their actions on questions of fact ascertained judicially or otherwise.

ORIGINATING with Sir William Perkin's classic researches, the coal-tar dyestuff industry in Great Britain was an early victim to German scientific enterprise and organisation. A tardy realisation of the place of chemical science in the national economy born of war conditions, followed by effective political action during the past ten years, has resulted in the home production of dyes rising to so much as 93 per cent of the consumption; coincidently there have grown up in the universities of Great Britain and in industrial laboratories active schools of research directed towards a strengthening of the foundations of the chemical industries in general. This fundamental work has been in large measure rendered possible by direct assistance and by offers of employment by the industries concerned. Even were it possible to ignore the incidence of these developments on intellectual momentum, on future employment in parallel branches of manufacture, and on health and comfort, there still remains the fact that a million pounds is spent annually in the purchase of foreign

dyes. Deprived of effective protection and encouragement, and exposed to the full blast of world competition in home markets, the industry may survive, but it can scarcely be expected to develop in the way which our national security demands. It is earnestly to be hoped that the decision which has been announced is amenable to modification on reconsideration, and that in the event of its being confirmed, alternative means to encourage progress in organic chemical industry and education will be immediately substituted.

AT the anniversary meeting of the Royal Society one hundred years ago, a new president had to be elected as a successor to Mr. Davies Gilbert, who had resigned office. Other changes were also necessary at the time, choice having to be made, respectively, of a new treasurer, secretary, and foreign secretary. The considerations attending an appointment to the presidential chair were, in many aspects, peculiar, yet apparent. At the period in question dissensions and breaches were rife in the scientific hierarchy, due, it may be, partly to transmitted differences, partly to lack of adaptability to current movements in science. The relevant history of this perplexing era remains, however, to be written. Two candidates for election were put forward: (1) no less a personage than H.R.H. Augustus Frederick, Duke of Sussex, and (2) J. F. W. Herschel, the distinguished astronomer and physicist, designated in influential circles as eminently qualified by his varied and profound knowledge, and as one acceptable to men of science in England and in foreign countries. Weld, the compiler, records that the selection of a president was left in the hands of the general body of fellows coming to the anniversary meeting. The public journals announced that in the ballot the Duke received 119 votes, Herschel, 111. It is of interest to note here that Herschel had been elected into the fellowship in 1813 and when twenty-one years of age; also, that Faraday was a member of council in 1830.

IT was resolved that a deputation should wait upon the newly elected president and inform him of the decision taken. Further, it is recorded (in the same public manner) that His Royal Highness had afterwards addressed the fellows, assuring them that he would use every endeavour to advance the interests of science and of the Society. He stated that it was his intention to throw open his house alternately on the forenoons and evenings of Wednesdays for the reception of the fellows and men of science; those who could not do him the pleasure of breakfasting with him, might be able to attend from half-past eight to eleven at night. The Duke maintained the duties of office until Nov. 30, 1838, and we are told that during his tenure of the presidency he constantly presided at all meetings of the council and Society. It was to Davies Gilbert, the president referred to above, that the eccentric Earl of Bridgewater, who died in 1829, left by will the sum of £8000, placing upon him the responsibility of nominating some person or persons to write, print, publish, and expose to public sale one thousand copies of a work "On the Power, Wisdom, and Goodness of God, as manifested in the Creation". The 'Bridgewater Treatises' were published in 1833–35, Whewell, Charles Bell, Buckland, and others providing the essays.

IN the year 1830 the Royal Society did not allot its Copley medal; neither, by the way, had it done so in the two previous years. Also, the gift of the Rumford medal was intermitted in 1830. Medals were given only to David Brewster and Prof. Antoine Jérôme Balard, of Montpellier, who each received a Royal medal, the former "for his communications to the Royal Society on the Polarization and other properties of Light"; the latter "for his discovery of Brome". Brewster was elected into the Royal Society in 1815; in the same year he was awarded the Copley medal, a double distinction probably in character without any parallel. Antoine J. Balard was born at Montpellier in 1802, and he died in Paris in 1876. Originally Balard had worked in his native town as a pharmacist, but, later on, researches in various branches of applied chemistry claimed his undivided interest. In 1826 he succeeded in isolating from sea-water the chemical element bromine, whilst he studied its compounds in sea-water, particularly from the point of view of production for industrial purposes. A wider sphere offered itself in Paris as successor to Thenard at the Faculté des Sciences; in addition, in 1851, he was appointed professor of chemistry in the Collège de France. Balard was elected a member of the Paris Academy of Sciences in 1844, but his name does not appear on the foreign membership roll of the Royal Society.

THREE fellows of the Royal Society, all of them distinguished by long and notable scientific activity, have celebrated birthdays during the past week. They are, respectively: Prof. J. Cossar Ewart, a graduate and formerly Regius professor of natural history of the University of Edinburgh, who, on Nov. 26, entered on his eightieth year; Prof. Horace Lamb, a graduate of Trinity College, Cambridge, and formerly professor of mathematics in the University of Manchester, who, on Nov. 27, reached the age of eighty-one; and Sir J. Crichton-Browne, also a graduate of Edinburgh, past president of the Medical Society of London, the Neurological Society, and the Medico-Psychological Association, and for many years treasurer of the Royal Institution, who attained the age of ninety on Nov. 28. To all three our hearty congratulations are extended.

"BIOLOGY in Education and Human Life" was the subject of the Henry Sidgwick Memorial Lecture for 1930, delivered at Cambridge by Prof. A. V. Hill. It was a strong plea for a wider appreciation of the interest and value of biology in human affairs. At present, biology is unfairly handicapped. At school, classics and sciences like mathematics, physics, and chemistry usurp the time-table to the exclusion of biology, biasing the outlook of youth before it can decide the course of its own likings, and forming an anchorage of knowledge which the student fears to leave on a voyage into the unknown. "As a practical

step biology must demand that, with all its intellectual interest and its importance in human affairs, it should be brought sufficiently to the notice of boys and girls to enable them to decide with their eyes open whether that, or something else, is what they wish to study." It is, indeed, a strange thing that a science fundamental to an understanding of the world around us and of the workings of the human body and mind should be regarded as a sort of cultural embellishment, when the reasonable position is that ignorance of the nature of living things should be looked upon as a real lack of education. The pity is the greater because children in general, regardless of their upbringing, find the world of living Nature vastly interesting, and so far from finding it beyond their grasp, they display ample evidence in their biological studies of ability to classify facts, recognise relations between ideas, make generalisations, and formulate results.

PROF. HILL proceeded to illustrate from current problems in human affairs the necessity of a sound biological point of view. The incidence of feeble-mindedness and the limited extent by which it may be reduced by the methods generally urged by eugenists, the impossibility of amalgamating social notions and race improvement based upon the type of selection and breeding common to the development of domestic animals, the fallacies of sense observation and mental processes—these and many other problems can be understood only when brought into relation with the known facts of biology. There is something to be said for the creation in the universities of professors of conjuring, so that proper emphasis may be placed upon the extreme fallibility of the senses. In the wider study of humanity, also, biology must play an important part. It offers the most humane and charitable approach to the study of human conduct; its exploration of mankind as a biological unit may become a field of extraordinary fertility and significance for the future of the race; and perhaps its most important service would be to give man a reasonable attitude towards life. The address should be read by all educationists, and not least carefully by the exponents of classics, mathematics, physics, and chemistry. Prof. Hill has kindly consented to its publication shortly as a Special Supplement to NATURE.

MR. ARNOLD BENNETT, in the course of an article in the *Evening Standard* of Nov. 20 on Sir James Jeans's book, "The Mysterious Universe", pays NATURE a compliment which we gratefully acknowledge. He says, "I regard NATURE as perhaps the most important weekly printed in English, far more important than any political weekly. My esteem for NATURE is enormous, for I have learnt a tremendous lot from it. But the writing of it is considerably inferior to the matter of it." As examples of this inferiority, Mr. Bennett quotes two sentences from an article in our issue of Nov. 8. We suggest to him, however, in all humility, that similar examples of careless construction could be selected from the pages of any issue of any literary periodical, and that his generalisation is scarcely just to us. We cannot pretend that the highly specialised subjects of modern science can always be described in words of common speech, but we do endeavour to maintain a high standard of English in contributions generally, and we regret as much as anyone when slipshod or ambiguous phrases escape our notice. It would be easy, however, to find on almost every page of every issue of the *Evening Standard* worse examples of hasty or clumsy writing than the two quoted by Mr. Bennett from a single article in NATURE; but no doubt he assumes that our literary standard should be higher than that of an evening newspaper—as indeed it is.

THE Association of Scientific Workers, in spite of the financial stringency with which it, like other good causes, is afflicted, still adds to its record of achievement. During the past few months it has prepared, and submitted to the Royal Commission on the Civil Service, a formidable body of evidence dealing with the position of the scientific Civil servant *vis-à-vis* his administrative colleague, and advocating the unification of all the State scientific services under a Ministry of Science. At the same time, the Association has prepared an index of references to science and cognate matters in the Parliamentary Debates, and through its general secretary, Major A. G. Church, M.P., has formed a Parliamentary Science Committee. This Committee, consisting of members of both Houses and all parties, meets periodically to hear the views of acknowledged experts on scientific questions which bear on public affairs.

SOME years ago the Association issued an appeal for members, in the form of a letter signed by some of the most prominent men of science in Great Britain. This letter was sent to about 20,000 scientific workers, and resulted in a large increase of membership. At the present time the Association is sending out another such appeal, on a much more elaborate scale. It consists of a sixteen-page booklet entitled "The Profession of Science", containing articles by Sir Richard Gregory, Prof. Julian Huxley, and others, with messages from Sir Ernest Rutherford, Sir William Bragg, the Rt. Hon. W. G. A. Ormsby-Gore, and Prof. Donnan, and a preface by Sir Daniel Hall as president of the Association. The booklet is being sent to 25,000 scientific workers, and at the same time a card index of qualified scientific men is being prepared, with the intention of preserving it and keeping it continually up-to-date. In this way, as a by-product of the Association's own propagandist activities, information is being collected which will prove invaluable when it becomes possible to create an authoritative register of the profession of science, such as the professions of law, medicine, dental surgery, and teaching already possess. Work on this card index has been in progress for four weeks, and it is already clear that the figure of 25,000 falls considerably short of the total of qualified workers in Great Britain.

AT the annual general meeting of the British School of Archæology in Jerusalem, which was held on Nov. 21, Prof. J. L. Myres, chairman of the Council, made the first public announcement of an important archæo-

logical enterprise which is to be undertaken on an international basis. Harvard University, which has been considering an intensive investigation of the important site of Samaria, excavated in part only by Dr. Reisner, has invited the co-operation of the Palestine Exploration Fund, the British School of Archæology in Jerusalem, and the Hebrew University of Jerusalem. The British Academy has also consented to co-operate and has promised a contribution of £1000 from the accumulated income of the Scheiwz Fund towards the expenses of the British wing in the first year. The work will be under the direction of Mr. J. W. Crowfoot, who will leave England shortly to make the preliminary survey and organise the labour required. It is expected that the actual work of excavation will begin in March or April next and continue until well into the summer as weather permits. An undertaking has been given to provide about £1000 a year for the next three years to meet the liberal proportion which Harvard and its friends are providing.

THE Electricity Commissioners have issued a 'return of the fuel consumption and units generated' in Great Britain for the year ended Mar. 31, 1930 (London: H.M. Stationery Office). The first return was issued for the year 1921 and the comparison of the results is very satisfactory. In 1921 there were 463 power stations and 3·32 lb. of coal and coke were used per kilowatt hour generated. Last year's return covers 568 power stations, the average consumption being 1·97 lb. per unit, or only a little greater than a half that of nine years ago. The most economical station was that at North Tees, which had a consumption of 1·28 lb. of fuel per electrical unit generated. At twelve very large power stations the consumption was less than 1·5 lb. per unit. In 1921 the most economical station consumed 1·7 lb. per unit. The total electricity generated last year increased ten per cent above that of the preceding year, while the total fuel consumed increased only six per cent. During the year 33 stations were closed, 13 new stations were put into operation, and returns for 24 more are given for the first time. The North Tees station of the Newcastle-upon-Tyne Electric Supply Company obtained an average thermal efficiency of 23 per cent taken over the whole year. These figures prove that the provisions of the Electricity (Supply) Act, 1926, are beginning to act beneficially for the country. Whilst water power stations only produced 1·38 per cent of the total, the utilisation of waste heat from blast furnaces, etc., produced 2·06 per cent of the total.

