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The Imperial Conference and Science.

IN the House of Commons on July 30, the Prime Minister, Mr. Ramsay MacDonald, stated that the Imperial Conference, which is to be held in the autumn, will afford an opportunity for the Home Government and representatives from the various parts of the British Empire to make a general survey and discuss all matters, both in the political and economic spheres, of common interest to the members of the British Commonwealth. These matters will be dealt with under three headings: (1) inter-imperial relations; (2) foreign policy and defence; (3) economic questions. As regards inter-imperial relations, particular questions for consideration will be the recommendations of the recent conference on the operation of Dominion legislation and other matters of a constitutional character cognate to and arising from those discussed in the Report of the Inter-Imperial Relations Committee of the Imperial Conference of 1926.

As regards foreign policy and defence, the agenda will cover the further development of peace and arbitration policy, and will include the question of the reduction and limitation of armaments. Obviously, any consideration of the problems arising out of the effort made by the constituent parts of the British Commonwealth to reduce and limit armaments must include in its scope the bearing of scientific research on the materials for defence. But even more obvious is the ultimate connexion between science and the economic questions to be considered by the Conference. These questions include the general one of the trade of the Empire, the effect of successive tariff changes, and the extent and effect of inter-imperial tariff preferences; bulk purchase and price stabilisation; oversea settlement; the past and future work of the Imperial Economic Committee, the Empire Marketing Board, and the Imperial Institute; co-operation in agricultural research (including cotton-growing), forestry, and minerals; special meetings of experts on industrial research and standardisation; transport and communications, including review of the work of the Imperial Shipping Committee and the Oversea Mechanical Transport Council, survey of steamship services and development of civil aviation, cable, radio, broadcasting, postal and news services.

The programme is certainly comprehensive. It includes consideration of a number of subjects around which the fiercest political controversy has raged for many years past in every part of the Commonwealth. The only grave omission is a

reference to any discussion on the effect of the return to the Gold Standard in 1925 on trade and industry, a subject which has lately become one of most serious concern to economists, industrialists, and financiers. But the programme will commend itself as an honest attempt to project into the field of discussion almost every subject worthy of consideration, however unpalatable some of them may be to certain members of His Majesty's Government, charged as they are with potentialities for exhibiting marked differences of opinion, not merely between the oversea members of the Commonwealth and the Home Government, but also between those representing the Home Government itself. It demonstrates, moreover, that since 1926 the emphasis of the Conference has been shifted from constitutional to economic questions, the basis of which must in future be free co-operation, each Dominion being the sole judge of the nature and extent of its co-operation.

It is interesting to compare the subjects for discussion at the Imperial Conference with those which engaged the attention of representatives from the non-self-governing dependencies of the Crown and Mandated Territories at the recent Colonial Office Conference. At that conference discussion ranged mainly around the methods by which the potential resources of the Colonial Empire could best be developed. The report of that Conference has already been issued,* and more than half of it is devoted to subjects of direct interest to scientific workers. It surveys in broad outline the administration of the scientific and technical departments of the Colonial Empire, with special reference to the possibilities of creating a unified agricultural service, the Imperial College of Agriculture, veterinary services and research, the organisation of work on animal husbandry, medical services and research and their bearing on the recent report of the Colonial Development Public Health Committee, the place of the biologist in the education services, and forest services and research. The work of the Empire Marketing Board in fostering general research and assisting various colonies to undertake *ad hoc* investigations into problems of special interest was reviewed, and consideration was given to the development of fisheries, the extension of cable and wireless communications, civil aviation, transport services, and the function of the Imperial Institute. No questions relating to tariffs were discussed, with the result that full time was given to and due emphasis laid on considerations of the place of science in the life of the subject races of the British Empire.

We do not suggest that consideration of tariffs and imperial preferences, or what has come to be regarded as the alternative, bulk purchase and stabilisation of prices, should not be adequately discussed by the assembly of imperial statesmen. Everything is to be gained by the ventilation of these subjects, more particularly if the protagonists of these economic dogmas will provide the Conference with adequate statistical data bearing on their convictions. But there is a danger that most of the plenary sessions of the Conference may be taken up by such discussions, and those questions dealing with the bearing of science and co-operation in scientific research upon the development of the resources of the Dominions will be relegated to sub-committees consisting solely of experts. The inevitable consequence will be that the proceedings of these sub-committees will receive scant attention from the popular organs of the Press, wedded as these are to acutely controversial matter which the Conference will provide in abundance, and their reports will be presented at the end of the Conference and hurriedly adopted without comment or discussion.

It may be urged that the prominence given at the Imperial Conference in 1926 to the need for the encouragement of scientific research is a guarantee that there will be the same interest in science at this one. We trust this may prove to be the case, but there is reason to doubt it. It has to be remembered that the late Lord Balfour presided over the Research Sub-Committee appointed by the last Imperial Conference. He presented its report to a plenary session. His was a personality which commanded attention. He added to political renown an intimate knowledge of the subject-matter he presented and an unrivalled capacity in a statesman for presenting the facts and the outlook of science to the uninitiated. Unfortunately, none of the statesmen at the forthcoming conference possesses this unique combination of qualities. It does not follow, of course, that the reports of the sub-committees of experts presented to the Conference will not be of the greatest importance, or that lack of publicity in the Press or adequate discussion at a plenary session necessarily means that their recommendations will not eventually be put into effect. But it does mean that a restatement of the claims of science to the attention of the civilised world and the bearing of science on world progress, as well as the re-emphasis of the place of science in education, must be made without rather than within the Conference,

* Colonial Office Conference, 1930. Summary of Proceedings (Cmd. 3628.) (London: H.M. Stationery Office.) 2*s*. net.

What is wanted is a mobilisation of the supporters of science to take part in a preliminary educative campaign. Help can be expected from certain statesmen no longer in office, of whom the most prominent in England are Mr. Amery, Mr. Ormsby-Gore, and Major Walter Elliott. They have already done much to awaken their political colleagues at home and in the Dominions and Colonies to the need for more earnest encouragement of scientific research, and they have in their recent Empire travels done much also to spread the gospel of science among the unofficial classes in the various countries which they have visited. But the task is primarily one for scientific workers themselves. They should not ignobly depend upon others to interpret their work for them. It is a confession of impotence. It is their obvious duty to the peoples of the Empire to make unmistakably clear the problems which confront them, what new problems the application of science has created for the civilised world, and what hope there is of their solution.

The next few weeks will provide scientific workers with their opportunity to take part in this useful and necessary form of propaganda. A splendid lead has been given them by Dr. A. C. D. Rivett, deputy chairman of the Australian Council for Scientific and Industrial Research. In an article which appeared in the *Times* of Aug. 7 he pointed out that the coming Imperial Conference, in exploring the possibilities of closer economic co-operation, would do well to realise the fact " that before political and administrative measures can attain full success in dealing with the interchange of products it is essential to reach as high a degree of efficiency as possible in methods of production in both primary and secondary industries ". He adds that it will not " be without significance politically if, by improved methods, Empire goods are able to compete in British markets with a smaller measure of artificial aid than is deemed by some to be necessary at present ". These improved methods, he suggests, must be based on scientific experiment and reasoning, so that " it becomes of major importance to ensure that the growing scientific powers of the Empire shall be strengthened by union and made available, in the full force so attained, for the solution of problems of production and marketing ".

Much of Dr. Rivett's article is devoted to a survey of the problems confronting pastoralists and agriculturists in Australia. The diseases which ravage their sheep, blow-fly, foot-rot, braxy-like diseases, internal parasitic troubles, caseous lymphadenitis, are all preventable, he avers. The beef industry in North and North-West Australia is threatened by the rapidly spreading buffalo-fly pest. The prickly-pear has more or less ruined 60,000,000 acres of valuable stock-raising land in Queensland. Ignorance of soil science has been responsible for the economic ruin of many agriculturists and the failure of settlement schemes.

Fortunately, Australian statesmen of all parties realise that it is wise economy to spend money, even at a time of acute financial depression, on those services to which alone they can look for a solution of such problems, and it is equally fortunate that those in control of their scientific services realise the importance of co-operation and the pooling of knowledge through the medium of the various imperial bureaux and imperial research institutions which now exist in the different countries of the Empire. What is true of Australia is also true of every British Dominion, and Great Britain can be proud to have created the institutions which have served as models for them all.

Nevertheless, it is not enough to have persuaded governments that production and distribution are best improved by the assiduous prosecution of scientific research and its application. Science has a greater and nobler rôle to play than that in world affairs. Science, in fact, cannot be dissociated from any aspect of policy which seeks to determine the future course of the form of civilisation for which science itself is mainly responsible.

The Wider Biochemistry.

Outlines of Biochemistry: the Organic Chemistry and the Physico-Chemical Reactions of Biologically Important Compounds and Systems. By Prof. Ross Aiken Gortner. Pp. xv + 793. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 30*s.* net.

IT will be generally agreed that, up to the present time, the development of biochemistry has been most active in those aspects of the science which are associated with medicine in general and with animal physiology in particular. Such, according to Prof. Gortner, has been the case in most of the universities of America, and such, most of us will agree, has likewise been the case in Great Britain. Biochemistry has not on that account suffered any undue restriction of its activities. The reviewer feels personally that the future development of biochemistry can best be secured by retaining and even widening the administrative contacts with physiology and especially with

animal physiology. But such a viewpoint in no sense implies a denial of the necessity for developing biochemistry as an independent science incorporating within its wide bounds the methods of any sister science which give promise of elucidating the mechanisms of the living plant or animal.

It is clear that during the last two decades the younger science has found increasing utility for the techniques of the older physico-chemical sciences, and this ever-widening scope of biochemistry is very well brought before us in "Outlines of Biochemistry", which collates and amplifies the lecture material used in Prof. Gortner's classes in agricultural chemistry in the University of Minnesota. It must be made clear, however, that this is not a text-book of agricultural chemistry in the strict sense. It is much more. Thus it devotes ten chapters and 277 pages to a consideration of physico-chemical problems intimately associated with cellular chemistry. Some may regard this as an undue allowance in a book of this size, but they are adequately answered by the originality of selection and the freshness of treatment of the matter embodied in these chapters, much of it distinctly unusual in biochemical text-books. Prof. Gortner is certainly to be congratulated on his breadth of vision in the more physical fields of biochemistry. The remainder of the book covers the proteins, nitrogen bases and alkaloids, carbohydrates and allied compounds, tannins, plant pigments, lipides, essential oils, and, finally, the 'biocatalysts'—the vitamins and enzymes.