IN a previous issue (Aug. 9, p. 220) we gave a preliminary account of the recent descent in the Atlantic Ocean to a depth of 1426 feet by Dr. William Beebe and Mr. Otis Barton in the 'bathosphere'. An article by Mr. Barton in the October issue of the *Scientific American* gives further details of this remarkable apparatus. The bathosphere, which was designed by Mr. Otis Barton and Mr. J. H. J. Butler, is a single spherical steel casting 4 ft. 9 in. in diameter, with walls more than 1½ in. thick, and weighing 5000 lb. Access is gained by a 400 lb. door which can be screwed down on a special gasket and packed with white lead to be waterproof under a test submersion to 2400 ft. There are three projecting windows, each of which will take a cylinder of fused quartz 8 inches in diameter and 3 inches thick. In the dive in question, only two of the quartz cylinders were in place, the third window having been closed with a steel plug temporarily owing to damage to the quartz in fitting. These windows withstood submersion to a depth of 2400 ft. The breathing apparatus was designed by Dr. Alvan Barach, of New York, and consisted of two oxygen tanks fitted with special valves. A valve was set to allow 2 quarts of oxygen to escape per minute for the two divers. Under these conditions, each tank would last about three hours. Soda lime and calcium chloride held in wire mesh trays were used to absorb the carbon dioxide and moisture respectively from the air. The divers were in the tank for more than an hour and a half and felt no untoward effects beyond a slight excess of pressure. The bathosphere was operated by a 5-ton winch holding 3500 feet of ⅞ in. steel-centre non-spinning cable, capable of sustaining 29 tons.

THE Annual Report of the Director describes the activities of the Meteorological Office during the year ended Mar. 31, 1930, the seventy-fifth year of its existence and the tenth year since it has been a department of the Air Ministry. The year was one of great activity in international co-operation, and, as well as meetings of several commissions, the report includes accounts of three important conferences—the International Conference on Safety of Life at Sea, in London in April and May 1929; the Conference of Empire Meteorologists, in London in August; and the International Conference of Directors of Meteorological Services, at Copenhagen in September. These conferences led to the recognition of marine meteorology in international treatises, to a radical improvement in the interchange of meteorological data throughout the world, and a much closer connexion between the meteorological services of the British Empire. During the year a new international code for the transmission of the meteorological messages, approved at the Copenhagen Conference, was adopted. Among other matters in the Report it is of interest to note that at the Copenhagen Conference the proposals for a second Polar Year in 1932–33, fifty years after the first in 1882–83, was adopted with enthusiasm. The proposals now under discussion are that a number of small observing stations should be established around and within the Arctic regions, and similarly so far as possible in and around the Antarctic regions, where observation of terrestrial magnetism, aurora, weather, upper air currents, and temperature should be carried out during twelve months according to an international plan.

IN the issue of NATURE for Aug. 16 (p. 259) we published a brief résumé of certain observations by Dr. Harry L. Shapiro on the physical characters of the descendants of the mutineers of the *Bounty*, which had appeared in the *Memoirs of the Bernice P. Bishop*

Museum of Honolulu. The well-authenticated origin of these people and their prolonged isolation give them an especial importance in anthropological science. Studies of hybrids based upon well-attested data in which the component factors can be distinguished with any certainty have not often been made. Although we dealt with physical characters only, Dr. Shapiro went on to record further impressions which are of considerable psychological and sociological import. A correspondent has written to us stressing this aspect of Dr. Shapiro's work in relation to the discussion of the "so-called 'inherent defects' of 'half-castes'". The writer quotes the following passage in particular from Dr. Shapiro: "This study of race mixture on the whole rather definitely shows that the crossing of two fairly divergent groups leads to physical vigour and exuberance which equals if not surpasses either parent stock. . . . This conclusion regarding the physical vigour of the Norfolk hybrids applies also to their social structure, which on Pitcairn was not only superior to the society instituted by the Englishmen themselves but also contained elements of successful originality and adaptability". So far, then, as Dr. Shapiro's observation goes, neither cross-breeding nor in-breeding has produced any evidence of degeneration in these people, but it is obvious that certain reservations would have to be made before this conclusion could be given extended application. It is to be noted, however, that the Pitcairn Islanders are an instance of hybridisation in which no allowance has to be made for the social factor of an adverse environment which so often vitiates argument concerning cross-breeds.

THE Report of the Scottish Marine Biological Station for the year ending Mar. 31, 1929, shows very satisfactory progress. Before their departure to the Great Barrier Reef, Miss M. Marshall and Mr. A. P. Orr continued in the spring their plankton investigations on the diatom increase in Loch Striven and the physical and chemical conditions accompanying it. This was much less regular than usual, owing mainly to the strong winds mixing the water down to a considerable depth and carrying the diatoms below, where photosynthesis was impossible. Cultures of diatoms were sunk at different depths at the same time and their photosynthesis measured by the oxygen production. The results showed that the depth limit of growth was much affected by the presence of diatoms in the water, the water becoming more and more turbid as the diatoms increased, the turbidity decreasing again as the diatoms sank. Experiments showed that an actively growing diatom culture adds no perceptible quantity of soluble organic matter to the culture fluid. Mr. J. Mitchell, working on the food of the copepod *Pseudocalanus elongatus*, concludes that it feeds mainly on diatoms, for although no skeletal remains were found inside the gut, a green fluid was present in half the specimens examined and a similar green fluid was in the guts of *Pseudocalanus* living in a persistent culture of the diatom *Coscinosira polychorda*. Mr. H. B. Moore and Mr. R. G. Neill have been analysing the Clyde mud from various stations and find significant difference between the muds of different levels. Miss Lloyd has investigated the marine bacteria of the Clyde area, and Mr. A. C. Stephen has continued his researches on the biology of *Tellina tenuis*.

THE Department of Geology of the British Museum (Natural History) has received a plaster cast of the skull of Peking man. The skull has been described in NATURE by Prof. G. Elliot Smith (Mar. 22, p. 448, and Aug. 9, p. 210.) Recent accessions in the Department of Entomology of the Museum include more than 1400 specimens of two-winged flies (Diptera) from Mt. Kinabalu (13,455 ft.), British North Borneo. Many plants and animals (including even birds) found there do not occur anywhere else in the world, and possibly represent old forms of life which have persisted on the mountain during successive ages. Some species show affinities with the mountain fauna of the Philippine Islands. Similar interest attaches to the presentation by Dr. K. H. Barnard of five species of the remarkable African stagbeetles of the genus *Colophon*, including the types of four species discovered by the donor and new to the collection. These insects are confined to mountain summits in the south-western area of the Cape Province, South Africa. They are unable to fly, and each form is completely isolated from the other species. Stagbeetles are woodfeeders, and the occurrence of representatives on treeless South African mountain-tops is at present unexplained. The Rev. J. W. Spreckley has presented to the Department of Botany three bundles of the Chinese fungus, *Cordyceps sinensis*. This fungus attacks the larva of an insect which eventually dies, and its interior is gradually absorbed until it is practically a solid mass of mycelium though it retains its shape. Out of one end the fertile part of the fungus grows. It is a celebrated drug and is found apparently only on the Tibetan border. It is said to bestow energy and to be partaken of with stewed duck. Another interesting gift is a quantity of hazel nuts of immediate post-glacial date, from Loch Treig, Inverness-shire, presented by the North British Aluminium Co., Ltd. This year, owing to an unusual spell of dry weather, the level of the lake was reduced and a thick bed of dark-coloured hazel nuts was seen at the north (exit) end of the lake at 741 ft. above sea-level.

DR. C. S. MYERS, who has been Director of the National Institute of Industrial Psychology since its inception nine years ago, has asked to be released from the duties of directorship, and has been appointed Principal in order that he may devote the whole of his time to the Institute's research and educational activities. Dr. G. H. Miles, who has been Assistant Director for several years, has now been appointed Director of the Institute and will take charge of the whole of its practical activities. The number of firms requesting advice from the Institute has been a record one this year, and the number of young people applying to the Institute for recommendations as to the careers to which they are best suited has increased by 50 per cent on last year.

AT a Congregation held at Oxford on Nov. 22 the degree of D.Sc. was conferred on Mr. J. J. Manley, research fellow of Magdalen College. Dr. Manley's work, extending over thirty-five years, includes papers concerned with the preparation of 100 per cent nitric acid (with V. H. Veley, *Phil. Trans.*, 1898), devices for increasing accuracy in weighing (*Phil. Trans.*, 1910), the apparent change in mass during chemical reaction (*Phil. Trans.*, 1912), and the union of helium with mercury (NATURE, Dec. 13, 1924, p. 861; *Phil. Mag.*, 1927). His work upon the law of conservation of mass is a distinct advance upon that of Landolt, due to the greatly increased accuracy in weighing, and the simplicity of the reaction studied (barium chloride and sodium sulphate). Dr. Manley is now engaged upon a study of the change in physical properties (other than boiling point) of benzene and its homologues when submitted to prolonged drying.

AT a well-attended meeting of medical men and women representative of the study and practice of physical methods of treatment, held on Nov. 14 under the chairmanship of Sir Leonard Hill, it was resolved to form a Society of Physical Medicine. A sub-committee under the chairmanship of Sir Leonard Hill was appointed for the purpose of drafting a constitution and dealing with other urgent matters. The acting honorary secretary is Dr. King Brown, 69 Grove Park, Denmark Hill, London, S.E.5.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in civil engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Dec. 8). Temporary assistants under the Department of Agriculture for Scotland for, respectively, work on virus diseases of the potato and for field work in connexion with potato culture—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (Dec. 9). A part-time physics demonstrator at the London (Royal Free Hospital) School of Medicine for Women—The Warden and Secretary, 8 Hunter Street, W.C.1 (Dec. 10). A professor of education in the Rhodes University College, South Africa — The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W.C.2 (Dec. 15). A resident lecturer in fruit and vegetable preserving at the Swanley Horticultural College for Women, Swanley—The Secretary, Horticultural College, Swanley, Kent (Dec. 15). An assistant in botany in the University of Glasgow—The Professor of Botany, The University, Glasgow, W.2. A head of the Chemistry Department in the Chulalongkorn University, Bangkok, Siam — The Siamese Legation, S.W.7. A part-time physics demonstrator at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W.8.

Our Astronomical Column.

Comet 1930 *g*.—*Circ.* No. 304 of the I.A.U. Bureau, Copenhagen, announces the discovery of a comet of magnitude 13·5 by Prof. Nakamura at Kyoto, Japan, at $13^h\ 50{\cdot}0^m$ U.T. on Nov. 13, its position being R.A. $3^h\ 40^m\ 41{\cdot}5^s$, N. Decl. 18° 53′ 25″. The comet is 1930 *g*, being the seventh discovery this year, but the eighth to pass perihelion this year. The above circular wrongly assigns the letter *f* to it; that letter was assigned to Tempel's periodic comet.

Mr. Sibata has deduced the following parabolic elements for the new comet :

T	1930 Aug. 21·370 U.T.	
ω	40° 19′	1930·0
Ω	231 26	
i	8 7	
log q	9·3071	

The following ephemeris for 0 h. U.T. is calculated from these elements :

	R.A.	N. Decl.	log r.	log Δ.
Nov. 28.	$3^h\ 6^m\ 10^s$	16° 14′	0·3353	0·0792
Dec. 2.	2 59 35	15 42	0·3477	0·1082
Dec. 6.	2 53 57	14 58	0·3595	0·1433

The comet is well placed for observation, being not far from opposition; the distance from both sun and earth is increasing, so it will fade fairly rapidly. The small inclination suggests that it may prove to be periodic.

Fireball.—Mr. Denning writes: "A brilliant fireball was observed by the Rev. F. H. Carr-Gregg of Nuneaton, on Nov. 16, at $9^h\ 44^m$ P.M. It moved slowly, being visible for 5 seconds, and gave a strong outburst of light before it disappeared. Its flight was from 165° +55° to 135° +35° and its probable radiant point was in the south-west region of Hercules or near the star alpha Capricorni. Another observation would be valuable for the purpose of computing its real path. It must have been a very lustrous object as seen from the north-western counties of England."

The Leonids.—A few Leonids appeared on Nov. 16–17, but they were less in number than the meteors which are usually seen during an ordinary display of the Perseids. They were, however, more active than in several preceding years, and gave promise that in 1931 and 1932 they may be observed in greatly increasing numbers.

Pluto.—An article by E. C. Bower and F. L. Whipple in *Publ. Astr. Soc. Pacific* for August 1930 states that the Mount Wilson plates of December 1919 were taken with the 10-inch refractor specially to search for the Lowell planet: this was, however, so much fainter than was expected that the images were not detected until last June, when a fairly accurate ephemeris was available derived from the positions of 1927 and 1930: they were then located with the aid of a blink microscope. The final orbit of Messrs. Bower and Whipple represents the observations as follows :

Date.	Place.	Observed—Tabular R.A.	Decl.
1919 Dec.	Mt. Wilson	+0·8″	+2·8″
1921 Jan.	Yerkes	+13·6	−3·4
1927 Jan.	Yerkes	+0·2	−2·1
1927 Jan.	Uccle	+3·5	+2·2
1930 Jan.	Flagstaff	−2·3	−2·9
1930 Feb.	Flagstaff	..	−0·5
1930 Mar. 26	..	0·0	0·0
1930 April 24	..	+0·3	+0·1
1930 May 24	..	0·0	+0·2
1930 Aug. 21	Yerkes	−0·5	−0·1
1930 Aug. 22	Yerkes	−0·6	+0·6
1930 Sept. 1	Yerkes	+0·2	+0·2

The revised Uccle position of 1927 January has been used.

The nearest approach to Neptune in recent years was 19 units in 1892; that to Uranus was 30 units in 1853. The Gaussian constant in the investigation was taken as 0·017213628; this is derived by adding the masses of all the planets to that of the sun.

Research Items.

Hawaiian Feather Cape.—A remarkable feather cape, practically in mint condition, is figured and described in *Man* for November, by the owner, Mr. H. Beasley. The cape, which had hitherto not been recorded, was presented to Admiral Otto von Kotzebue, of the Russian frigate *Rurik*, by Namehana, wife of Kamehameha I., in 1816, and remained in the possession of the family until 1928. The cape measures 32½ inches across the top, and 27 inches in depth. It is therefore of more than average size. The main groundwork is of Red Iiwi, while the border, a double crescent, and six pointed panels along the top are all of yellow 'oo'. The second half of the six panels, as well as the semi-lunar details in the double crescent, are in black.

Geophagy.—The interesting but obscure custom of earth-eating, which has been recorded among a number of peoples in various parts of the world, is studied by Dr. Berthold Lauffer in a monograph published by the Field Museum of Chicago (*Publication* 280, Anthropological Series, Vol. 18, No. 2). Geophagy is not a universal custom, yet it may occur almost anywhere, among civilised peoples as well as primitive tribes. Nor is it general in any particular tribe or group. It is recorded in China, Indo-China, Malaysia, Melanesia, Polynesia, Australia, India, Burma, Siam, Central Asia, Siberia, Persia, Arabia, Africa, Europe, and America. Not every kind of earth is eaten; colour, odour, flavour, softness, and plasticity determine the choice. The most important from the point of view of edibility is the so-called diatomaceous earth or kieselguhr, known as 'fossil meal', 'mountain meal', or in China 'stone meal' or 'earth rice', which resembles chalk or clay and consists of silicious remains of very minute aquatic organisms or diatoms. Earths used for medicine or enjoyment are fine, fat, and usually ferruginous clays. They are consumed in their natural state or lightly baked. Although geophagy has been characterised as a vice or depraved appetite, this is meaningless. Earth is eaten as a substitute for food in time of scarcity, as a relish, medicinally as by pregnant women, or as a part of a religious rite. In practice it appears to have nothing to do with climate, race, creed, culture areas, or higher or lesser degrees of culture. Dr. Lauffer gives a great many new facts which have escaped previous investigators, and the Chinese and American data are fully treated for the first time.

Coloration of Insects and Plant Pigments.—Well-known experiments by Poulton, Linden, and others appeared to have proved definitely that green and yellow colours of caterpillars are due to the absorption of plant pigments in the intestine. Later investigations suggested that at least certain insects are able to produce green pigments synthetically. The whole problem has now been very thoroughly revised by P. F. Meyer, who has published an interesting and well documented account of his experiments (*Zeitschr. vergl. Physiol.*, vol. 11, 1930). He experimented with caterpillars of various species, which were raised on white bread, with or without the addition of the respective plant pigments, and the hæmolymph was then examined chemically for the pigments. It was found that neither chlorophyll nor any of its products is absorbed in the intestine of insects, and the green pigment in the hæmolymph of insects has no relation to chlorophyll, but represents an oxidation product of a protein. Carotin was found in the hæmolymph, but it was present in the caterpillars bred on food free of carotin as well. The experiments proved also that the absence of chlorophyll and of carotin in the food did not affect the coloration, growth, or reproduction of the insects.

Colloidal Particles in Water as Food for Mosquito Larvæ.—Larvæ of *Anopheles* obtain their food mainly by filtration of water through their highly specialised mouth-parts. It was usually thought that in this way only certain Protozoa, algæ, and generally particles not less than 5μ in size are ingested and serve as food. Investigations carried out by N. K. Shipitzina in the Zoological Laboratory of the University of Perm (*Bull. Biol. Institute*, Perm Univ., **7**, No. 4) prove that the larvæ are capable of catching and retaining even colloidal particles, as for example, those of collargol, Chinese ink, and carmin. Larvæ of all stages placed in water with the above substances in colloidal solution filled their guts with them. This shows that their filtering apparatus is a kind of ultra-filter capable of retaining colloidal particles. The retention is not selective and any particles suspended in water are collected in the gut. Experiments with rearing larvæ in pond water without any other food except the colloidal substances proved that they can develop only up to the fourth stage, when they died.

Physiology of Digestion in *Sabella*.—Edith A. T. Nicol (*Trans. R. Soc. Edin.*, **56**, 1930) describes in detail the branchial crown of *Sabella pavonina*, a tube-dwelling polychæte which occurs in estuarine mud in great numbers in some localities. The pinnules of this crown are ciliated and cause a current of water to flow between the filaments. Particles in suspension are caught by the cilia and carried to a groove on each filament, down which they pass to a pair of basal folds. Here they are sorted into three grades according to size; the largest particles are carried to the palps and rejected, the medium-sized are carried to a pair of ventral sacs and stored there until required for tube building, and the finest particles are conveyed to the mouth. Particles from the ventral sacs are mixed with mucus, laid, like a rope, along the edge of the tube, and cemented into place by the mucous secretion of the first body segment. The fine particles, including flagellates, algal spores, and diatoms, pass into the gut. The food takes an average of twenty-two and a half hours to pass through the gut at 16° C. The enzymes present in the gut are an amylase, a protease, and a lipase. The reserve materials are stored in the body as fat and glycogen; the latter occurs in large quantities in the eggs but not in other tissues. An account is given of the anatomy and histology of the branchial crown and of the alimentary tract.

Effect of Sunlight on Aquatic Organisms.—In the *Canadian Journal of Research* (Vol. 3, pp. 104-106; 1930) Dr. A. Brooker Klugh gives data of experiments to study the effect of the ultra-violet component of the sun's light on certain aquatic animals which live at or near the surface of the sea or in shallow fresh water. Dr. Klugh dealt with young eels (*Anguilla rostrata*), an amphipod (*Gammarus locusta*), and a ctenophore (*Bolinopsis infundibulum*) which lives near the sea surface. Under the filter transmitting ultra-violet light only, eels were killed in 18-24 hours; amphipods, young and adult, in 2-4 days; and the ctenophore appeared little affected. These results were in marked contrast to those previously published for animals which live at some considerable depth in the sea or come to the surface only when the illumination is very weak; such forms were readily killed by exposure to ultra-violet radiation. In the experiments three filters were used, the first transmitting both the visible and the ultra-violet regions, the second only the visible, and the third the ultra-violet only.

Venom of an Australian Snake.—In the Cape York Peninsula, one of the two most common venomous

snakes is *Pseudechis australis*, from a living example of which was obtained the venom used in experiments described by C. H. Kellaway and Donald F. Thomson (*Australian Jour. Exp. Biol. and Med. Sc.*, vol. 7, p. 133). The venom was collected weekly, and gave a low yield during sloughing, and a high yield after the snake had fed when sloughing was over. Its secretion is a relatively rapid process. Subcutaneous injections were made in sheep, monkeys, cats, rabbits, guinea-pigs, rats, and mice, and the assured lethal dose varied from 3·0 mgm. per kgm. weight of the animal, in mice, to less than 0·6 mgm. per kgm., in sheep. The poison has a powerful hæmolytic action and a more marked anticoagulant action than the venom of any other Australian snake. There is little evidence of any neurotoxic action, the only hints of such action being afforded by the ptosis which occurs as an early symptom in monkeys, the effects on the blood pressure of rabbits, and the failure of respiration which in some species is the final event following its injection. Unlike most Australian venoms, it has a striking action on the heart muscle. Possibly the venom contains a hæmorrhagin; but even if present, this plays no striking part in causing death.

Caribbean Land Molluscs.—A short expedition to the Caribbean islands, made by the yacht *Mary Pinchot* between April 16 and 27, resulted in the collection of a series of land molluscs, of which twenty-seven are regarded by Henry A. Pilsbry as new forms (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 82, p. 221; 1930). Of the general results of the analysis of this collection the most striking is that 78·26 per cent of the shells from Grand Cayman are Jamaican in their affinities. The possible explanations are either that Grand Cayman was formerly a block of a greater Jamaica, or that the fauna has been carried across the intervening sea from Jamaica by hurricanes or by the ocean current. Both suggestions meet with difficulties. There is no definite set of current in the direction required, even if the molluscs were adapted for marine transport, which some are not. Transportation by birds has been observed in the case of *Succinea*, and *Cerion* and *Helicina* may have been carried by ocean currents, but the most credible explanation of the high similarity is that Grand Cayman, never connected with Cuba, which has a different assemblage of molluscs, had a land connexion with Jamaica in early Tertiary times.

Chromosome Numbers in certain Legumes.—A cytotaxonomic study of the related leguminous genera *Medicago*, *Melilotus*, and *Trigonella* has been made by Prof. J. R. Fryer (*Can. Jour. Research*, Vol. 3, No. 1). The number of chromosomes and their morphology has been recorded for 25 species of *Medicago*, 4 of *Melilotus*, and 3 of *Trigonella*, from a study of the root tips. The chromosomes are grouped as of six lengths, ranging from about 5 μ to 1 μ. All the chromosomes of each species are usually of the same size in some sections of the genus *Medicago*, but in the subsection Pachyspiræ there are usually two sizes present in the chromosome group. Satellites are also present on certain chromosomes, and tetraploid cells or sectors sometimes occur in otherwise diploid roots. In *Medicago* the somatic numbers found are 14, 16, and 32. The same numbers have been found in different species of the related genus *Trifolium*. In the genera *Melilotus* and *Trigonella* the only number found was 16. The Falcago section of *Medicago* contained some species with 16 chromosomes and others with 32, suggesting that the tetraploid species may have arisen directly from related diploid species. There is found to be no relation between tetraploidy and the perennial habit, since some diploids are perennial and some tetraploids annual. Both diploid and tetraploid strains were found in *Medicago falcata*, and reasons are given for regarding *M. media* as a hybrid between *M. sativa* and *M. falcata*.

Origin of Coal.—A readable and well documented account of recent work upon this question will be found in the *Naturwissenschaftliche Umschau* of the *Chemiker-Zeitung*, **19**, No. 9/10, by Dr. Fritz Rosendahl. Coal obviously arises from plants, and the different types of plants responsible for lignite and coal respectively can, to a considerable extent, still be recognised by the microscope. But, although attacked in various ways—by analysis of the end products in the earth, by laboratory experiments upon the behaviour of present-day plants when left to decompose under various conditions, etc.—the factors responsible for the production of peat, lignite, and coal are still in dispute. It now seems fairly clear that cellulose constituents disappear before the lignin constituents in the plant walls; fatty and waxy deposits such as plant cuticles, probably vary in importance in different deposits, varying particularly with the content in these substances of the original plant material. Lignite and coal have probably developed from peat-like deposits, and Dr. Rosendahl makes it clear what an important influence the theories of Taylor have had upon recent developments in investigation of this subject. Taylor has directed attention to the great influence the nature of the mineral covering layer will have upon the further chemical changes proceeding in buried deposits of peat-like plant material.