The proteins are very fully treated, and special mention may be made of Chapter xiv. on protein structure and isomerism, and of Chapter xix. on the biological reactions of the proteins. The latter is perhaps unduly brief, but the matter of both chapters is presented in a most stimulating manner. In the section on nitrogenous bases the newer work on thyroxine, ergothioneine, and spermine is included, but the references to glutathione will require alteration in later editions. The carbohydrates are well treated, and in all cases the pyranoside and furanoside formulæ are used for the stable and reactive isomers respectively of the monosaccharide components. There is a mistake in the formula of gentiobiose on page 543, the reducing glucose component being represented as glucofuranose instead of glucopyranose. Glucofuranose has not yet been found in any natural source, either free or in combination. There is some confusion on pp. 549 and 550 regarding the individual monosaccharide components of some of the lesser known tri- and tetra-saccharides. Moreover, the α-configuration is given to the glucosidic linkage in sucrose. The reviewer is not aware of the evidence upon which this is based. All these are minor slips and can readily be rectified in a later edition. In the section dealing with the polysaccharides there is included the extremely interesting work of Heidelberger and his associates on specific immunological carbohydrates, whilst the nature of the problems to be considered in relation to the internal structure of cellulose is well illustrated by diagrams from the papers of Sponsler and Dore on X-ray analysis of ramie fibres—both very welcome features in a text-book of biochemistry. The chapters on fats and oils, sterols, and lipides are perhaps less satisfactory than those already reviewed; the treatment, though efficient, strikes one as being somewhat less original and lacking a little in enthusiasm.

There are certain omissions which are perhaps explained by the circumstance that the book is based on courses of lectures to students of agricultural chemistry. This notwithstanding, one feels that the important field of biological oxidations and reductions—including some reference to that fundamental plant product, cytochrome—might well have been included in a comprehensive work of this type. Moreover, although melanin and its formation are referred to in various parts of the book, no mention is made of the important work of Raper in this field. The rôle of hexose phosphates in fermentation is dismissed in two lines, and no reference is made to the parallel phenomena of muscle chemistry.

The reviewer is well aware of the impossibility of the author's anticipating all the strictures of the critic determined to be critical, and the above remarks are advanced, not with the intention of casting any reflection upon Prof. Gortner's noteworthy contribution to the literature of biochemistry, but rather that they may serve as a guide to the reader as to what fields he may expect to find covered, and what omitted, in the impressive mass of well-ordered information embraced within the covers of this work. Textual references to the original literature are ample, and are extended in a series of general references at the end of the volume. "Outlines of Biochemistry" will be deservedly popular on both sides of the Atlantic, and it is the certainty of the demand for further editions that encourages the reviewer to stress his personal regrets regarding what is omitted. In no sense does it lessen his enthusiasm for what is included and treated so admirably. J. P.

A Biologist in the New Hebrides.

Man and Animals in the New Hebrides. By Dr. John R. Baker. Pp. xiv + 200 + 17 plates. (London: George Routledge and Sons, Ltd., 1929.) 12*s.* 6*d.* net.

ON two occasions, in 1922 and 1927, Dr. Baker spent five and seven months in the New Hebrides, bent on scientific pursuits. No one will read in his account of these explorations vivid or wordy descriptions of tropical scenery and tropical mankind; the style is matter of fact, rather abrupt, sometimes a little careless, but no one will gainsay the importance of the facts themselves, or but admire the pains taken by the author to make his investigations as thorough as difficult conditions would allow.

The rapid depopulation of Melanesia has exercised the minds of many travellers, and various recent writers have attributed it to a score of different causes. Dr. Baker makes his own contribution. In Espiritu Santo, where the expedition was based, relics of villages the inhabitants of which had died off were frequent amidst the dense forests of the interior, and an estimate made by an English resident of some twenty-five years' standing placed the population then at ten times its present numbers. A census of a considerable number of the villages brought out the striking fact that for each 100 females there were 159 males, the second highest male/female ratio recorded of any people in the world at the present day. While Dr. Baker admits that introduced diseases and abortion are the chief causes of depopulation, he agrees with Buxton in regarding this abnormal sex-ratio as a factor of great importance. Unless the birth-rate were very high, and here it is the reverse, no race could fail to decline under such conditions.

To our knowledge of the fauna of the islands Dr. Baker made very considerable additions, as witness his list of some 29 new species (mostly Arthropoda). Undoubtedly his most interesting faunistic survey was that of the almost hitherto unknown "Steaming Hill Lake" in the hollow of the ancient crater of Santa Maria. Of thirty species, ten are probably new to science, a large proportion; but we are not prepared to agree with the author when he suggests that the specific differences cannot possibly be regarded as "of use" to their possessors. The physical conditions of the lake are so peculiar, its altitude, relatively high temperature, and curious temperature gradient, that who is to say what variations they may induce?

On the sea-shore of the island of Gaua some excellent ecological observations were made. A study of the coral reef in the mass suggested a modification of the gradual subsidence theory of fringing reef formation. The new idea is that a relatively slight sinking, which need not be continued, may offer conditions suitable for a gradually broadening fringe of coral, since even in the presence of the reef the coast-line itself recedes before the erosive action of shore breakers. Instead, therefore, of expanding outwards from the original shore-line, the reef expands inwards over erosion-submerged coast. Detailed examination of the half-mile of reef brought to light a fairly definite zoning of coral genera, and even more definite was the zonal arrangement of holothurian genera and species revealed by a count of individuals from the shore to the edge of the reef, an observation which fits in with recent work on the zoning of mollusca on Scottish shores.

Finally, reference must be made to the scientific use to which the extraordinary abundance of intersexual pigs was put. The abnormality elsewhere is extremely rare amongst mammals, but in these islands, where pigs are the most highly valued of possessions, between ten and twenty intersexes occurred to every hundred normal males. The type is quite distinct from those known in Europe, and its abundance and variety have led the natives to classify the intersexes into seven recognisable groups. Dr. Baker traces the probable development of these different stages, and suggests a convincing theory of their origin and of their genetics.

This is an interesting book, because, touching upon many different subjects, it sees all from the point of view of the scientific student. J. R.

Infra-Red Spectroscopy.

Das ultrarote Spektrum. Von Prof. Dr. Clemens Schaefer und Dr. Frank Matossi. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 10.) Pp. vi + 400. (Berlin: Julius Springer, 1930.) 28 gold marks.

THE remark has not infrequently been made that progress in scientific knowledge depends ultimately upon the discovery of new methods of technique and the perfection of older ones. However much one may wish to uphold the claims of pure theory, there remains the conviction that, broadly speaking, it is the experimentalists who set the pace, either in providing trustworthy data or, for various reasons, failing to do so. In few branches of physics has this been more obvious

than in research upon infra-red radiation and its reactions with matter. As the authors of the book now under review remind us, it was Herschel who discovered the existence of these radiations so long ago as 1800; yet other parts of the spectrum—X-rays, for example—came to light decades later and grew in importance far more rapidly. The reason is to be sought in the exceedingly difficult nature of experimentation in the infra-red. It is not too much to say that the conquests of the last few years have reduced many of the technical rebels to a satisfactory degree of subordination: a few, however, still offer stout resistance, and against them a war of attrition is probably the only course.

Prof. Schaefer is not only a pioneer in infra-red spectroscopy and the founder of an enthusiastic school of disciples which includes Dr. Matossi, but it has also come his way to hold chairs of both theoretical and experimental physics at various times. The book now before us is the work of labourers in a vineyard who take no delight in picking to bareness for the say-so of it, but who have garnered judiciously, assessing almost to perfection the value of the crop. It is this that has made the laboratories at Marburg and at Breslau institutions whereunto seekers may resort, and be certain that they will come away humbler and wiser.

After a short historical introduction, the reader is asked to face some seventy pages devoted to experimental affairs. It is all very valuable, and the fact that it comes first serves to stress the hardly won battle for technical supremacy. The only drawback is that it might give the impression that the subject is little beyond the sum of its inherent difficulties. The next chapter is more encouraging, and deals adequately with the questions of heat radiation and their theoretical significance. A brief but sufficient treatment of the general Maxwellian relations follows, together with the work of Rubens on optical constants. The reader may now pause and take breath, for it is here that the book changes its outlook.

So far, infra-red rays have done all that electromagnetic waves of such a range of frequencies should, they have fitted reasonably well into the classical scheme and have provided a host of traps for the unwary observer. The authors, however, are not amongst those who ruminate on past victories: they are about to show how this region of the spectrum is of the first importance as the means whereby the physicist probes into the nature of the molecule. Theoretically, in this the chemist should rejoice (though in practice he usually does no such thing), and the X-ray worker will benefit from evidence on crystal structure from directions whence he least expected it.

Chap. iv. is devoted to the infra-red spectra of gases and liquids. After a general treatment along what must now be called classical quantum lines, the authors expound such portions of the new mechanics as are directly applicable. One wonders whether so much space need have been given to the Hamiltonian and the correspondence principle: they are discussed at length in countless text-books, while it seems unlikely that anybody would embark upon such a special study as that of infra-red spectra without a working knowledge of such matters. On the other hand, the recent verifications for polyatomic gases and the finer points of molecular structure provide very welcome reading; they are presented with a generosity to workers outside Germany which is a pleasure to record.

Solids next receive attention. Here, too, there is a good deal that one is accustomed to find elsewhere, included no doubt for completeness and the reader's convenience, but the story of the gradual unravelling of crystal spectra and the fitting together of fundamentals, overtones, combination tones, and inactive vibrations into a consistent whole is told as only those can tell it who have kept many a night vigil watching the excursions of the spot of light on the scale. The value of the results is great, both for crystal dynamics and sometimes even for the revelation (from the character of the absorption bands) of subtle niceties in crystal structure.

In spite of the high price, spectroscopists and physical chemists should strive to add this volume to their library: they will find in it not only enlightenment but also a certain majesty as of those who return from the harvest, bringing their sheaves with them. F. IAN G. RAWLINS.

The Older Rocks and Physiography of Scotland.