Geology of the Shetlands.—Continuing his investigation of the Old Red Sandstone of the Shetlands, Dr. T. M. Finlay describes in the *Trans. Roy. Soc. Edin.*, Vol. 56, Pt. 3, No. 27, 1930, the sedimentary and igneous rocks lying to the west of the metamorphic series that forms the backbone of the islands. The sediments turn out to be quite unlike those of the same system from other areas, partly because of the metamorphism they have suffered and partly because they represent fine-grained sediment slowly accumulated in a deeper basin. Plant remains are the only fossils, and they are quite untrustworthy for detailed correlation. The assemblage of igneous rocks, however, bears so close a resemblance to those of the Lower Old Red Sandstone in Scotland that the balance of evidence supports the view that here, too, the rocks are of the same age. Andesitic lavas and tuffs underlain by rhyolite and basalt are strongly developed. This volcanic phase is succeeded by an intrusive complex ranging from gabbro to granite. A third phase is represented by dykes of three series; the earliest is lamprophyric; the second is of quartz-porphyry, chilled against the first and including xenoliths derived from them; the third consists of highly acid granophyres containing spherulites with fibres of riebeckite. It is suggested that these latest dykes may possibly be of Tertiary age.

Production of Low Temperatures.—The apparatus usually employed to produce liquid hydrogen is elaborate and costly, with the result that it is available for low temperature researches in very few laboratories, although quite small quantities of liquid would often suffice. A small and inexpensive liquefier is described by M. Ruhemann in the *Zeitschrift für Physik* for Oct. 8, which, it is claimed, can be assembled in a few days by any laboratory workshop. It operates on the Linde principle, hydrogen drawn at high pressure from a cylinder, after purification, being first circulated through a tube immersed in liquid air, and then subjected to valve expansion with

regenerative cooling in the usual way. The main part of the system is supported in a Dewar flask. The temperature of liquid hydrogen (20° absolute) is attained in from five to eight minutes with an initial pressure of rather more than 100 atmospheres and a flow of a few litres per second, whilst liquid helium can be equally readily produced if liquid hydrogen is available in quantity. The use of the apparatus is obviously limited by the small volume of the vessel into which the valve opens, but, with this restriction, it makes the production of very low temperatures feasible in any place when liquid air can be obtained.

Variation of 'Flashover' Characteristics.—The use of a pressure of 132,000 volts for the transmission of electric power on the English network has brought prominently to the front many new problems in connexion with high voltages. In *World Power* for November, S. Whitehead and W. D. Owen discuss the influence of altitude on the flashover characteristics of electrical equipment. It is well known that sparks occur more readily between electrodes the smaller the density of the surrounding gas and the higher its temperature. At high altitudes also, the brush discharge, which is called the corona and is due to the high electric pressure, makes its appearance more readily. The authors discuss the formulæ from which the flashover and corona can be predicted and state that they give accurate results. The standard density and temperature of the atmosphere in engineering work is 760 mm. and 25° C. respectively. Experimental results for sparkover and flashover are reduced to this standard density and pressure. It is pointed out that this temperature is too high for general use in Great Britain. For rating machinery it is most convenient to use the standard conditions at sea-level. But the mean sea-level temperature is only 14° C., and this introduces a four per cent error in the rating. They suggest that this temperature should be taken as the standard. It is important that the rating of all the machinery and devices for very high voltages should be done for the same temperature.

Low Temperature Oxidation.—Some experiments on the lag in ignition (the interval of time between the rapid heating of a combustible mixture to, or above, the ignition point and the appearance of flame) in the case of mixtures of hydrocarbons and air are described by J. S. Lewis in the October number of the *Journal of the Chemical Society*. The lag may, in certain cases, terminate in rapid oxidation unaccompanied by flame, examples of which are given in the paper. The experiments were conducted in glass bulbs of 125 c.c. capacity with a long narrow neck, which were maintained at the desired temperature, and the liquid introduced in small wide-mouthed tubes of thin glass. Experiments with petrol freed from aromatic hydrocarbons showed that removal of the lighter constituents caused an appreciable drop in lag and in ignition temperature, and such fuel would probably 'knock' more readily. The effects of powdered glass, charcoal, metals, etc., were studied.

Replacement of Castings by Weldings.—In a paper read before the Institution of Welding Engineers on Oct. 16, Mr. P. L. Roberts discussed the possibilities of replacing iron castings by welded structures built up from rolled steel. Among the advantages which are claimed are an increase of strength of 2·5 times or a corresponding reduction of weight; economies in material used, in the workshop accommodation required, and in machining, the latter being due to increased accuracy of dimensions. Among the examples given the two extremes may be mentioned. In the first case a casting weighing 1750 lb. was replaced by a 'welding' the weight of which was 850 lb. The cost per lb. was much the same in each case, with the result that a saving of 52 per cent was effected. The largest part recorded was a casting weighing 16,000 lb. The corresponding welding weighed only 9300 lb. and cost but a little more per lb. In the aggregate a saving of 32 per cent was obtained. The greatest saving, 66 per cent, was effected on a part which as a casting weighed 5576 lb. and as a welded structure but 1920 lb. It is pointed out that if welded parts are to be as economical as possible, their design should be treated *ab initio*. The mere modification of the design of the casting means the retention of many features—such, for example, as arrangements for coring and withdrawal from the mould which, though necessary in the casting itself, are of no importance in the welding.

Preparation of Catalysts.—Dr. R. Dankoff, of the State Physical-Technical Institute, Leningrad, has sent us a communication on this subject. The method he uses consists in depositing metals from the vapour form on cold surfaces, since it was expected that such surfaces should possess a very fine structure and great capacity for adsorption. Previous experiments of Gauger with nickel and platinum so deposited, with a mixture of ethylene and hydrogen, showed that no reaction occurred, but Dr. Dankoff states that deposits of nickel, platinum, and iron produced by condensation in vacuum of 10^{-5} mm. on glass at 0° C. showed considerable activity. No great variation in the results was found with metals deposited at −180°. A mixture of hydrogen and ethylene introduced into the apparatus reacted energetically at 0°, in the case of nickel two-thirds of the mixture reacting during the first minute. The initial pressure was 55 mm., the volume 200 c.c., and the catalyst surface 100 cm.^{2}. Platinum was more active, iron less active, than nickel. In the case of nickel a dependence on the thickness of the deposit was found, indicating the porous character of the surface, as found in adsorptive experiments. A curve accompanying the communication shows the dependence of the rate of reaction on the thickness of the layer expressed as the number of layers of atoms in the deposit, but it is not suitable for reproduction.

Hydrolysis of Di- and Poly- Saccharides.—The determination of the relative ease of hydrolysis of disaccharides and of polysaccharides such as starch and cellulose has recently received attention by several experimenters. Since the structure of cellulose as a long chain of cellobiose units is now established on a reasonably firm basis, and since it may be assumed that starch is presumably derived in a similar manner from maltose, the interrelation of the reactions involving both the analysis and synthesis of these products is of interest. In the October number of the *Journal of the American Chemical Society*, Hibbert and Percival describe the hydrolysis of cellulose, cellobiose, cellodextrin, starch, inulin, and levan (from the action of *B. mesentericus* on sucrose), using zinc chloride dissolved in hydrochloric acid as a medium. A single unimolecular velocity constant is assumed. It is concluded that the slow hydrolysis of cellulose is, in a large part, due to the slow hydrolysis of cellobiose; that cellobiose is not a reversion product; and that there seem to be no grounds to suppose that starch and cellulose are essentially different, except for the α-linkages in the former and the β-linkages in the latter. The rates of hydrolysis of sucrose, levan, and inulin in 0·1 *N* oxalic acid at 65° are almost the same, and it is concluded that this behaviour is related to the γ-fructose residue present in each.

The Antiquity of Civilised Man.

THE Huxley Memorial Lecture for 1930 of the Royal Anthropological Institute was delivered on Nov. 19 by Prof. A. H. Sayce, who took as his subject "The Antiquity of Civilised Man".

One of the leading obsessions of the historian has been the belief in the recent evolution of civilisation and the shortness of the period during which it has endured, an obsession derived from medieval tradition. Another tradition derived from medieval belief was that of the decline instead of the progress of civilisation and culture. The belief in a 'Golden Age' had been fostered by the manifest relapse into barbarism which characterised medieval Europe. Civilised man, it was held, had had but a brief existence, and the documents which ascribed to him an earlier date were unworthy of credence. The heroes of the old legends became 'solar myths' and 'the ancient empires of the east' were stripped of their antiquity.

A new era has dawned upon us. The scientific method, aided by the spade, has opened up a new world and furnished us with facts instead of theories. The result is that the story of the antiquity of man which is being told by geology is being retold of civilised man by archæology. The age of civilised man must be pushed back through the centuries like the age of uncivilised man. The last hundred years have unfolded a new world—that of the civilised past.

Historical Egypt now has its lessons to teach us. While the literary historians have been vying with one another in the endeavour to minimise its antiquity, the spade of the excavator has made discoveries which have rightly been termed revolutionary. At Saqqara Mr. Firth has laid bare a complex of buildings without parallel anywhere else in the country. In the art and architecture of these buildings, and in the work of artists of the Third Dynasty in the time of King Zoser, described so recently as 1895 as a 'mythical' king, Egypt would seem to have reached its climax. Architecture, art, and glazed tiles all testify to long centuries of development which must have preceded the period of perfection to which they belong. The same impression is made upon us when we come to examine the hieroglyphic script. It is already as complete and conventionalised by use as in the days of Rameses and Darius. The alphabets are there by the side of the syllabary and ideographs; and there are indications that the hieratic or cursive hand was already employed. The smaller objects of daily life—the furniture of the house, the jewellery and garments that were worn, or the articles of the toilet—the discoveries made by Dr. Reisner in the tomb of the mother of Kheops—prove that at the beginning of the fourth dynasty the culture and art of Egypt were still at their highest level.

When we turn to Babylonia, there also the latest discoveries have pushed back the highest development of its art yet known to us to an undetermined but remote antiquity. Hitherto ancient Babylonia, whether Sumerian or Semitic, has seemed artistically deficient and inferior; its inhabitants were primarily men of business and trade, the initiators of banking and international commerce, but with little artistic sense. The Royal and other tombs found by Mr. Woolley at Ur have revolutionised our judgment on this matter. The gold and silver work, the inlaid designs in shell, have revealed an art of the first order. Yet the tombs and their contents actually belong to Babylonian pre-history rather than history. The few inscriptions found with them are not yet in the fully developed cuneiform or linear script which already had a long history behind it when Sargon of Akkad founded the first Babylonian empire in 2700 B.C. They are in fact still the pictographic designs out of which the first semi-linear and then the cuneiform signs developed. With them goes another remarkable fact. This advanced art and culture exhibited in the tombs is accompanied by human sacrifice on a vast scale, which reminds us of Dahomey rather than of the Near East. Human sacrifice was not only unknown in historical Babylonia, but also its very existence in any period of the past history of the country was ignored. Yet the Royal tombs by no means belong to the earliest period of Babylonian history. Mr. Woolley tells us of five further layers all necessarily older than the cemetery into which the Royal tombs were sunk. By them we are taken back to the times when the alluvial plains of Babylonia were only beginning to be formed at the head of the Persian Gulf.

It may be that the Royal tombs of Ur, modern as they are when compared with the strata below them, belong to a pre-Sumerian time and a pre-Sumerian race. The Sumerian people called themselves "the black-headed race". This implies that there was also a blond race in the country, an inference confirmed by the fact that Sumerian art represents them as broad-skulled, whereas most of the early skulls discovered at Ur and examined by Sir Arthur Keith prove to be dolichocephalic. On the Egyptian monuments the Amorites of Palestine are depicted as blonds with fair hair and blue eyes. In these blond Murru we must see the Mesopotamian Mitannians of later history, the Murrian or Amorite predecessors of the Sumerians. At Tepe Gawra Dr. Speiser has discovered two strata of cultural remains below the stratum which belongs to the Bronze age and the appearance of the Sumerians. In this last the copper objects resemble those found at Ur and El Obeid, which are dated to the period of the first dynasty of Ur (about 3100 B.C.), whereas the earlier strata take us back to the æneolithic period and the painted pottery of Jemdet Nasr.

The tombs of Ur, however, testify to more than an advanced art and human sacrifice. They indicate a wide international trade and the working of mines. Gold, silver, and lapis lazuli are all found in them in profusion as well as copper. Gold came from the Persian Gulf, but silver was probably brought from the mines of the Taurus. This fact is in harmony with the discoveries recently made in China and north-west India. Both at Mehenjo-Daro and at Harappa a civilisation has been brought to light which was in close touch with Elam and Sumerian Babylonia. In China, Prof. Andersson has found painted and polished pottery of the neolithic and chalcolithic age which is related to the neolithic pottery discovered in Susa; similar ware has been found in Babylonia and at Sakche-gozü, north of the Gulf of Antioch; while the recent excavations of Prof. Li at Yin in Honan have shown not only that the Shang Dynasty (1766–1154 B.C.) was historical, but also that the account of its sculpture and script, with the long preceding development and commercial intercourse implied by them, was based on fact.

The so-called Cappadocian cuneiform tablets discovered at Kara Eyuk show how extensive and modern in character Babylonian commerce must have been. The date of the Kara Eyuk documents is known. The forms of the characters and the Assyrian proper names point to the Third Dynasty of Ur (2400–2300 B.C.).

It is unnecessary to dwell upon the length of time presupposed for the rise and development of all this trading activity, with the means of traffic and use of writing which it implies. Civilised man is far older than the purely literary scholar has dreamed.

Caledon Meeting of the South African Association for the Advancement of Science.

THE twenty-eighth annual meeting of the South African Association for the Advancement of Science was held at Caledon on July 7–12, 1930, under the presidency of Mr. H. E. Wood, Union Astronomer. The meeting was well attended and eighty-two papers were read. The South Africa Medal and grant were presented to Dr. A. L. du Toit at the close of the presidential address. A popular illustrated lecture was given by Dr. G. H. Skaife on heredity. There was a reception by the Mayor and councillors and visits to various places of interest in the neighbourhood.

The presidential address by Mr. H. E. Wood was entitled "Recent Astronomical Developments". In it he pointed out that astronomical observatories throughout the world are about to combine to redetermine the mean distance of the sun from the earth, the unit in terms of which all astronomical distances are measured. This is being undertaken now because the minor planet No. 433, Eros, makes a near approach to the earth early in 1931. Mr. Wood also indicated that in many cases he enumerated, while the actual object has not been attained, many other highly important astronomical discoveries have resulted. Problems of the determination of the distances of the stars were discussed and the various methods compared. The constitution of interstellar space in the light of recent work was described. Recent advances in knowledge of the nature of light and Millikan's work on high frequency radiation were noted. The address closed with a review of man's conception of the universe at various stages of his history.

The presidential address to Section A was delivered by Prof. H. H. Paine, who dealt with "The Motion of Ions and Colloid Particles in an Electric Field". The alliance of physics, chemistry, and mathematics was indicated, with a possible extension to biology. Research in electrical specific conductivity of solutions was discussed, as were the possible effects of neighbouring ions on each other's mobilities. The rôle of the ionic atmosphere and the work of Debye and Hückel were set forth. Onsager's work, eliminating the use of Stokes's law for the movement of ions, and the Brownian movement of ions were discussed. Evidence was given from personal work that the initial rise in mobility so often observed is due to the residual electrolyte impurities in a colloidal solution. The analogy between ions and colloidal particles, so far as their electrical structures are concerned, was the chief argument of the address.

Prof. W. F. Barker chose "Some Effects of Light" as his presidential address to Section B. He first set forth the relationships of the various kinds of radiation and the effect of the excited atom or molecule. Photochemical processes were discussed in relation to photography, vision, and carbon assimilation in plants. The photochemical association in rhodopsin was briefly outlined. The far-reaching importance of photosynthesis of plants was indicated. The synthesis of sugars by plants and the decomposition products of activated carbonic acid, especially the possible intermediate production of formaldehyde, were discussed. The work of Baly, Porter, and Ramsperger was analysed and the importance of surface reactions indicated. The reactions of activated formaldehyde with simple inorganic nitrogenous compounds, with the synthesis of proteins in the daytime and their transport at night, probably as asparagine, were discussed. The nitrate supply as the limiting factor in the synthesis of proteins in plants and the practical application to the fertiliser problem were indicated. The chemistry of chlorophyll and vitamins was described and also the effects of ultra-violet light on living organisms.

The president of Section C, Dr. E. P. Phillips, gave "A Brief Historical Sketch of the Development of Botanical Science in South Africa and the Contribution of South Africa to Botany" as his address. It comprised a review of botanical progress over two hundred and fifty years. Three periods were set forth. The first commenced with the early botanical collectors from the Cape, to the time of W. H. Harvey and his "Genera of South African Plants". At the close of this period, about 1868, the first South African botanists appeared, and the second period, ending about 1903, was marked first by quiescence and then by renewed activity. The third period, from 1903, marked the development of botanical science in the universities. The collectors, botanical literature, and trends of each period were detailed. The first period was marked by much taxonomic work and at its end by publications. The second period saw great extension of this work, and the influence of Bolus at the Cape and of Medley Wood in Natal was marked. The activities of many other collectors were detailed and the vast amount of work on systematic botany and plant geography indicated. The third period, from 1903 onwards, was marked by university developments, plant biology studies, economic botany in many phases, plant embryology, and the institution of the Union Botanical Survey.

"Some Aspects of Bird Life" was chosen by Dr. E. L. Gill as his presidential address to Section D. Adaptations were discussed. It was pointed out that the reaction against adaptation to environment has almost certainly overshot the mark, though correlation of structure and way of life are not necessarily close. Wading birds were discussed in relation to their feeding habits, bills, and legs. The avocet's turned-up bill "may be the result of some phase of racial pathology perhaps not just disastrous enough to lead to the extinction of the stock". Plumage and its relation to flight were also discussed. The subject of subspecies and races of birds was introduced and the time-factor for the development of subspecies indicated with reference to Moreau's work on crested larks in Egypt. Bird behaviour and patterns of behaviour in courting, play, and leisure were noted, and migration of birds as affecting South Africa discussed. South Africa has few islands and on the mainland dispersal is rapid. South Africa is the terminus for the great migrations from the far north. Great numbers of European birds winter at the Cape, and many African birds come to breed and then return to tropical Africa for the southern winter. The movements of the purely African birds are still largely a mystery. The birds of the Southern Ocean need more investigation—a matter of difficulty. The physiological effect of migration and the unknown stimulus that moves birds to such unaccustomed feats of endurance were also mentioned.

The subject of "South Africa's Place in Prehistory: A Plea for Organised Research and the Better Preservation of Historic Remains", formed the presidential address to Section E given by Mr. C. van Riet Lowe. The early history of archæology was briefly reviewed, the South African work dating roughly from Dale, 1866, since when a number of workers have appeared. The reasons for differences in nomenclature in South African and European cultures were detailed, and also the relationship of European and African Stone Ages. The importance

of geology and geography in relation to ethnology was stressed. Various aspects of African prehistoric art were detailed and stress laid on the value of rock engravings or petroglyphs, the evolution of numerous styles and four probable successive phases being outlined. The need of correlation of all associations and of detailed search for such associations was urged. The address concluded with an appeal for greater study and better preservation of archæological objects.

"Some Problems of the Transition from Subsistence to Money Economy" was the subject of the presidential address of Mrs. M. Palmer to Section F. The transition is inevitable and many South African natives are now in the transition stage. The conservatism of subsistence economy is because of its guidance by customs and absence of markets, competition, and profits; and communal tenure of land is correlated with such economy. The social and economic reactions to be expected under the extremely rapid transition in the African and eastern areas of the world were discussed. Private ownership of land has caused misunderstandings repeatedly among primitive peoples and the commercial use of land is incomprehensible to them. The widely divergent accounts of the economic position of the native were explained. Even when individual peasant tenancies are established, an unemployment problem appears in the second generation. Commercial agriculture requires commercial development to balance it. The teaching of primitive crafts by out-of-date means to natives was deplored, for it gives them false ideas of successful livelihood that cannot materialise in competition with machinery. Artificial means of inducing natives to take up wage-labour have been necessary, and taxation and organised recruiting have supplied these. At first the native, who only works in town about half the year, separated from his land and family, regards wages as tax money or as a means to luxury. Later, as his needs increase, subsistence in the reserve largely disappears and his town wages are his real support. Under such conditions, undercultivation of the reserves, inefficient and casual labour, a lessened market for the products of industry, and numerous evils due to lack of supervision and separation of families result. The system of 'native treasuries' and of co-operative credit societies was explained and recommended as a great aid in bridging this transition period.

In Section A, meteorological work in the Transvaal and in Mozambique was described. The effects of oil on the coefficient of restitution and the electrical field of the atmosphere are of interest to physicists; astronomers dealt with the origin of meteorites and the apparent orbit of a spectroscopic binary. A new method of deducing borehole capacity was propounded; and the veteran mathematician, Sir Thomas Muir, made his tenth contribution to the bibliography of determinants.

In Section B, soil chemistry in connexion with the potash requirements of South African soils, base exchange in the Malmesbury shale series, soil acidity, sticky point water, and hard pan formation produced a number of papers. Slangbos oils and the antimony electrode were discussed. The state of natural water supply and the effect of destruction of vegetal cover received serious consideration, as did also a paper on the medicinal waters of South Africa in international measurements.

In Section C, systematic work on the Virosæ division of the Euphorbiaceæ, on new Liliaceæ, Hydrocharitaceæ, Dianthaceæ, and Lobostemon was detailed by various workers. Economic botany was represented by work on barley diseases, South African fungi, root nodules, abnormalities in the composition of oranges and seed formation in pears, and effects of fire on biotic communities. Ecological work dealt with 'Gifblaar' (a stock poison), flora of a lamsiekte farm, bush groups, and floras of individual areas. The physiological side was represented by work on hydrolysis in the vine and the influence of soil water around roots on the hydrogen ion concentration of tracheal sap.

In Section D a number of interesting topics were discussed. A series of papers by members of the University of Stellenbosch dealt with Amphibian osteology, osteogeny, and ontogenesis in regard to various forms, including *Heleophryne*, and there was discussion of Noble's dictum in relation to the latter form. Ecological notes were given on the Acridiidæ of the Cape Peninsula. Seasonal variation in the coat of common domestic mammals and density in variation of the fleece of the merino are of economic importance. Animal ecologists also dealt with the methods of studying numbers of terrestrial animals and numbers of tsetse fly in Tanganyika Territory. A modification of the rapid agglutination test, of use to the veterinary profession, was set forth. Descriptions were given of a number of new species of Protozoa, including new and economically important Myxosporidia of fish and new Protoopalinidæ. Cases of physical inheritance and of racial admixture, including Chinese crosses with various natives and Indians, were described. Variations in the skulls of vervet monkeys, ovine schistosomiasis, and social hydrology were also discussed, and a morning was devoted to a discussion on provision for marine biology. The centenary of the death of Lamarck was commemorated.

In Section E a human skull was described. The chronology of the Mossel Bay industries was detailed and illustrated, as were implements found in a cave at Tafelberg Hall. Interesting accounts of cattle magic and medicines in Bechuanaland and of Bantu customs in relation to widowhood and lobola formed important contributions to social anthropology.

In Section F, the historical side was interestingly represented by short papers on an eighteenth century MS. on agricultural improvement at the Cape and on the first leper settlement in South Africa. The psychology of mysticism and of personality were discussed, and a reasoned account of the psychological factors affecting the attitude of black to white was presented. The crisis in our present civilisation was given a fine exposition. The progress of Portuguese children in Lourenço Marques and in Portugal were compared.

The next annual meeting of the Association will be held in July 1931 at Grahamstown, under the presidency of Prof. J. W. Bews, professor of botany at the Natal University College, Pietermaritzburg, Natal.

H. B. F.

University and Educational Intelligence.

CAMBRIDGE.—J. C. P. Miller, of Trinity College, has been elected to an additional Isaac Newton Studentship tenable for one year.

The General Board has recommended that a readership in statistics shall be established as from Jan. 1 next, and that it should be authorised to appoint as first holder of the readership Mr. G. Udney Yule, of St. John's College. It is recommended that the readership shall be assigned primarily to the Faculty of Agriculture and Forestry.

The Faculty Board of Archæology and Anthropology has appointed C. B. Humphreys, of Christ's College, to

be honorary keeper of the Melanesian Collection in the Museum of Archæology and Ethnology.

The Gedge Prize for original observations in physiology has been awarded to H. Barcroft, of King's College, who gained first-class honours in the Natural Sciences Tripos Pt. II., 1927.