Chapters on the Geology of Scotland. By the late Dr. Benjamin Neeve Peach and the late Dr. John Horne. Pp. xvi + 232 + 18 plates. (London: Oxford University Press, 1930.) 10*s.* 6d. net.

THE late Dr. B. N. Peach, of the Scottish Geological Survey, is well known to have advocated the view that the Moine gneiss, the most extensive formation in Scotland, is the metamorphosed eastern extension of the Torridon Sandstone. His remarkable personal influence gave that conclusion long currency among his colleagues and inspired a series of ingenious hypotheses to reconcile

it with the facts. This view was, however, never adequately explained in print and remained generally unintelligible. One of its unfortunate consequences was that it prevented the preparation of the work on the geology of Scotland which had been planned by Peach and Horne; for Horne rejected this view of the relation of the Moine and Torridonian rocks and the two authors could not complete their account of the first section of Scottish geology.

After Peach's death Horne resumed work on the book, and prepared five chapters, which give a valuable account of Scottish physiography, and of the petrography, distribution, and history of the investigation of the older rocks. These chapters contain so much inconsistent with Peach's opinions that they are clearly the work of Horne. The sixth and seventh chapters with the accompanying illustrations, Fig. 27 and Plate XVIII., are the work of Peach, and their publication is of importance as they record opinions which have had a great influence on Scottish geology. The arguments for Peach's conclusion that the Moine gneiss is altered Torridon Sandstone are clearly stated by Horne on pp. 199-200 ; and they are followed by three objections which appear unanswerable. In the text (p. 76) reference is made to the occurrence of Moine pebbles in the Torridon conglomerates of Loch Broom; if those pebbles are Moine they are an absolute objection to the Moine and Torridonian being of the same age. The text quotes Teall to the effect that the five pebbles from the Torridonian submitted to him could all be matched by rocks mapped by the Survey as Moine; and a footnote adds that Dr. Horne was of the opinion that they are typical Moine granulites.

In Peach's chapter on Islay some of the sandstones are represented as Torridonian, as if there were no doubt of the fact ; and on the map and the section (Plate XVIII. f. 3) those rocks are marked as Torridonian without the query which Horne insisted on inserting in the Survey maps. The note of interrogation is retained in the block reproduced on p. 204. The identification of these rocks as Torridonian is said on p. 205 to be convincing ; but it has been emphatically rejected by Mr. J. F. N. Green and the reviewer. The upper quartzites of Islay are identified as Cambrian on evidence that appears quite inadequate. Dr. Peach's general views are clearly shown by the Plate XVIII. and are bewildering. The succession includes neither Moine nor Dalradian. The Loch Tay Limestone is represented as the equivalent of the limestone in the slates of Toward, of the Margie Limestone of the Highland Border series and of the fossiliferous Stinchar Limestone (Llandeilo, or Middle Ordovician) near Girvan. The Ben Ledi Grits are claimed as Silurian ; the bulk of the Dalradian as Cambrian, and the Islay Limestone as Torridonian. Dr. Peach expressed such views in conversation, but they appeared vague and variable, and it was difficult to see how they could be reconciled with the general evidence. They are now published explicitly in Plate XVIII.

This definite statement of the opinions which Peach advocated so persuasively renders the volume of historic importance, though the sections which explain his views will probably be regarded ultimately as one of the curiosities of Scottish geology.

J. W. G.

Bibliographical Guides.

Reference Books : a Classified and Annotated Guide to the Principal Works of Reference. Compiled by John Minto. Pp. vii + 356. (London : The Library Association, 1929.) 21*s*.

THE need for a new guide to the literature of books of reference compiled from the point of view of the requirements of the larger libraries in Great Britain is undoubted, and no better choice could have been made in the selection of an editor-in-chief than Mr. Minto, the learned librarian of the Signet Library in Edinburgh. The Brussels decimal system of classification has been adopted as a basis for the classification of the entries. Strict adherence to any system of classification leads to unsatisfactory results, for while a work can be placed only in one class its contents may justify duplication or multiple entry in several. For example, the most complete bibliography of American literature is Sabin's " Bibliotheca Americana ", but it does not appear in this class, though it does elsewhere under works relating to America. This is a case where repetition is justifiable ; but when need for repetition arises from defects in the classification, the better course is to modify the classification by amending the class definition or by transferring the class elsewhere. For example, alchemy is treated in the Brussels classification as a branch of occult philosophy and only one entry appears relating to alchemical MSS. This is a case for class transference—for the bibliography of alchemy and chemistry are often combined. It cannot be too strongly stressed that in preparing guides of the character of this work great freedom is permissible in amending a classification if such amendment tends to clarify the results for the users of the book.

The classes most fully dealt with in the guide are "General Reference", Social Sciences", and "History and Geography". These classes go to confirm Mr. Minto's reputation for solid and scholarly workmanship; but in the classes "Natural Science" and "Useful Arts" Mr. Minto and his coadjutors are clearly out of their depth. The nature of the omissions may be gathered from the following examples. In the class "Chemistry" there is no reference to any of the chemical abstracts or under "Chemical Technology" to the annual reports of the Chemical Society. Under "Mining Engineering" "The Mineral Industry" is omitted, and there are only two entries under the "Bibliography of Agriculture"—one a 44-page pamphlet which is described as representing an important collection! The agriculturists' Bible, "The Experiment Station Record", is not recorded. In turning to the list of contributors mentioned in the preface we see that the advice of librarians of scientific institutions was not thought worth securing. It is regrettable that the Library Association did not insist upon a proper representation of scientific bibliographers upon the advisory panel. The neglect of scientific advice has rendered an otherwise valuable work useless for scientific and technical workers.

Our Bookshelf.

Geologische Karte der Erde. Von Franz Beyschlag. Bearbeitet mit Unterstützung durch die Preussische Geologische Landesanstalt. 1 : 15,000,000. Lieferung 2, enthaltend die Blätter 5, 6, 9, 10. (Berlin : Gebrüder Borntraeger, 1929.) Gesamt-Subskriptionspreis 150 gold marks.

THE second section of this map on the scale of 1 to 15 million, which is being issued by the Prussian Geological Institute under the supervision of Prof. Beyschlag, includes the four sheets of the southern part of the New World. Two of them were easily prepared, for one covers the Central Pacific with part of California, and another the south Pacific and New Zealand. The islands are too small to show their composition by colour, but initials might have been used for the purpose. As it is, islands such as Barbados and those off Brazil are left without any indication of their geology.

The most important of the new sheets is one covering Central and most of South America, and another of Patagonia and the South Atlantic Islands. These two sheets are especially useful. It is not easy to read them fully without the index of colours, which is to be issued with the last section; but they give a clear view of the general structure of South America. South Georgia is unfortunately coloured as Archean, and that mistake is the more remarkable since the fossil which most clearly proves that at least part of the slates in the island are Mesozoic was found by a German doctor, was determined by Pompeckj, and is in the collection of the University of Heidelberg. The uncertainty as to the geology of South America may be realised by comparison of this map with that compiled by Du Toit in 1927. Prof. Beyschlag greatly reduces the area of Lower Mesozoic volcanic rocks in the Upper Parana basin and south-western Brazil, but includes in the lavas a large area near Ascension which Du Toit marks as Devonian, Carboniferous, and Archean. The composition of the Sierra de Tanjil and range to the south of it are also different from Du Toit's map. The maps are an example of clear and beautiful colour printing.

Les Étapes de la physique. Par H. Volkringer. (Encyclopédie Gauthier-Villars.) Pp. ix + 217. (Paris : Gauthier-Villars et Cie, 1929.) 20 francs.

THIS little book of 200 pages is such a good example of the specially French art of popularisation that it is worth examining how the success is obtained. The first point is obvious and clearly attained in the case of M. Volkringer : the author must be a master of his subject. Wherever he gives details of any particular conclusion or experiment, he speaks clearly, as one who has been through that stage and knows it. In the second place, he must be able to select with judgment. This book, slight as it is, gives some enlightening illustrations of all the main stages from Archimedes to Planck and Rutherford. The third point is one on which the French are nearly always more successful than others, one on which the English populariser is apt to feel shy and open to comment. The successful author of such a book must give a certain amount of moralising and what may be thought commonplace generalisation. In this matter M. Volkringer is particularly good; he gives it and it does not appear cheap. Not only his own remarks but apt quotations from greater men punctuate and enliven especially the later pages. "Le succès est le plus puissant toxique." "Le but essentiel de l'industrie est l'adaptation des richesses à la satisfaction les besoins humains." "Tout le secret de sa valeur et son influence [that is, of physics] est dans le fait qu'elle est la science de la mesure."

The book concludes with two short but sufficient chapters on the place of theory in science and the nature of scientific law. The reader gets a glimpse of the philosophy of the subject, but is not immersed in it. F. S. M.

An Introduction to Organic Chemistry. By Dr. Eric John Holmyard. Pp. xi + 282 + 10 plates. (London : Edward Arnold and Co., 1930.) 4*s.* 6*d.*

DR. HOLMYARD has attempted to arouse interest in organic chemistry among boys and girls in upper forms who have already passed the school certificate examination, by describing the structure and chemical properties of some of the simpler compounds in both the aliphatic and the aromatic series. Stress is laid upon methods used in the purification and analysis of compounds and upon the development of structural formulæ in order to

familiarise the student in the first place with the kind of reasoning by means of which a knowledge of molecular structure may be acquired, and, secondly, with the general properties associated with particular groupings. To each chapter is appended a list of questions to be answered, but no practical details are given for the guidance of beginners. The illustrations include ten full-page plates, six of which are portraits of eminent chemists. The descriptive narrative is occasionally relieved by the introduction of chemical theories, such as Baeyer's strain theory, the theory devised by Le Bel and van't Hoff to interpret the existence of optical isomerism, the polymerisation of formaldehyde to account for the photosynthesis of carbohydrates, and the discussion of the orientation of derivatives of benzene. Notes are also given upon modern commercial processes. The style is clear and the text is not overloaded with detail.

The Art and Religion of Fossil Man. By Prof. G.-H. Luquet. Translated by J. Townsend Russell, Jr. Pp. xiv + 213. (New Haven: Yale University Press; London: Oxford University Press, 1930.) 23*s.* net.

THIS volume is a translation—and it may be said an excellent translation—by Mr. Townsend Russell, of the American School of Archæology in France, of Prof. Luquet's "L'Art et la Religion des Hommes fossiles". M. Luquet is the author of a considerable number of works on the psychology of primitive and prehistoric art; but a wise choice was made in selecting this particular volume for translation into English. Not only is it a valuable description and analysis of the various classes of Palæolithic art, but it is one of the most important contributions to be made by French archæologists to the discussion of the meaning and purpose of that art. M. Luquet is a strong supporter of the view which holds to the disinterested origin of the art of Palæolithic man, though it is recognised that in certain cases a magical element must be admitted. The evidence for a belief in some sort of life after death to be deduced from the burial customs of Palæolithic man is here well marshalled and thoroughly sifted. The illustrations are excellent; they have been selected with discrimination, but at the same time without undue partiality to the line of argument followed by the author.

A Dictionary of Scientific Terms: Pronunciation, Derivation, and Definition of Terms in Biology, Botany, Zoology, Anatomy, Cytology, Embryology, Physiology. By I. F. Henderson and Dr. W. D. Henderson. Second edition, revised. Pp. xi + 352. (Edinburgh and London: Oliver and Boyd, 1929.) 16*s.* net.

THE first edition of this dictionary was published in 1920. Nine years later a second edition appears. Clearly the scientific workers for whom it was compiled have found the book useful.

The present-day student of science is usually ill-educated on the classical side. He often employs the commonest terms in vogue without any serious reflection as to their literal meaning, and his mispronunciations must appal the scholar of Latin and Greek. But if he possess this dictionary and consult it faithfully, there will be less excuse for his blunders.

The second edition contains fifteen hundred new terms, but is no bulkier than its predecessor. Much care and thought must have gone to the recompilation, and the publishers are to be congratulated on their wise decision to allow the whole book to be reset. The authors offer their thanks to those colleagues who have suggested new terms that might be included, and they hope that further suggestions will be forthcoming for future editions.

D. L. M.

The Wilderness of Denali: Explorations of a Hunter-Naturalist in Northern Alaska. By Charles Sheldon. Pp. xxv + 412 + 63 plates. (New York and London: Charles Scribner's Sons, 1930.) 21*s.* net.

THE late Charles Sheldon was a great hunter, and this posthumous work describes the last of his hunting trips, amongst the snows of Denali or Mt. M'Kinley in Alaska. But Sheldon was also a sound observer of Nature, and while the sportsman will be thrilled by his descriptions of difficult stalks after bighorn, moose, and reindeer, the naturalist turns, with some relief, from the tales and pictures of slaughter, to his comments upon the lives of these and other wild animals. Colour protection attracted his attention: snowy owls hunting for mice in the snow were inconspicuous, and motionless ptarmigan were invisible; the markings and coloration of the lynx blended with the rocks; but the colour of the moose rather revealed than concealed it, and the white bighorns were sometimes visible three or four miles away. A sudden plague of field mice and lemmings sprang up in 1907, where none had been seen before; marsh-hawks increased in numbers, and by May of the following year mice were scarce again. There are many such notes scattered throughout the text, but the book is primarily a hunter's account of the pursuit of big game and the habits which had to be explored to make the pursuit fruitful.

The Physiology of Love. By Dr. George M. Katsainos. Pp. vi + 326. (Boston, Mass.: The Author, 176 Huntington Avenue, 1929.) 4 dollars.

DR. KATSAINOS cannot be said to have contributed any great advance to our knowledge in the work under notice. He is somewhat intolerant of the views of others and shows a lack of the critical faculty in his discussion, allowing his emotions to run away with him. To attribute homosexuality to satiety with heterodox sex cravings shows a very superficial knowledge of up-to-date psychopathology, and this is confirmed when we find him attributing *Psychopathia Sexualis* to Freud! One would hesitate to compare dyspepsia to what the author pleases to call dyseros—surely this is a travesty of physiological principles. The book leaves a feeling of dissatisfaction.

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.*]

Stellar Structure and the Origin of Stellar Energy.

THE generally accepted theory of the internal conditions in stars, due to Sir A. S. Eddington, depends largely on a special solution of the fundamental equations, and according to this a definite calculable luminosity is associated with a given mass. If this were the only solution of the equations it would conflict, as I have repeatedly shown in recent papers, with the obvious physical considerations which show that we can build up a given mass in equilibrium so as to have an *arbitrary* luminosity (not too large) whatever the assumed physical properties of the material. I have recently noticed that the fundamental equations possess a whole family of solutions, corresponding to arbitrarily assigned luminosity for given mass. These solutions show immediately that Eddington's solution is a special solution and corresponds to an unstable distribution of mass. In the stable distributions the density and temperature tend to very high values as the centre is approached, theoretically becoming infinite if the classical gas laws held to unlimited compressibility.

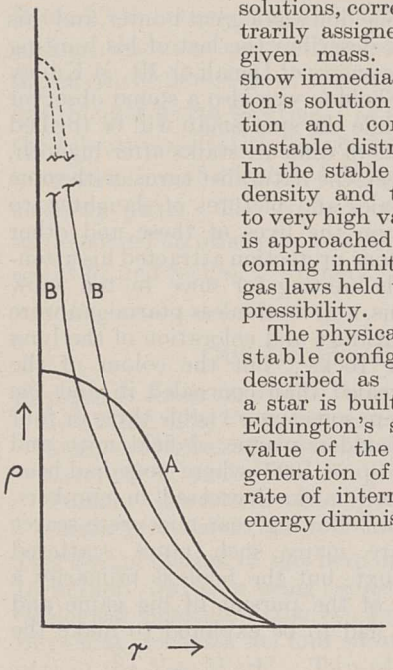

FIG. 1.

The physical properties of the stable configurations can be described as follows. Suppose a star is built up according to Eddington's solution with his value of the rate of internal generation of energy. Let the rate of internal generation of energy diminish ever so slightly. Then the density distribution suffers a remarkable change. The mass suffers an intense concentration towards its centre, the external radius not necessarily being changed. The star tends to precipitate itself at its centre, to crystallise out so to speak, forming a core or nucleus of very dense material. The star tends to generate a kind of 'white-dwarf' at its centre, surrounded of course by a gaseous distribution of more familiar type; the star is like a yolk in an egg. In this configuration the density and temperature are prevented from assuming infinite values by the failure of the classical gas laws, but they reach values incomparably higher than current estimates. For example, it seems probable (though the following estimates are subject to revision) that the central temperature exceeds 10^{11} degrees, in comparison with the current estimates of the order of 10^7 degrees; and the density may run up to the maximum density of which ionised matter is capable.

The unstable density distribution of Eddington's model (curve A) and the stable density distribution of actual stars (curves B) are indicated roughly in Fig. 1, which is not drawn to scale. It may be mentioned that the instability is of a radically different kind from that discussed by Sir James Jeans. He concluded that perfect-gas stars of Eddington's model were *vibrationally* unstable. In my investigations, the instability of Eddington's model arises from any slight departure of the rate of generation of energy below the critical value found by Eddington. The perfect-gas distribution of my solutions is perfectly stable, but the density necessarily increases until degeneracy or imperfect compressibility takes control.

The consequences amount to a complete revolution in our picture of the internal constitution of the stars. In the intensely hot, intensely dense nucleus, the temperatures and densities are high enough for the transformation of matter into radiation to take place with ease. It is to this nucleus that we must look for the origin of stellar energy, a nucleus the existence of which has previously been unsuspected. The difficulties previously felt as to stellar conditions being sufficiently drastic to permit the evolution of energy largely disappear. Many of the cherished results of current investigations of the interiors of stars must be abandoned; current estimates of central temperature, central density, the current theory of pulsating stars, the current view that high mass necessarily implies high radiation pressure, the supposed method of deducing opacity of stellar material from observed masses and luminosities, the supposed proof of the observed mass-luminosity correlation—all these require serious modification.

The new results are not a speculation. They are derived by taking the observed mass and luminosity of a star, and finding the restrictions these impose on the possible density distributions compatible with this mass and luminosity. By integrating the fundamental equations from the boundary inwards, we are inevitably led to high central temperatures and densities. So long as the classical gas laws persist, the solution is one of the family with a central singularity (infinities in ρ and T), and it is only the ultimate failure of the gas laws which rounds off the distribution with a finite though very large central ρ and T.

E. A. MILNE.

Wadham College, Oxford,
July 29.

Structure of Carbohydrates and their Optical Rotatory Power.

IT would appear from two recent publications by Dr. C. S. Hudson of New York (*J. Amer. Chem. Soc.*, **52**, pp. 1680, 1707; 1930) that the classification of the ring structure of sugars can be decided upon little more evidence than that of the optical rotations which these substances display in a single solvent and for light of one selected wave-length. If this claim could be substantiated, the method might be usefully extended to other groups of compounds and the labours of organic and bio-chemists would be immeasurably simplified.

Dr. Hudson is satisfied, however, with a standard of constitutional proof for the carbohydrates which will not find general acceptance. In no case does he advance evidence which is unequivocal for any sugar, although he attempts to apply definitive formulæ to many. His scheme finds its origin in the assumption that optical rotation is an additive property. At the same time that he is seeking to test this hypothesis he assigns differing structural formulæ to explain the anomalies that arise from it. These are at variance with many of the constitutional formulæ which my co-workers and I have established from a fundamental

study of the behaviour of sugars, although now, after some years of disagreement, he accepts my formula for glucose (NATURE, **116**, 430, Sept. 10, 1925).

Dr. C. S. Hudson has not utilised the means which were open to him to test the validity of his views by direct chemical experiments. The basis on which he develops his argument is the presumed existence, which his statistical methods enable him to detect, of the residue of a new form of mannose (calculated $[\alpha]_D + 77°$) in acetobromo-, chloro-, etc., derivatives of 4-glucosido-mannose, obtainable from cellobiose through cellobial. All the calculations leading to the allocations of structure for the remaining sugars are made to rest upon the assumption that the mannose occurring in the ordinary known form of α-methylmannoside is not present as a residue in this biose. If this foundation for his scheme fails, then the entire superstructure of rival formulæ which he has raised upon it must collapse.