LONDON.—The following doctorates have been awarded: *D.Sc. Degrees in chemistry* on K. R. I. Krishnaswami (University College) for a thesis entitled "A Revision of the Atomic Weight of Tantalum" (*Jour. Chem. Soc.*, June 1930), and (2) "The Atomic Weight of Antimony from different Sources" (*Jour. Chem. Soc.*, 1927); and H. L. Riley (Imperial College—Royal College of Science) for a thesis entitled "Studies in Complex Salts" (*Jour. Chem. Soc.*, 1928–30, *Phil. Mag.*, 1924, 1927). *D.Sc. Degrees in physics* on J. H. Brinkworth (Imperial College—Royal College of Science) for a thesis entitled "On the Measurement of the Ratio of the Specific Heats of Gases" (*Proc. Roy. Soc.*, 1925, 1926, 1930); and Prof. H. Dingle (Imperial College—Royal College of Science) for a thesis entitled "The Successive Spectra of Fluorine" (*Proc. Roy. Soc.*, 1926, 1928, 1929, 1930). *D.Sc. Degree in zoology* on H. Mukhopadhyay (Imperial College—Royal College of Science) for a thesis entitled "On the Development of the Vertebral Columns of Urodela and Anura" (*Phil. Trans.*, 1930). *D.Sc. Degree in geology* on G. Sheppard, for a thesis entitled "The Geology of South-West Ecuador", together with thirteen subsidiary contributions.

PROPOSALS have been made for the formation of an Association of Examiners for the adequate discussion and ventilation of the problems with which examiners are faced. It is suggested that the inaugural meeting be held early in January. Further particulars and information may be had from Mr. B. C. Wallis, 345 Stag Lane, London, N.W.9.

REFERRING to the note in NATURE of Nov. 15 p. 791, we are informed that while it is true that Prof. R. Robinson (Oxford) has received an invitation to act as the non-resident lecturer on the George Fisher Baker Foundation of Cornell University during the second term of the academic year 1933–34, he has not yet intimated his acceptance of this invitation.

THE Harvard Engineering School is offering this year a new course on vibration problems, a subject which is growing in importance in the design of high-speed machinery, although it has been neglected in most American engineering schools. The course will deal mainly with the physical and mathematical basis of mechanical vibration and is being given by outside lecturers, Messrs. J. Ormondroyd and A. L. Kimball, the general direction of the course being under Prof. Arthur E. Norton, of the Harvard Engineering School. Mr. Ormondroyd is manager of the Experimental Engineering Division of the South Philadelphia Works of the Westinghouse Electric and Manufacturing Co., and has had wide experience in vibration problems. Mr. Kimball is Associate Head of the Mechanics Section of the General Electric Company Research Laboratory at Schenectady; he has made a special study of photoelastic methods of stress analysis and is an authority on vibration damping.

A PRELIMINARY programme has been issued of the nineteenth annual Conference of Educational Associations, to be held at University College, London, W.C.1, on Dec. 31–Jan. 7, under the presidency of Sir Richard Gregory, whose presidential address, entitled "The Worth of Science", will be delivered on the first day of the Conference. Among the papers and discussions arranged are the following: Learning how to study, by Prof. T. H. Pear (British Psychological Society—Education Section); efficiency of first school examinations and their relation to matriculation, by Sir Philip Hartog (New Education Fellowship); "The Beauty and Wonder of the World", by Sir Arthur Thomson (School Nature Study Union); vocational guidance, by Dr. Macrae (Training College Association); individual work in mathematics, by Mr. G. W. Spriggs (Dalton Association); discussion on experimental phonetics, Prof. E. W. Scripture and Prof. P. Menzrath (Modern Language Association); educational handicap of the deaf from the psychologist's point of view, by Dr. J. Drever (National College of Teachers of the Deaf); and a joint conference on the teaching of geography, at which the speakers will include Sir Richard Gregory (chairman), Mr. J. Fairgrieve, Sir William Furse, Miss B. Hosgood and Mr. C. B. Thurston. Exhibitions of books, handwork, and school equipment will be open during the Conference, the B.B.C. is arranging a lecture and demonstration on school broadcasting, and Prof. Winifred Cullis is giving a lecture demonstration on teaching biology by wireless. Full particulars of the Conference can be obtained from the Secretary, Miss M. A. Challen, 29 Gordon Square, London, W.C.1.

Historic Natural Events.

Nov. 30, A.D. 60. St. Paul's Storm.—St. Paul, being carried for trial at Rome, was taken on board a ship at Cæsarea. The ship touched at Sidon and was then forced by northerly winds to pass south of Cyprus to the south coast of Crete. By this time "the Fast was already past" [probably that of Expiation, Sept. 25], and Paul advised the master of the ship to winter in harbour. This advice was disregarded, however, and the ship set out for a more commodious harbour. The account continues: "But not long after there blew from the shore a tempestuous wind, called Euroclydon. And when the ship was caught, and could not bear up against the wind, we let her drive." Neither the sun nor stars appeared for many days, and there was "no small tempest". On the fourteenth night, "falling into a place where two seas met", they ran the ship aground on an island called Melita, where she was broken up by the violence of the waves, but all were saved. This is believed to be the island of Malta, but Dr. William Falconer, who prepared a dissertation on the voyage, identified it with Melada in the Adriatic. The date of the shipwreck is not known accurately, but Dr. Falconer calculated that it was most probably at the end of November or beginning of December.

Nov. 30, 1645. Earthquake in the Philippines.—The greatest earthquake known in the Archipelago. From Manila to the northern provinces of Cagayan and Ilocos Norte, few stone buildings escaped destruction, some native villages completely disappeared, while there were many changes in the surface features and in river-courses.

Nov. 30, 1775. Destruction of Fish.—An account of the drought of 1775–76 in Sumatra (*Philosophical Transactions*, Abridged Ed., Vol. 15, p. 127) states that: "In the month of November, the dry season having then exceeded its usual period and the S.E. winds continuing with unremitting violence, the sea was observed to be covered, to the distance of a mile and in some places a league from shore, with fish floating on the surface. Great quantities of them

were at the same time driven on the beach or left there by the tide, some quite alive, others dying, but the greatest part quite dead. The fish thus found were not of one but of various species, both large and small, flat and round, the cat-fish and mullet being generally the most prevalent. The numbers were prodigious, and overspread the shore to the extent of some degrees. Their first appearance was sudden; but though the numbers diminished, they continued to be thrown up, in some parts of the coast, for at least a month, furnishing the inhabitants with food, which, though attended with no immediate ill consequence, probably contributed to the unhealthiness so severely felt. No alteration to the weather had been remarked for many days previous to their appearance. The thermometer stood as usual at the time of year at about 85°."

Dec. 1, 1607. Frost in Lake District.—The Watermillock Register in the English Lake District records "a marveillous great frost which contynued from the first day of December until the 15th. day of February after. Ulles water was frozen ower and so continued from the 6th. day of December untill the 22nd. day of February followinge. So stronge that men in great companies made a common way up the same . . . with horses loaden with corne. Upon the 6th. day of January the younge folkes of Sowlby went unto the midst of the same water and had a Minstrell with them and there daanced all the after Noone. On . . . the 9th. day of February, at Weathermeallock was a Boone fire builded on the Ise and matches of Shotinges Shott. . . ."

Dec. 4, 1495. Tiber Flood.—One of the greatest floods of the Tiber, remembered as the "deluge of Rome", is described at length in a pamphlet reprinted by Dr. G. Hellmann in No. 12 of his "Neudrücke von Schriften und Karten über Meteorologie und Erdmagnetismus", with a rough wood-cut showing the flooded streets and drowning citizens. A torrent of water ran through the city, and many houses were destroyed.

Dec. 4, 1879. Low Temperature in British Isles.—Throughout the greater part of December 1879, intensely cold weather was experienced. The coldest day was Dec. 4, when a minimum of −23° F. was reported at Blackadder in Berwickshire, the lowest known shade temperature in the British Isles. Temperatures below 10° F. were registered over southern Scotland and northern England as far as the Valley of the Trent, and over almost the whole of England, Scotland, and Ireland temperature fell below 20° F. Many persons were frozen to death, and evergreens were killed, including a holly nearly a hundred years old.

Dec. 5, 1922. Mirage.—At about 10.30 A.M. the lightkeeper at Cape Wrath lighthouse, in the north of Scotland, observed in the sky above a conical hill to the southward a mirage of land and sea, giving a perfect representation of the whole of the coast line from Cape Wrath to Dunnet Head, as it would have been seen from a distance of about ten miles. There were three repetitions of the mirage, one above the other, with sea separating each pair. The appearance lasted about 30 minutes, but was only visible through a telescope. It was attributed by Mr. Brunt to double refraction from two nearly vertical surfaces of discontinuity between warm and cold air.

Dec. 5, 1927. Hurricane in Pacific.—A violent hurricane struck Butaritari in the Gilbert and Ellice Islands shortly after 2 A.M.; nearly all the houses were blown down or damaged and many trees destroyed. Butaritari is in only lat. 3° N., and hurricanes so near the equator are very rare.

Societies and Academies.

LONDON.

Royal Society, Nov. 20.—**Lord Rayleigh**: Iridescent colours of birds and insects. The reflection spectra have been examined in the ultra-violet. *Morpho* butterflies and *Urania* moths show ultra-violet maxima in general agreement with the theory of interference. In *M. achilles* the blue colour is due to a reflection of the second order. No *Morpho* butterflies show their blue colour by transmission. Iridescent beetles showing a deep red colour at normal incidence may be made to pass through all the colours of the spectrum to violet, provided that arrangements are made to annul refraction at the air-chitin surface so as to obtain very oblique incidence without. Some of the golden beetles show transmission spectra of bands which vary continuously in position with the part of the specimen examined. It seems impossible to interpret this reasonably except on the theory of interference. Moist chlorine gas does not destroy the colours of *Morpho* or of *Urania*, though the black background is bleached; nor does chlorine decolorise the metallic beetles. Peacock feathers undergo a progressive change of colour in ultra-violet light or long-continued sunlight, the colours becoming more refrangible. Other feathers are slowly decolorised without change of refrangibility. Fading under light or chlorine is attributed to the breaking down of an interference structure. The generalisation seems to hold good that colour which is stable in chlorine is certainly *not* due to pigments.—**C. R. Bailey, A. B. D. Cassie, and W. R. Angus**: Investigations in the infra-red region of the spectrum (1, 2). The infra-red absorption spectrum of sulphur dioxide has been re-examined in the region 1-22 μ with a prism spectrometer fitted with quartz, fluorite, rocksalt, and sylvine prisms. The partial resolution of most of the bands has rendered possible the determination of a number of the molecular constants, in particular the size and shape of the molecule, the moments of inertia, and the fundamental vibrational frequencies.—**J. K. Roberts**: The exchange of energy between gas atoms and solid surfaces. Experiments on the accommodation coefficients of helium with tungsten and nickel surfaces have been carried out under conditions in which the surfaces could be freed from films of adsorbed gas. The values obtained were 0·05-0·07 for tungsten and 0·08 for nickel, and are considerably lower than the values ordinarily obtained for gas-covered surfaces.—**G. N. Watson**: The use of series of Bessel functions in problems connected with cylindrical wind tunnels. Various Fourrier-Bessel and Dini series are encountered in problems concerning cylindrical wind-tunnels, and the convergence of these series in certain parts of the tunnel is slow. The object of the paper is to transform these series into more rapidly convergent series in order to make it possible to compute their sums.—**A. J. Allmand and R. B. King**: The sorption of water vapour at low pressures by activated charcoals (1). Isothermals of water vapour have been determined for six different and typical activated charcoal specimens, at 25° C. and over a pressure range of 10^{-1} mm. down to 10^{-3} mm. Undisplaced gases on the charcoal surface cause 'drift', as in other cases. When this displacement had proceeded to its limit under the experimental conditions, the isothermals were apparently reversible. No sign of the validity of 'Henry's Law' was observed. Water vapour is apparently relatively ineffective as a displacing agent for adsorbed oxygen. Heat of adsorption increases as the quantity sorbed decreases. No definite evidence of discontinuity in the isothermals was discovered.

DUBLIN.

Royal Irish Academy, Nov. 10.—**J. J. Nolan**: The effect of water vapour on the mobilities of negative ions in air. A series of values of mobility ranging from 2·4 to 1·5 cm./sec. is found corresponding to certain favoured sizes of ions. At least two such discrete sizes of ions are present in considerable quantity at each value of the humidity. In addition it is shown that high mobility ions are present in small quantities; for example, at vapour pressure 0·87 mm., ions of mobility 12 cm./sec. constitute about 0·1 per cent of the total ionisation.