A survey of Dr. Hudson's two recent papers (*v. supra*) has led me to select for this critical test an experimental method which he has tacitly approved: he has accepted and utilised the observation of Fischer that β-methylmaltoside gives rise by enzyme hydrolysis to β-methylglucoside without ring change. Implicit in Dr. Hudson's scheme, therefore, is the expectation that 4-glucosido-α-methylmannoside will yield by enzyme cleavage his hypothetical α-methylmannoside ($[\alpha]_D + 125°$), inasmuch as this is the glycoside of the unknown form of mannose to which he has assigned the 1 : 5-ring.

With my colleague Dr. E. L. Hirst and other co-workers (R. J. W. Reynolds, H. R. L. Streight, H. A. Thomas, J. I. Webb, and Miss M. Plant) I have prepared and investigated the chemical behaviour of both 4-glucosido-α-methylmannoside and 4-galactosido-α-methylmannoside to which the 1 : 4-ring for the mannosido residue cannot apply, since the 4-position in this residue is occupied by the biose link. We have found that these substances are hydrolysed by *emulsin* and yield the ordinary known form of α-methylmannoside ($[\alpha]_D + 79°$) which is the pyranoside (1 : 5-ring). To this pivotal compound Dr. Hudson has assigned the furanoside (1 : 4-ring) structure. It follows that the whole of his rival formulæ for mono- and di-saccharides become meaningless.

The above biosides are prepared in the same way as the bioses, namely, from cellobial and lactal by the action of perbenzoic acid, but in the presence of methyl alcohol instead of water. The same 4-glucosido-α-methylmannoside has also been obtained from acetobromo-glucosido-mannose, the reference compound quoted in the statistical scheme.

Had Dr. Hudson tried these experiments it is difficult to see how he could have committed himself to speculations that are at variance with this and with much more chemical evidence which is on record. Moreover, should it be the case that rotational values only are considered the relevant factors, then one may add that the rotations of these biosides and of the corresponding bioses are widely divergent from those required by his system of classification based on epimeric differences with cellobiosides and lactosides and the free sugars. From the optical rotations of these new compounds in the series upon which his case is based, he could have confuted his own thesis and demonstrated by statistical methods the presence of a residue of the ordinary known form, and not the hypothetical form, of methylmannoside or mannose. We showed two years ago that the 'principle of optical superposition' does not apply uniformly throughout the sugar group and that in the mannose, lyxose, rhamnose series the failure was conspicuously evident. The results now summarised are in complete agreement with the sugar formulæ we have established over many years by methylation studies, lactone formation and degradation, and by a comparison of the reaction velocities of glycosides under hydrolysis, and by other direct chemical methods.

W. N. HAWORTH.

University, Edgbaston,
Birmingham,
July 24.

Predissociation of the Phosphorus (P_2) Molecule.

IN a recent letter to NATURE, H. H. Van Iddekinge (NATURE, **125**, 858; 1930) communicated the observation that in the emission spectrum of S_2 the same bands occurred as in the absorption spectrum with the exception of those bands which are diffuse in the absorption spectrum (Henri and Teves, NATURE, **114**, 894; 1924; and Rosen, *Z. f. Phys.*, **52**, 16; 1928). According to Van Iddekinge (see also Kronig, *Z. f. Phys.*, **62**, 300; 1930), this is readily explained by the fact that the diffuseness of the band lines is due to a spontaneous dissociation of the molecule in the upper state of these diffuse absorption bands (predissociation) which occurs before radiation can take place; emission of these bands cannot therefore be observed.

When investigating the emission band spectra of the phosphorus (P_2) molecule, I found, about six months ago, an extended band system from 3500 A. to the far ultra-violet, the longer wave-length part of which has already been measured by Geuter (*Z. f. wiss. Phot.*, **5**, 1; 1907). The vibrational structure of this part was easily analysed, whereas the shorter wave-length part is rather difficult because of overlapping of the bands and vibrational perturbations, and has not been yet completely analysed. The analysis of the short wave-length part showed that those bands are present, the ν' of which is below a certain value, say a.[1] In that region there are five strong bands with $\nu' = a$, but no bands at all with $\nu' = a+1$, $a+2$, etc. What is even more significant is that the band lines of the bands with $\nu' = a$ suddenly stop at a certain low value of the rotational quantum number, the last line being very intense; whereas the lines of the bands with $\nu' = a - 1$ stop at a certain higher value of the rotational quantum number, no fall of intensity being evident for lower values of ν'.

The explanation of this phenomenon was rather obvious, and is the same as that independently obtained by Van Iddekinge and Kronig in the case of S_2. Though the absorption spectrum of P_2 vapour has not yet been investigated, it may be assumed as certain that the sudden stop of the bands at the value $\nu' = a$ corresponds to the beginning of bands with diffuse lines in the absorption spectrum at the value $\nu' = a + 1$. These absorption bands, however, lie in the far ultra-violet, because, as always for absorption bands, ν'' will be small, whereas the emission bands in question lie on the other branch of the Franck-Condon parabola, that is, high values of ν'', and therefore at longer wave-length.

In all cases of diffuse molecular *absorption* spectra observed hitherto, diffuseness sets in at a certain band, but it has not been previously observed that it sets in at a certain line of a band. It seems, however, to be so in the case of P_2 as shown by the fact of the drop of intensity in the *emission* bands discussed above. This sharpness of the limit of predissociation seems to be rather significant. Therefore, it would be highly interesting to investigate the absorption spectrum of the P_2 molecule, and it is hoped to do that later.

Recently Grundström and Hulthén (NATURE, **125**, 634; 1930), Stenvinkel (*Z. f. Phys.*, **62**, 201; 1930) and Kronig (*Z. f. Phys.*, **62**, 300; 1930) have tried to explain several examples of the breaking off of emission bands of hydride molecules by predissociation. It seems to me, however, that in most of these cases the available data are not sufficient definitely to exclude Oldenberg's explanation by rotational instability (*Z. f. Phys.*, **56**, 563; 1929), because the energies of dissociation of all electronic states involved are very small and, as nearly always in hydride spectra, cannot be determined accurately, if at all. In the case of P_2, however, which seems to be the first molecule other than a hydride showing this breaking off of band lines, Oldenberg's explanation can be definitely excluded, because the last observed vibrational frequency is 424·5 cm.$^{-1}$ and the decrease for successive vibrational quantums is 4·7 cm.$^{-1}$ as shown by more than six definitely located levels.

The absolute value of the predissociation limit thus found cannot be given very accurately for the moment, because the origin of the band system has not yet been found. A rough value of 45,000 cm.[1] (5·5 volts) may, however, be given. This represents an upper limit for the heat of dissociation of the P_2 molecule (cf. G. Herzberg, *Z. f. Phys.*, **61**, 604; 1930).

G. HERZBERG.

H. H. Wills Physical Laboratory,
University of Bristol,
July 10.

[1] The absolute value of *a* cannot be given, because the origin of the band system has not yet been found.

Distribution of Growth Activity in *Eupagurus*.

INVESTIGATIONS on the relative growth of parts in the common hermit crab, *Eupagurus prideauxi*, which will shortly be published *in extenso* in *Rouxs Archiv*, reveal some interesting facts of general significance.

In previous communications [1] it has been pointed out that when organs or regions are growing at rates different from that of the body as a whole, there exists in them a *gradient* of growth-activity, with a maximum point (*growth-centre*) from which the intensity of growth decreases in both directions. In the case of markedly heterogonic crustacean limbs, this growth-centre has always been the penultimate segment (propus). This is confirmed for the male right chela of *Eupagurus*, which is heterogonic in later stages. But in earlier life this limb is growing only slightly faster than the body; and in this phase the growth-centre is two segments more proximal, in the merus.

The following table gives the percentage increases of the various segments of the right chela, and that of the thorax-length as standard for the body, in young and old males.

	Thorax.	Ischius.	Merus.	Carpus.	Propus.	Dactylus.
Small males (thorax length, 9·0-11·36 mm.)	26·6	28·5	*40·0*	35·0	30·0	27·5
Large males (thorax length, 12·2-13·3 mm.)	9·5	13·0	16·4	16·3	*16·6*	14·5

The interesting point is that the slower-growing left chela and the two long walking legs (pereiopods 2 and 3) show, throughout the size-range examined, a gradient similar to that of the right chela in its early stages, with high point in the merus. Thus different constructions and different rates of relative growth of appendages demand that the main increase of growth shall be in different regions; but in both cases increased growth proceeds by means of growth-gradients culminating in a high point or growth-centre.

It then appears that we can extend this conception of growth-gradients from the growth of single appendages to that of the body as a whole. Fig. 1 shows the percentage increase in length of the various appendages (or conveniently measurable portions thereof) in both males and females, for a percentage increase in thorax-length of 48·2 per cent, for specimens between 9 and 12 mm. thorax-length. The graded effect is well shown on the left side of the male curve. Small eyestalks and maxillipeds, lengthy 2nd and 3rd pereiopods, short 4th and 5th pereiopods —all, when considered in regard to their growth-rate instead of their absolute size, fall into a single gradient-system with high point at pereiopod 3. The male right side shows a similar gradient, but interrupted locally by the strong heterogony of the right chela. The female appendages show a different distribution of growth-intensity—everywhere save posteriorly this is less than the male's, and has two high points, one between maxilliped and 2nd pereiopod, the other in the abdomen.

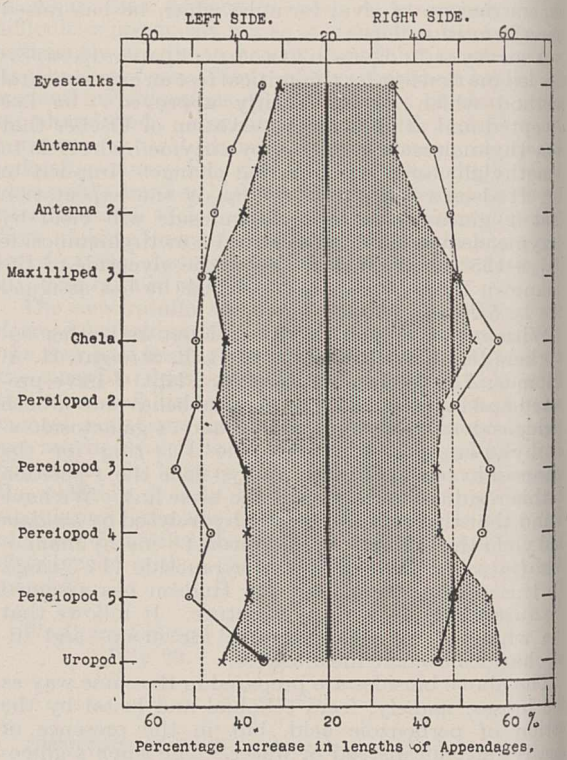

FIG. 1.—⊙——⊙, male; ×----×, female (stippled). Vertical dotted line represents percentage increase of thorax length.

The graded effect is shown also as regards the degree of asymmetry, which may be measured as the percentage ratio of the lengths of left-hand to right-hand appendages. Fig. 2, which illustrates this, requires little comment. Note that the greater right-handedness of the male thorax, culminating in the chela, causes males to remain predominantly right-handed for a third of a segment farther down the body than is the case in females.

These facts would indicate that what we may loosely call 'growth-potential' is distributed in an orderly fashion through the animal body, in a series

of growth-gradients, which are of varying shape and steepness, and apparently interact with one another as illustrated by the fact (*loc. cit.* p. 910) that an active

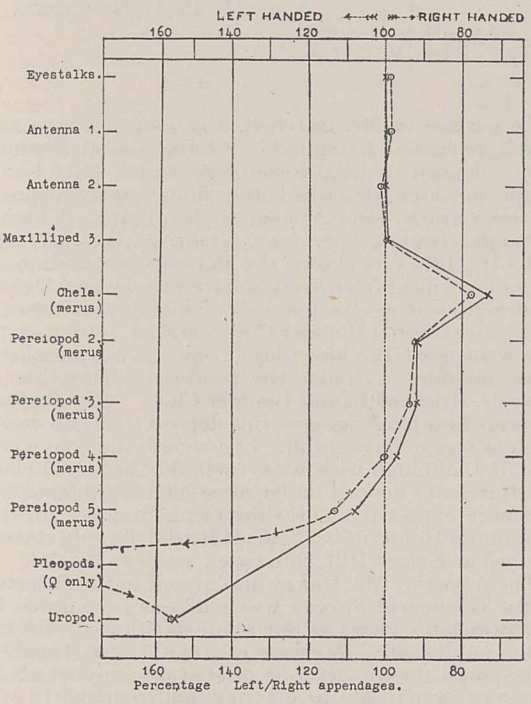

FIG. 2.—×——×, male; ⊙----⊙, female.

growth-centre in one appendage is correlated with increased growth-activity in limbs immediately posterior to it, decreased growth-activity in those immediately anterior.

S. F. BUSH.
J. S. HUXLEY.

King's College, London, W.C.2.,
July 28.

[1] Huxley and Tazelaar, NATURE, June 15, 1929, p. 910; Huxley, *ib.* April 13, 1929, p. 563.

Virus Disease of the Potato: Streak.

THE term 'streak' has been applied to a diseased condition of the potato in which the leaf and stem tissues become to a greater or lesser extent involved in a necrotic process. The condition was first described as a separate disease by Atanasoff under the name of 'stipple streak', and has since received considerable attention from the clinical point of view from Quanjer and others. In this Institute I have shown how 'streak' may be but an alternative symptom of another disease, namely, crinkle *A*; and my colleague, Dr. Kenneth Smith, that it may assume a somewhat similar relation to ringspot disease of tobacco. In the former, the change from crinkle to streak is induced by varietal susceptibility; in the latter, by *passage* of an original potato mosaic virus through tobacco before being used as an inoculum to reinfect the healthy potato. Streak is clearly a clinical picture which may be reproduced by different agents.

In pursuance of the task of obtaining virus-free stocks, I have frequently been brought up against the problem of the apparently healthy virus carrier, and have dealt with the question in some detail in two recent papers.[1] This year's work has given me good reason to believe that there may be at least two distinct viruses which produce streak, and, as in the case of the two distinct crinkles, namely, crinkle *A* and paracrinkle, they are to be distinguished by their varietal reactions.

The variety Di Vernon is only with some difficulty to be obtained free from all external signs of virus disease. Two out of three such apparently healthy and very vigorous stocks in my possession, when grafted to healthy Arran Victory plants, produced in them but a mild mosaic, but when grafted to healthy President plants, a violent and lethal streak. Further, if the mosaic-affected Arran Victory be grafted to President, the latter succumbs to acute streak in the same way as did those grafted directly from the Di Vernon.

Uptodate has long been known to carry a latent streak, though it itself may appear to be in the best of health. I have tested out a great many units of Uptodate from the very best stocks obtainable in Scotland and Ireland, and have, with one doubtful exception, found them all to be carriers of virus disease. Now the streak which Uptodate may carry reacts differently from that carried by Di Vernon: here both healthy test plants, Arran Victory and President, develop a moderate and generally non-lethal streak. However, the Arran Victory usually suffers more severely than does the President—the reverse of what was found with Di Vernon streak.

To the Uptodate class of streak reaction belongs that found in two more carriers, namely, Kerr's Pink and Majestic. In the latter variety, streak carriers seem rather rare; in the former the matter is complicated by the fact that whilst all Kerr's Pink stocks (in my opinion) are carriers, the virus they carry is clearly depressed in virulence by its sojourn in Kerr's Pink, and it is only rarely that its reaction on grafting to other varieties is in terms of streak.

A corresponding difference of reaction is found when Daturas are inoculated with the two types of streak. The Di Vernon carriers produce no reaction in Datura; the Uptodate and Kerr's Pink carriers, on the other hand, cause a reaction identical with that following inoculation with crinkle *A*.

As it seems wisest to discriminate between the viruses of the potato by their reaction in standard healthy varieties rather than by their clinical appearance in any one variety, I would suggest that the virus which produces streak in both healthy Arran Victory and President and may be latent in Uptodate, Kerr's Pink, and Majestic, be termed streak *A*; and that which may be latent in Di Vernon, produces a streak in healthy President but fails to do so in healthy Arran Victory, be called streak *B*. Such a system of nomenclature leaves room for the identification of other streaks, evidence for which is now accumulating in our Institute.

REDCLIFFE N. SALAMAN (Director).
Potato Virus Research Institute,
Cambridge, July 30.

[1] "Crinkle 'A'; an Infectious Disease of the Potato," and "Paracrinkle: a Potato Disease of the Virus Group." *Proc. Roy. Soc.* B, vol. 106, 1930.

Transmission of Potato Leaf Roll.

IN his letter in NATURE of July 19, p. 96, Dr. Kenneth Smith appears to be under the impression that I 'deplore' the importance attached by virus workers to *Myzus persicæ* as a vector of potato leaf roll. The importance of this insect in this respect was not called into question in my letter in NATURE of June 28, but rather "the growing tendency . . . to regard the relation of *M. persicæ* to leaf roll transmission as specific and unique". Dr. Smith reminds me that in May 1929 he expressed the opinion that *M. persicæ* is probably not the only carrier of leaf roll.

In his latest publication, however, (*Jour. Min. Agric.*, June 1930, p. 227) he emphasises the similarity between leaf roll transmission by *M. persicæ* and other plant virus diseases in which it is said that one, and only one, insect is capable of carrying the virus. *M. persicæ*, he states, has a marked affinity for several potato viruses, especially for the leaf roll virus, whilst "other insects such as capsid bugs, leaf-hoppers, and the *remaining species of aphides*, have failed to transmit the diseases". Here is evidence of the growing tendency referred to in the mind of at least one virus worker. Although proof is lacking, I think it quite probable that *M. persicæ* bears a more subtle relationship to leaf roll transmission than that of a mere mechanical agent, but this relationship, whatever it may be, would appear to be shared to some extent by *M. circumflexus*. So far from minimising the importance of *M. persicæ* in leaf roll transmission, in my letter I attributed little or no importance to *M. circumflexus* as an active agent in spreading virus diseases.

Dr. Smith disagrees with my suggestion that *M. circumflexus* should prove of value in virus transmission studies, apparently because (1) it is not uncommon for the characteristic dorsal markings to be absent from specimens of *M. circumflexus*, and (2) this species is stated to be a poor transmitter of mosaic and to possess, in its saliva, a toxin which produces a 'false mosaic' in Solanaceous plants, including the potato. With regard to the first objection, it is obvious that the absence of the dorsal bands in occasional adults makes the task of detecting such apterous females of this species uncertain, but surely not more so than in other unmarked species, for example, *M. persicæ*. Exceptional individuals need not be selected for use in artificial infestations, and any initial error in diagnosis can thus be obviated. The appearance of unmarked adults in the cages will, at least, raise a suspicion of admixture of species in the mind of the worker and will induce caution in interpreting results.

The suggestion that *M. circumflexus* possesses a toxin in its saliva is, if substantiated, of great importance and marks a definite advance in our knowledge of viruses. It will of course restrict the use of this species to special aspects of mosaic transmission, but it is difficult to see in what way the power to produce a false mosaic will impair the value of *M. circumflexus* in *leaf roll* transmission studies; and these studies, after all, formed the subject matter of my first letter.

T. WHITEHEAD.

University College of North Wales,
Bangor, July 28.

Flint Implements of Upper Palæolithic Age from Yorkshire.

In regard to Mr. Bromehead's objection (NATURE, July 5, p. 13) to my letter in the issue of June 7, p. 858, it might perhaps dispel any misunderstanding that may have arisen in connexion with the same if I say that Messrs. Dewey and Bromehead, after they had investigated the sites under consideration last May, were unanimous in relegating Lamplugh's "Late Glacial Boulder Clay" deposit of Danes' Dyke to Late Pleistocene times, though, I was given to understand, they regarded it as a hill-wash formed under cold conditions rather than a boulder clay. In accordance with these opinions, Mr. Dewey afterwards supplied me with the wording for par. 2 of my letter in NATURE of June 7 as representing both his and Mr. Bromehead's views concerning the age of the deposit they had been asked to examine.

As space cannot be spared in NATURE for a full statement of the facts, I have given the details in a letter which I am circulating privately, and I am content to leave these to speak for themselves.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2, July 7.