PARIS.

Academy of Sciences, Oct. 27.—The president announced the deaths of Pierre Termier and Paul Appell.—**Maurice de Broglie**: A possible conception of nuclear phenomena.—**E. Bataillon** and **Tchou Su**: Abortion of gametogenesis in hybrids of *Molge marmorata* and *M. cristata*, two years old.—**A. Buhl**: Wave geometry. Explicit developments.—**V. Romanovsky**: The continued doubly connected chains of Markoff.—**Marcel Brelot**: A generalised problem of Dirichlet.—**V. G. Siadbey**: The motion of large meteors. An analysis of a collection of data recently published by Hoffmeister. For large meteorites the average height of appearance (545 cases) was 131·9 km. and of extinction (553 cases) 53·5 km. Classifying in three classes, large meteors, detonating meteors, and meteorites, the geocentric velocities were respectively 42·5, 38·8, and 25·7 km. per second.—**Henri Mineur**: The explanation of some anomalies presented by the proper motions of the stars.—**Lyot**: The polarisation of Mercury compared with that of the moon; results obtained at the Pic-du-Midi in 1930. The clearness of the sky at the Pic-du-Midi enabled 26 observations to be taken under excellent conditions, the results of which are given graphically.—**Louis Kahn**: The methods of navigation employed by Costes and Bellonte. The method proposed by the author in earlier communications was used with success by Costes and Bellonte in their flight from Paris to New York.—**A. Dauvillier**: The application of the diffraction of electrons to the study of organic substances. The structure of cellulose. Diffraction diagrams of organic substances can be obtained provided that extremely thin films, with a thickness of the order of 100 A., can be prepared. Diagrams are given for films of nitrocellulose: these are entirely different from those given by the X-rays and are not due to the crystalline network.—**Mlle. Foret**: Calcium chloro-, bromo-, and iodoaluminate.—**H. Muraour**: The influence of radiation in the combustion of (explosive) colloidal powders in closed vessels. In a previous communication, as an explanation of the observed diminution in the area of the pressure-time curve, it was suggested that energy was contributed under the influence of the calorific radiation of the gas: further experiments now described prove that this hypothesis is insufficient to explain the experimental results.—**Justin Dupont** and **Jean Jacques Guerlain**: The dry distillation of Tolu balsam. This distillation gives rise to notable quantities of the monomethyl esters of pyrocatechol and its homologues, identical with those extracted by Béhal and Choay from wood tar creosote.—**Georges Mignonac** and **Charles Hoffmann**: The ketene-imines and the tautomerism of the nitriles.—**St. Pavlovitch**: The metallographic study of some metallic minerals of Yugo-Slavia.—**Jacques Bourcart**: The stratigraphy of the Atlantic zone of the Spanish Protectorate in Morocco.—**L. Margaillan**: The vitamins and refining olive oils. Comparative curves of growth of rats are given, the diet being the same except that unrefined olive oil was added in one set and refined olive oil in the other. Contrary to the view generally held, olive oil contains vitamins, but these are reduced or eliminated by the process of refining.—**E. Chemin**: The action of ultra-violet radiations on the spores and germination of the Florideæ. Arrest of development and cell alteration is always produced by the action of ultra-violet light.—**H. Colin** and **E. Bougy**: The characters of some hybrids of beetroot.—**Mme. L. Randoin** and **R. Lecoq**: The possibility of producing experimental rickets in the guinea-pig. Although very sensitive to a deficiency of the antiscorbutic vitamin, the guinea-pig does not appear to react to a deficiency of the antirachitic vitamin and presents no true rickety lesions.—**Aversenq, Jaloustre**, and **Maurin**: The neutralisation of the toxic power of various poisons by thorium-X. Either by its radioactivity or by its metallic ions, thorium-X is capable of exercising in the animal or plant a certain amount of protective action against various poisons (sparteine, picrotoxin, potassium cyanide). The mechanism of this neutralisation is doubtful.—**Fontaine**: Modifications of the internal medium of river fishes in the course of reproduction.—**S. Metalnikov, B. Hergula**, and **Miss Strail**: The utilisation of micro-organisms in the fight against *Pyralis* of maize. An account of field experiments carried out at Zagreb, with emulsions of cultures of micro-organisms isolated from dead or dying insects. The results were satisfactory.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 13, 1930.—**I. Kurbatov** and **V. Kargin**: Chemical composition and properties of the Crimean keffekilite.—**G. Frederiks**: The Palæozoic deposits in the Urals. During the whole of the Palæozoic period up to the end of the Carboniferous, only vertical movements occurred in the area of the Uralian geosynclinal. In the early Permian the first phase of the vertical folding occurred, while the second coincided with the end of the Chussov period.—**B. Kupletskij**: A contribution to the mineralogy of the Khibin tundras. Descriptions of a number of minerals.—**B. Gavrusevich**: A new find of palygorskite in the Ukraine.—**G. Laemmlein**: Corrosion and regeneration of quartz-porphyrites.—**A. Saukov**: Antimony and molybdenum deposits near Novotroitzk, on the River Unda, Transbaikalia.

Comptes rendus, No. 14, 1930.—**N. Zelinjski**: Chemical nature of the Petchora bitumen.—**B. Galerkin**: A contribution to the investigations of tensions and deformations in an elastic isotropic body.—**V. Barovskij**: A description of two new species of the genus *Dictyoptera* Latr. (Coleoptera, Lycidæ) from eastern Asia. *D. motschulskii* and *D. miranda*, spp. nn., from the South Ussuri region.—**L. Jakubova** and **E. Malm**: The phenomena of the temporary anærobiosis in some representatives of the Black Sea benthos. Experiments in the aquarium showed that the majority of benthonic animals, particularly the less mobile or sedentary animals, can live for a long time (more than a month) at very low concentrations of oxygen—for example, at 0·2-0·4 c.c. per litre at 12° C.—**N. Kuznecov-Ugamskij**: A contribution to the study of the factors of the evolution of faunistic groups. The evolution of faunas is due not only to the evolution of the environmental conditions, but also mainly to the interaction of different component elements of the fauna.—**N. Filipjev**: Lepidopterological notes (7). A new genus of Tortricidæ from the mountains of the Ussuri region. *Eurydoxa advena*, gen. and sp. n.—**V. Rylov**: A preliminary communication on the plankton of Lake Kardyvatch, north-west Caucasus.

Official Publications Received.

BRITISH.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 45: A Soil Survey of the Woorinen Settlement, Swan Hill Irrigation District, Victoria. By J. K. Taylor and F. Penman. Pp. 41+4 plates. (Melbourne: H. J. Green.)

Ministry of Agriculture and Fisheries. Report on the Work of the Research and Education Division for the Year 1928–29. Pp. 100. (London: H.M. Stationery Office.) 1s. 6d. net.

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1926, under the direction of Dr. B. N. Banerji and Dr. K. R. Ramanathan. Pp. iv+135+5 plates. (Calcutta: Government of India Central Publication Branch.) 10.12 rupees; 17s. 6d.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 41, Part 3, 21st October. Pp. 221-362+plates 15-28. (London: Edward Stanford, Ltd.) 5s.

The Gardens' Bulletin, Straits Settlements. Vol. 6, Part 3: The Medical Book of Malayan Medicine. Translated by Inche' Ismail, Munshi, possibly in Penang, circa 1886. Now edited with Medical Notes by J. D. Gimlette, and Determinations of the Drugs by I. H. Burkill. Pp. 323-474. (Singapore: Botanic Gardens.) 2.50 dollars.

British Cast Iron Research Association. Ninth Annual Report for the Year ending June 30th, 1930. Pp. 27. (Birmingham.)

The Quarterly Journal of the Geological Society. Vol. 86, Part 3, No. 343, October 21st. Pp. 331-462+22 plates. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 46: The Distribution of Pasture Plants in relation to Soil Acidity and other Factors. By Dr. W. R. G. Atkins and E. Wyllie Fenton. Pp. 533-547. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 27: The Kinetics of the Formation of Malonamide from Ethyl Malonate and Ammonia in Homogeneous Solution—A Reaction of the Third Order. By Dr. Kenneth C. Bailey. Pp. 567-573. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

Department of Scientific and Industrial Research. Report of the Building Research Board: with the Report of the Director of Building Research for the Year 1929. Pp. viii+121+10 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

Development Commission. Twentieth Report of the Development Commissioners, being for the Year ended the 31st March 1930. Pp. 247. (London: H.M. Stationery Office.) 3s. 6d. net.

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 14, Part 1, 30 October. Pp. 48. (Cambridge: Printed at the University Press.)

Proceedings of the Cambridge Philosophical Society. Vol. 26, Part 4, October. Pp. 429-574. (Cambridge: At the University Press.) 7s. 6d. net.

Transactions of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne. New Series, Vol. 7, Part 1. Pp. 150. (Newcastle-upon-Tyne.) 4s. 6d.

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Forestry Society. Vol. 44, Part 2, October. Pp. xx+45-148+51-62. (Edinburgh: Douglas and Foulis.) 7s. 6d.

Journal of the Indian Institute of Science. Vol. 13A, Part 11: i. The Physical Properties of Pure Triglycerides, by R. B. Joglekar and H. E. Watson; ii. The Preparation and Properties of α-Monoglycerides, by R. S. Rewadikar and H. E. Watson; iii. The Solidifying Points of Binary Mixtures of Fatty Acids and Esters, by L. A. Bhatt and H. E. Watson (with Z. H. Patel). Pp. 119-146. (Bangalore.) 2 rupees.

Proceedings of the Royal Irish Academy. Vol. 39, Section A, Nos. 6, 7: Notes on Resolving Power, by Dr. R. W. Ditchburn; The Uncertainty Principle in Quantum Mechanics, by Dr. R. W. Ditchburn. Pp. 58-81. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

FOREIGN.

United States Department of the Interior: Geological Survey. Bulletin 815: Geology and Mineral Resources of Northwestern Alaska. By Philip S. Smith and J. B. Mertie, Jr. Pp. viii+351+34 plates. 1 dollar. Water-Supply Paper 630: Surface Water Supply of the United States, 1926. Part 10: The Great Basin. Pp. v+145. 25 cents. (Washington, D.C.: Government Printing Office.)

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 11, No. 1, August 15th. Pp. 74+7 plates. (Tokyo: Maruzen Co. Ltd.) 2.00 yen.

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 13, No. 5, September. Pp. 323-367+5 plates. (Tokyo and Kyoto: Maruzen Co. Ltd.) 1.00 yen.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. Results of the Pinchot South Sea Expedition. 1: Land Mollusks of the Caribbean Islands, Grand Cayman, Swan, Old Providence and St. Andrew. By Henry A. Pilsbry. Pp. 221-261. (Philadelphia.)

Field Museum of Natural History. Botanical Series, Vol. 9, No. 1: The Differential Analysis of Starches. By James B. McNair. (Publication 275.) Pp. 44. Botanical Series, Vol. 9, No. 2: A Study of some Characteristics of Vegetable Oils. By James B. McNair. (Publication 276.) Pp. 45-68. Botanical Series, Vol. 8, No. 1: Studies of American Plants, III. By Paul C. Standley. (Publication 277.) Pp. 74. Botanical Series, Vol. 8, No. 2: Spermatophytes, mostly Peruvian, II. By J. Francis Macbride. (Publication 278.) Pp. 75-130. Botanical Series, Vol. 3, No. 3: Flora of Yucatan. By Paul C. Standley. (Publication 279.) Pp. 155-492. Anthropological Series, Vol. 18, No. 2: Geophagy. By Berthold Laufer. (Publication 280.) Pp. 97-198. Botany Leaflet No. 15: Spices and Condiments. By James B. McNair. Pp. 64. 25 cents. Zoology Leaflet No. 12: The Salamanders of the Chicago Area. By Karl P. Schmidt. Pp. 16+4 plates. 25 cents. (Chicago.)

Bulletin of the Vanderbilt Museum. Vol. 2: Scientific Results of the Cruises of the Yachts *Eagle* and *Ara*, 1921–1928, William K. Vanderbilt, Commanding. Crustacea: Stomatopoda and Brachyura. By Lee Boone. Pp. 298+74 plates. (Huntington, L.I.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 5, No. 2, August. Pp. 213-505. 40 cents. Vol. 5, No. 3, September. Pp. 507-779. 40 cents. (Washington, D.C.: Government Printing Office.)

Stanford University Publications: University Series. Medical Sciences, Vol. 2, No. 3: Lane Lectures on Experimental Pharmacology and Medicine. By Prof Rudolf Magnus. Pp. 108. (Stanford University, Calif.: Stanford University Press.) 1 dollar.

Baltic Geodetic Commission. Special Publication No. 1: Measuring of Seven Base Lines of the Baltic Polygon, executed in the Year 1929. By Ilmari Bonsdorff. Pp. 21+236+5 plates. (Helsinki.)

United States Department of the Interior: Geological Survey. Bulletin 822A: Geology and Mineral Resources of parts of Carbon, Big Horn, Yellowstone and Stillwater Counties, Montana. By R. S. Knappen and G. F. Moulton. (Contributions to Economic Geology, 1930, Part 2.) Pp. iv+70+5 plates. 25 cents. Water-Supply Paper 635: Surface Water Supply of Hawaii, July 1, 1925, to June 30, 1926. Pp. v+145. 25 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

A Catalogue of Important and Rare Books on Zoology, Geology and Palæontology. (No. 440.) Pp. 144. (London: Bernard Quaritch, Ltd.)

Hawaiiana. Pp. 20. (London: Francis Edwards, Ltd.)

Accessories for Radiology. (Publication No. C/30.) Pp. 48. (London: Newton and Wright, Ltd.)

The Nickel Bulletin. Vol. 3, No. 11, November. Pp. 345-376. Nickel, D2: Nickel in Light Aluminium Alloys. Pp. 24. (London: The Mond Nickel Co., Ltd.)

The Book Window: a Guide to Book Buying and Book Reading. Vol. 2, No. 5, Christmas Number. Pp. 149-188. (London: W. H. Smith and Son, Ltd.) 3d.

Diary of Societies.

FRIDAY, NOVEMBER 28.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Scottish District) (at County Buildings, Paisley), at 2.—T. Somers: The Sixth International Road Congress at Washington, D.C.

GENETICAL SOCIETY (at Linnean Society), at 3.—A. E. Gairdner and Dr. C. D. Darlington: The Theory of Ring-formation exemplified by *Campanula persicifolia*.—J. Philp: An Explanation of the Inheritance of Double Flowers in *Matthiola incana R.Br.* based on Cytological Evidence.—At 3.45.—Prof. A. H. R. Buller: Sexual Phenomena in the Higher Fungi.—C. Diver: Studies in the Genetics of the Common Garden Snail, *Helix aspersa*.—A. A. Moffet: Cytology of Pomoideæ.

ROYAL SOCIETY OF MEDICINE (Children Section), at 5.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Hinde: The Ocean-going Tramp Steamer from the Owner's Point of View.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. H. E. O'Brien: Electric Traction (Students' Lecture).

INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 6.30.—W. T. Benslyn and S. Willis: Steelwork in Cinema Construction.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.—R. Humphries and others: Discussion on Colouration in Textiles.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—E. Batten and others: Discussion on Export Trade Emancipation.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Society of Dyers and Colourists and Institute of Chemistry) (at 235 Buchanan Street, Glasgow), at 7.15.—F. W. Lake: Dyeing and Cleaning: Some Problems of the Industry.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—F. W. Rowe: The Selection and Treatment of Materials for Gears.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. H. Willett: Photography applied to Science.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. J. M. Hamill: Food as a Preventive of Disease.

INSTITUTION OF CHEMICAL ENGINEERS.—S. Mayne: The Sources of Published Technical Data and how they should be used.

SATURDAY, NOVEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene: Verse in Song.

MONDAY, DECEMBER 1.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. G. Bond: The Stem-endodermis in the Genus *Piper*.—A. Graham: On the Morphology, Feeding Mechanisms, and Digestion of *Ensis siliqua*.—Dr. L. Mirskaia and Prof. F. A. E. Crew: On the Pregnancy Rate in the Lactating Mouse, and the Effect of Suckling on the Duration of Pregnancy.—Dr. B. P. Wiesner: Further Observations on the Mechanism of the Diphasic Sex Cycle.

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4.30.—Sir Ambrose Fleming: Adaptation in Nature as Evidence of Purposive Thought.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—W. R. Baldwin-Wiseman: Some Ground Aspects of Aviation.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (Annual General Meeting) (at London Day Training College), at 6.—Miss S. Clement Brown: Some Case Studies of Delinquent Girls described as Leaders (From Social Study made in the County of Los Angeles, California.)

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—J. R. Leathart: Modern Cinema Design.
ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling: Modern Domestic Scientific Appliances (Cantor Lectures) (2).
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—J. H. Coste: Analytical Chemistry, its Past History and Future Development (Lecture).
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Rev. J. W. Hubbard: The Isoko Country, Southern Nigeria.

TUESDAY, DECEMBER 2.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5.10.—Prof. J. F. Spencer: Magneto Chemistry.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. E. A. Milne: Stellar Structure and the Origin of Stellar Energy (1).
INSTITUTION OF CIVIL ENGINEERS, at 6.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.45.—Dr. R. S. Morrell: The Oxidation Products of Drying Oils.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—P. B. Bannatt: Ten Thousand Miles with Two Babies.
INSTITUTE OF METALS (Scottish Local Section) (jointly with Institution of Engineers and Shipbuilders in Scotland) (at 39 Elmbank Crescent, Glasgow), at 7.30.—W. Lambert: Non-ferrous Alloys used by Engineers.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—J. Bradley and S. A. Wood: Some Experiments on the Factors affecting the Motion of a Four-wheeled Vehicle when some of its Wheels are locked.—J. Bradley and R. F. Allen: Factors affecting the Behaviour of Rubber Tyred Wheels on Road Surfaces.
ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—Dr. L. Böhler: The Treatment of Fractures of the Upper Extremity.

WEDNESDAY, DECEMBER 3.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. P. Tesch: The Riss Glaciation in the South-Eastern Parts of England.—H. Dewey: The Palæolithic Deposits of the Lower Thames Valley.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—T. Walmsley: Beam Arrays and Transmission Lines.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—E. G. Phillips: The Cost of Operating Industrial and Private Electric Generating Sets compared with Public Supply.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—J. C. Dixon: Wharf Cranes for the Handling of Cargo.
ROYAL SOCIETY OF ARTS, at 8.—S. Perks: The Building of the Mansion House.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—G. Middleton: A Storage and Delivery Apparatus for Antimony Chloride Solution and other Corrosive Reagents.—G. Middleton and F. C. Hymas: Tests for Impurities in Ether. Parts II. and III.—N. Evers: The Determination of Small Quantities of Calcium in Magnesium Salts.—Dr. P. K. Bose: A New Method for the Detection of Nitro-Group in Organic Compounds.
ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Discussion on Surgery in Diabetes. Openers: Prof. G. E. Gask, Dr. G. Graham, and Dr. Lawrence.

THURSDAY, DECEMBER 4.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. J. McLuckie: On a Natural *Grevillea* Hybrid.—B. Storrow: Some Fluctuations in Zoological Populations during the Nineteenth Century.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir John Russell: The Agricultural Development of the Empire (1): Reclaiming the Wastes.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. C. W. Kimmins: The Changes in the Child's Attitude to Life during the School Period.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—S. G. Brown: Loud-Speakers since their Conception with Gramophone Pick-ups and Wireless Recording Apparatus (Lecture).
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. Glauert: The Four-Foot Wind Tunnel.
SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—E. Potter: Patents.
CHEMICAL SOCIETY, at 8.

FRIDAY, DECEMBER 5.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Dr. G. Riddoch, Dr. A. B. Rosher, and others: Discussion on Intracranial Complications of Otitic Origin: Neurological and Pathological Investigation.
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.
PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. L. C. Martin: The Theory of the Microscope.—M. Fahmy: A Point of Analogy between the Equations of the Quantum Theory and Maxwell's Equations.—B. K. Johnson: Sources of Illumination for Ultra-violet Microscopy.—W. A. Wood: The Influence of the Orientation of the Cathode on that of an Electro Deposited Layer.—Demonstration by Prof. G. B. Bryan of some Stroboscopic Effects.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—U. R. Evans: The Protection of Metals by Painting.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. S. Turner: Machinery and Methods of Manufacture of Sheet Glass.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. T. Callan: The Estimation of Minute Traces of Copper.—Dr. F. C. Wood: (*a*) The Reaction of Formaldehyde Derivatives with Cellulose; (*b*) The Formation of Mono-cellulose Methylene Ether; (*c*) The Action of Grignard Reagent on Cellulose.—C. M. Whittaker: Some Notes on Viscose Dyeing.—J. M. Preston: A Skin Effect on Viscose Rayon.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—O. Howarth: The Metering of Three-Phase Supplies.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. L. Mayston: Oil Burning for Domestic Central Heating.
GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—A Journey through South and West Africa, with special reference to Igneous Phenomena (Lecture).
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.—G. F. O'Riordan: Recent Developments in Chemical Engineering.

SATURDAY, DECEMBER 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persia and the Persians (1): The Country and its History.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 5.30.—Sir Robert Philip: The Outlook on Tuberculosis: Changing Orientation (Malcolm Morris Memorial Lecture).

SATURDAY, NOVEMBER 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Some Mediæval Beasts, Real and Otherwise.

MONDAY, DECEMBER 1.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4.—F. W. Twort: Diseases of Bacteria. (Succeeding Lectures on Dec. 3, 5, 8, and 10.)
UNIVERSITY OF LEEDS, at 5.15.—Prof. F. O. Bower: The Morphology of the Leaf.

TUESDAY, DECEMBER 2.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Industry; Export and Import.—At 5.30.—Miss Hilda D. Oakeley: The Approach to Reality: Through Art.

WEDNESDAY, DECEMBER 3.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. D. B. Blacklock: The Prevention of Disorders and Disease in Tropical Countries.
BELFAST MUSEUM AND ART GALLERY, at 8.—Dr. A. Mahr: A Bygone Craft: Making an Old Style Coracle on the River Boyne.

THURSDAY, DECEMBER 4.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. F. J. McCann: Medical Arguments against Contraception.

SATURDAY, DECEMBER 6.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—Dr. Cyril Norwood: The Value of Exactness (Presidential Address).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Prehistoric Man in Minorca.

CONGRESSES AND EXHIBITION.

DECEMBER 3, 4, AND 5.

BRITISH INSTITUTE OF RADIOLOGY (at Central Hall, Westminster).

Wednesday, Dec. 3, at 2.30.—Sir Humphry Rolleston, Bart.: Official Opening.
At 3.30.—Major C. E. S. Phillips: Presidential Address.

Thursday, Dec. 4, 10.30 to 12.30.—F. D. Owen-King: The Multix Tube; a Self-Protected Tube for Therapy and Diagnosis with Twin Focus.
W. E. Schall: Limitations of the Single Valve Unit.
A. C. Gunstone and E. J. W. Watkinson: (*a*) The Milli-Ampere Second Relay; (*b*) A New Type of Control for X-Ray Apparatus.
At 5.—Prof. G. P. Thomson: Some Recent Experiments on Cathode Rays (Mackenzie Davidson Memorial Lecture).

Friday, Dec. 5, 10.30 to 12.30.—Dr. H. A. Harris: The Growth of Bone as illustrated by Radiography.
Dr. D. Hunter: Changes in the Bones in Hyperparathyroidism and Hyperthyroidism.
At 4.30.—Dr. A. E. Barclay: The Danger of Specialisation (Silvanus Thompson Memorial Lecture).

DECEMBER 4 AND 5.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—The Utilisation of Trade Wastes.

Thursday, Dec. 4, at 10.30 A.M.—J. B. C. Kershaw: Industrial Wastes.
A. T. King: The Treatment of Suint Liquors from Wool Scouring.
B. A. Smith: The Treatment and Disposal of Wool-washing Effluent.
At 2.30.—R. J. Marx: Whitewater in Paper and Pulp Mills and its Utilisation.
M. Schofield: The Distillation of Wood Waste and the Utilisation of the Products.
R. W. Griffith: The Utilisation of Industrial By-Products, with Special Reference to the Pulp Industry of the United States of America.

Friday, Dec. 5, at 10.30 A.M.—Dr. D. J. Lloyd: The Problem of Tannery Waste.
O. Wans: The Use of Wood Waste for Heating and Generation of Power.
At 2.30.—E. B. Busenburg: The Utilisation of Waste Rubber.
Prof. J. W. Hinchley: The Recovery of Metal from Waste Materials.