In answer to Mr. Burchell, it is inaccurate to say that I relegated Lamplugh's "Late Glacial Boulder Clay" deposit to Late Pleistocene times, since Lamplugh nowhere described the flint-bearing deposit by those words. In his paper on the Drifts of Flamborough Head (*Quart. Jour. Geol. Soc.*, vol. 47, pp. 384-431; 1891) he shows the deposit in question in only one of his fifteen sections, that at Danes' Dyke; he describes it as "a few feet of loamy stuff resembling a weathered Boulder Clay" and as "stony earth like weathered Boulder Clay", and in a generalised table includes it under the heading "Late Glacial Gravels, Brickearth, and Boulder Clay". In all other sections Lamplugh ignores this deposit; he also omits to show any soil or subsoil. I personally am convinced that if Lamplugh were with us to-day he would class Mr. Burchell's deposit under some such heading, or use the more expressive Yorkshire term, 'muck'. In the memoir on Holderness, Clement Reid definitely classes the bed at Kelsey Hill, Burstwick, as Post-Glacial.

The report by Mr. Dewey and myself to the Director of the Geological Survey was made as favourable to Mr. Burchell's views as our opinions allowed. In his letter published in NATURE of June 7, Mr. Burchell anticipated this report; he quoted the only words in any way favourable to his view and omitted to say that on the main question, whether the 'implements' are overlain by Boulder Clay, our decision was unfavourable. In his present letter he takes a similar course with regard to Lamplugh's published paper. I am therefore glad to know that his "full statement of the facts" has been circulated privately.

C. N. BROMEHEAD.

Geological Survey Office,
14A Parliament Street, York.

The Second World Power Conference at Berlin.

In his article in NATURE of July 19 on the Second Plenary World Power Conference in Berlin, Mr. H. Quigley has presented the results of the meeting in a somewhat wrong perspective. As a matter of fact, the constitution of the World Power Conference renders it almost impossible for immediate action to be taken such as he would suggest. The position is really as follows: a number of resolutions, some of which bear very directly upon the work of the Conference as a permanent organisation, were passed during the technical sessions, but in accordance with our unvarying practice, none of these resolutions was endorsed by the International Executive Council this year. They will be circulated to all the national committees, will be examined by a special sub-committee, and will come up for consideration and appropriate action at the next meeting of the Council, to be held in London at the time of the Faraday celebrations in September 1931. In other words, no exceptional treatment was accorded to the resolutions passed during the technical sessions this year.

On the other hand, the International Executive Council, of its own motion, took a number of decisions of first-rate importance concerning the future "work of the Conference". Specific proposals were put forward by the Central Office or by national com-

mittees for issuing a statistical year book based upon standard forms for the collection of data relating to the power resources of the world upon a comparative basis, in connexion with which a mass of preliminary work has been accomplished during the past three years. Arrangements were made for the publication of selected annotated bibliographies upon a uniform system. The possibility of issuing a periodical Central Office bulletin was explored. Lastly, a special sub-committee was appointed for the very purpose or re-examining the activities and organisation of the World Power Conference. The following passage occurs in the Report presented on behalf of the International Executive Council at the closing meeting of the Berlin Conference : " The International Executive Council has set up on the basis of some definite proposals put before it, a Sub-Committee which is to submit to its next meeting in 1931, after consultation with the National Committees, certain proposals promoting the rational development and increasing the usefulness of the World Power Conference ".

C. H. GRAY
(Secretary, International Executive Council).

Central Office,
World Power Conference,
63 Lincoln's Inn Fields,
London, W.C.2.
July 24.

Ultra-Violet Light and Atmospheric Pollution.

THERE are so few manufacturing towns where observations have been taken of the incidence of ultra-violet light that Mr. Bower's results which are given in a letter to NATURE of July 12, p. 59, are very welcome. On the average of three years he finds that Sunday is a day with 12 per cent more ultra-violet light than the average of all days of the week. In Rochdale, observations in 1929 show Sunday also to be a day of more ultra-violet light than the average of all days of the week, and the excess is 12 per cent, which is in exact agreement with Mr. Bower's results for Huddersfield.

Now in Rochdale a daily record has been kept of the soot-fall, and it is found that the number of particles deposited on Sundays is 29 per cent *less* than the average of all days, and there is therefore direct evidence that reduction in soot-fall and increase of ultra-violet radiation occur together. The falling off of deposited particles concurrently with the increase of ultra-violet rays which is found on passing from town to country is evidence in the same direction. There can be little doubt that factory smoke in manufacturing towns cuts off much of the valuable light of the sun.

By the kindness of Sir Leonard Hill I have been supplied with the daily observations of ultra-violet light in 1929 at London, Cardiff, Lowestoft, and Ventnor, and I have worked out the Sunday and week-day values. Confining attention to Lowestoft and Ventnor, two seaside resorts free from factory smoke, we have as the combined percentage result :

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Average.
97	100	104	100	104	101	94	100

Here Saturday and Sunday have less ultra-violet light than week-days. Contrast with this the combined result for Huddersfield and Rochdale, which is as follows :

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Average.
112	99	99	94	94	99	103	100

It seems reasonable to suppose that at the seaside resorts the week-end activities increase the pollution of the air, and this is the more probable as the diminution on Saturday and Sunday of ultra-violet radiation is mainly in evidence in the summer—the holiday time.

Thus the measurement of ultra-violet light, in addition to the value attached to it by medical men, will probably provide a new and it may be a delicate test for atmospheric pollution.

J. R. ASHWORTH.

Rochdale, July 22.

Atomic Diameters of the Rare Gases.

IN our note on the crystal structure of krypton in NATURE of June 14, p. 889, we gave the ratios of the distance of nearest neighbours in the crystal lattice to the atomic diameter deduced from viscosity measurements for neon, argon, krypton, and xenon, as 1·35, 1·29, 1·22, and 1·23 respectively.

We took the values of the atomic diameters calculated by Herzfeld from measurements by Rankine (" Handbuch der Physik ", vol. 22). We owe to Prof. Rankine himself the information that these values must be considered to be too large, as Herzfeld made use of the value of Sutherland's constant given in the Landolt-Börnstein Tables of 1923, which value is too low (cf. Rankine and Smith, *Phil. Mag.*, **42**, 601 ; 1921). Using the values of the atomic diameters 2·30, 2·87, 3·10, and 3·41 A. calculated by Prof. Rankine, the ratios become 1·39, 1·34, 1·28, and 1·28.

The value for krypton is lower than would be expected ; this may perhaps be explained by the fact that its structure was investigated by us at a relatively much lower temperature compared with the Debye characteristic temperature than was the case for the others. Indeed, Natta and Nasini's value of the distance of nearest neighbours at the temperature of liquid nitrogen leads to 1·32 for krypton.

W. H. KEESOM.
H. H. MOOY.

Leyden.

Gamma Rays of Potassium.

Two years ago W. Kolhörster published a short paper [1] on the gamma rays of potassium, which he ascertained partly by measurements in the Stassfurt mines and partly by analysing the radiation of a greater quantity of sylvin supplied by Messrs. C. A. F. Kahlbaum.

In our Institute ionisation measurements have been carried out using a large ionisation chamber of a capacity of 125 litres and about 120 kgm. of chloride of potassium. Kolhörster's results have been confirmed so far that chloride of potassium really emits penetrating radiation, the intensity of which is proportional to the quantity of potassium. The radiation is complex and consists of at least two groups of gamma rays. By absorption of these rays in lead 0·5-4·0 cm. thick an absorption coefficient for the first group of rays has been found of approximately the same order as in the case of the gamma rays of radium, whereas the second group is about twice as penetrating as the gamma rays of radium. On the other hand, the intensity of the gamma rays of potassium is much lower than that which would correspond to its period of $T = 10^{12}$ years, if we assume that every beta ray of potassium is followed by one gamma ray. A detailed description of the work done will be published next autumn.

F. BĚHOUNEK.

State Radiological Institute,
Prague-Podoli,
July 3.

[1] W. Kolhörster, *Die Naturwissenschaften*, **16**, 28 ; 1928.

Some Scientific Instrument Makers of the 18th Century.*

By ROBERT S. WHIPPLE.

ALTHOUGH numerous references are found in early British manuscripts to instruments of an elementary kind, chiefly for the determination of time or position, there is little evidence that before the sixteenth century scientific instrument making as a craft had obtained a position of any importance in Great Britain. The demand for instruments to assist navigation became more insistent as new lands were discovered and the length of the voyages increased.

Gradually the professional scientific instrument maker came into existence, two of the more distinguished being Humphrey Cole, the maker of the astrolabe used by Sir Francis Drake, and Elias Allen, the maker of Oughtred's double horizontal dial. In a book by Oughtred dated 1632 describing the double horizontal dial it is stated that it is printed for Elias Allen, "Maker of these and all other Mathematical Instruments and are to be sold at his Shop over against St. Clements Church without Temple-barr".

With the discovery of the telescope in 1608, and its development by Galileo in the following years, a great impetus was given to the instrument-making industry. Although Gregory and Newton propounded the reflecting telescopes known by their names in 1663 and 1666, they were unable to find makers capable of developing their ideas. Newton made his own instruments, but it was not until about 1730 that John Short of Edinburgh succeeded in making a Gregorian telescope.

The latter half of the seventeenth century was a great period of scientific development. Experimental science, under its leaders Boyle, Hooke, Newton, and others, created a demand for scientific instruments which could only be satisfied by skilled craftsmen. The work of Hooke and Leeuwenhoek did much to develop the microscope and to direct attention to the possibilities of the instrument. Fortunately an instrument made about 1670 and somewhat similar in its details to that described and illustrated in Hooke's "Micrographia" (1665) has been preserved. The evidence is, I think, convincing that this instrument was made by Christopher Cocks, the well-known telescope maker, who lived in Long Acre, and of whose telescopes there are at least three in existence. It is known that in March 1672 Cocks was ordered to make a four or five foot Newtonian reflecting telescope, but the instrument was not successful. About 1680 he was admitted a freeman of the Spectacle Makers' Company.

Owing to the publication of the "Micrographia", with its description of Hooke's microscope, great interest was created in microscopical work, and a demand arose for microscopes. Owing to the high quality of the optical and mechanical work the English microscope won a high reputation.

The greatest of the English instrument makers who bridge the seventeenth and eighteenth Centuries is undoubtedly John Marshall. Nothing is known of his early life, but part of a diary recently discovered in the British Museum by Mr. H. W. Robinson, by whose courtesy I am able to publish an extract, has thrown an interesting sidelight upon Marshall's career. The record covers five years of Hooke's life, 1688 to 1693—with the exception of some few months—and was thought to be the diary of James Pettiver, an apothecary friend of Hooke. Mr. Robinson has been able to prove that it was written by Hooke. The following is an extract, December 14, 1688: "One John Marshall who told me he was Dunning apprentice and now worked at turning at the 3 keys in Ivy Lane came to shew me some microscopes of his own making he told me Mr. Boyle had bought such of him". He appears to have set up later at the sign of the Gun as a maker of spectacles and microscopes, and there is little doubt that the microscopes were of the Hooke type. By 1690 he had built up a large business, and had introduced a new method of grinding lenses on brass tools. Marshall's double microscope was undoubtedly the greatest advance made in microscope construction for many years. The instrument was fitted with coarse and fine focusing adjustments, and for the first time the limb which carried the eyepiece, the object glass, and the object, formed one complete system which could be inclined as one unit. All the features are retained in the modern instrument.

The first outstanding English instrument maker in the eighteenth century is undoubtedly Benjamin Martin, a man who, so far as is known, was not apprenticed to the trade. He was born at Worplesdon, Surrey, in 1704, and began life as a ploughboy, later becoming a teacher of the 'three R's' at Guildford. He devoted his spare time to the study of mathematics. A legacy of £500 relieved him from the necessity of teaching, and enabled him to travel and lecture. He appears to have assisted at the lectures given by Dr. J. T. Desaguliers, which were eagerly attended by the fashionable world and were illustrated by experiments. Horne, afterwards president of Magdalen College, Oxford, sarcastically remarked that Ben Martin "who having attended Dr. Desaguliers' fine raree gallantry show for some years in the capacity of a turnspit, has it seems, taken it into his head to set up for a philosopher". This is a hit at Martin's literary efforts, because he proceeded to publish a large number of text-books dealing with a great range of subjects. When it is considered that Martin was a self-educated man, the extent and thoroughness of his knowledge, as shown in his publications, are remarkable. He appears to have lived for some time at Chichester, where he kept a school, and also wrote several elementary text-books and pamphlets describing scientific instruments. There is little doubt that he commenced to make scientific

* From a Friday evening discourse delivered at the Royal Institution on May 23.

instruments in Chichester, not improbably being asked by the readers of his books where it would be possible to obtain the instruments mentioned.

About 1750 Martin moved to London to a house in Fleet Street, three doors below Crane Court, where he became famous as a scientific instrument and spectacle maker at the sign of "Hadley's Quadrant and Visual Glasses". Martin was essentially a teacher, and continued to write after he had made his home in London. The books impress one with the care he takes to make every individual step in an explanation clear, and with the detailed drawings and references with which he explains the construction and use of an instrument. This is strikingly illustrated in his description of the various orreries he constructed. The orrery was almost the latest scientific novelty, and Martin appears to have been much impressed with the educational possibilities of the instrument. In his "Young Gentleman and Lady's Philosophy in a continued survey of the works of Nature and Art"—a book which had a great vogue—he uses planetaria to describe the difference between the Ptolemaic and Copernican systems, and the phenomena of eclipses, etc. He was evidently prepared to supply either form of planetarium to suit his customers' wishes. In one of his tracts published in 1771, "The Description and Use of an Orrery of a new Construction", he gives full details of the capabilities of the instrument, and also "the theory of calculations for the wheel-work of an orrery to the most extreme Degree of Accuracy". The prices of the instruments ranged from £12 12*s.* upwards, depending on the number of bodies demonstrated, and the accuracy of their movements, or as Martin himself states "proportional to the work". That Martin must have continued to lecture until late in life is shown by the fact that the apparatus made is adapted to show "all the Phaenomena [*sic*] of the Transits of Mercury and Venus over the Face of the Sun such as I shewed in Public to Thousands on the late memorable instance of 1769".

In 1740 Martin published a useful text-book on optics, "A New and Compendious System of Optics", and in many other writings took immense trouble to explain optical systems and instruments. His microscopes and especially his cabinets containing two or three instruments of various types were much sought after, and still remain as examples of first-class workmanship and ingenuity. There is little doubt that he invented the drum type of microscope (see Fig. 1) which had a great vogue and is still made in large numbers on the Continent. If the invention of the glass micrometer as applied to a microscope was not actually due to him he was undoubtedly one of the first to employ it. He was also one of the first to apply rack and pinion focusing adjustments to the compound microscope, and to fit inclining movements to the pillar carrying the stage and mirror.

It is a cause of wonder to me how Martin was able to produce such a large number of books. The "Dictionary of National Biography" mentions thirty-one, although some of them are only leaflets. Many of his books passed through several editions, and at least one was translated into French. They undoubtedly helped to popularise science and to create an interest in scientific instruments. Shortly before his death at the age of seventy-seven, he took his son into partnership, and unaware of the state of his affairs was adjudged bankrupt. He thereupon attempted suicide, and the wound hastened his death. His valuable collection of fossils and curiosities was sold by public auction

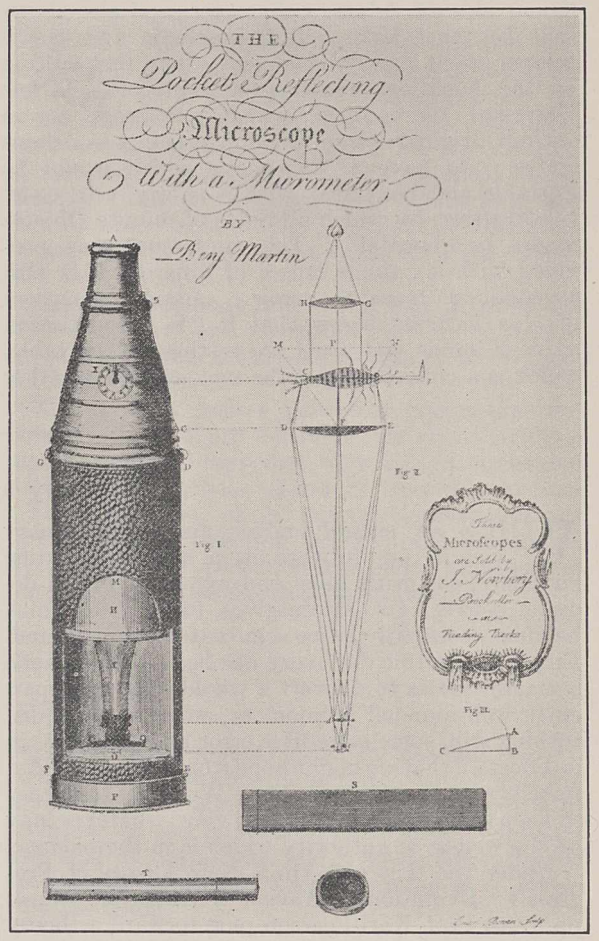

Fig. 1.—Microscope, drum type, by Benjamin Martin.

for a trifling sum—a tragic ending to a more than usually successful career.

George Adams, the elder, perhaps the greatest of English scientific instrument makers, was born about 1704. It is known that he was apprenticed in 1718, and that he was established in business on his own account at Tycho Brahe's Head in Fleet Street in 1735. It is also known that he was making instruments for the East India Company in 1735–36. He obtained a world-wide reputation as a maker of globes. In 1766 he published the first edition of his book "A Treatise describing and explaining the construction and use of new celestial and terrestrial globes". Dr. Samuel Johnson, the lexicographer, wrote the dedication to the King, and for so doing received a present

of "very curious meteorological instruments of a new and ingenuous construction". The book had a great vogue, passing through thirty editions.

Adams was essentially a mechanic and delighted in good workmanship. There can be little doubt, I think, that the microscope was his favourite instrument, and he developed several types of it. In 1746 he published his "Micrographia Illustrata: or The Knowledge of the Microscope explained in several new inventions etc.". The preface to the "Micrographia Illustrata" emphasises the religious side of Adams's character, and also shows that he must have had the artistic and poetic temperament highly developed. The first edition of the book contained an account of a "New Universal Microscope" which was made to an entirely original design, the object being, as Adams states, "to have a Microscope which would be Portable and Universal, that is to say, ONE ONLY INSTRUMENT, by which all Sorts of minute Objects might be observ'd". The microscope was provided with six single lenses of different foci with a common focusing screw. Adams remarked of this focusing screw that it "is to be turned as your hands and arms are resting on the table, which is a conveniency to be met with in no other Microscope". A second edition of the "Micrographia Illustrata" appeared in 1747, and a fourth in 1771. Despite exhaustive researches it has not been possible to find a copy of the third edition—if it were ever published.

The fourth edition commences with a description of the variable microscope of which Adams was evidently very proud. He states that "We owe the construction of the Variable Microscope to the ingenuity and generosity of a noble person", and we know that the "noble person" was the Earl of Bute. By having a compound eye lens and by introducing an auxiliary lens placed some distance above the objective the definition was improved. Adams also introduced the method of screwing two or three objective lenses one on top of the other. By drawing up the eyepiece relative to the object glass the power of the combination could be altered and hence the name "variable". Adams, in common with Martin and other makers of the period, developed the solar microscope with the large mirror projecting out of the window, by means of which brilliant illumination could be obtained, and magnified images of the object projected on to a screen.

(*To be continued.*)

Biometry and Evolution.

WHEN an entirely novel and revolutionary view is put forward by a man of scientific eminence, the critic must endeavour to form a decision between two alternatives, for both of which he must necessarily be, to some extent, unprepared. Either a scientific discovery has been made of such a magnitude as to subvert a whole body of apparently well-founded opinion, or, what is more disturbing still, some incredible error has frustrated in its effect all that we might hope from trained ability, industry, and patient thought. We owe it to science to keep this latter possibility in view, whatever may be the weight of authority which is in the balance.

Under the title of "On a New Theory of Progressive Evolution" (*Annals of Eugenics*, vol. 4, pp. 1-40) Prof. Karl Pearson puts forward a theory which, as he realises, will be difficult to bring home to the biologist. In his own words, "The intensity of heredity is such that with isolation and inbreeding any individual characteristic, or deviation from racial type, will be gradually emphasised and become a factor of progressive evolution. Thus all organisms if isolated are in a constant state of evolution, and it is only interbreeding and the selective action of environment which preserve a type. In other words, natural selection controls evolution, but the progressive urge is provided by heredity itself."

It is obvious that in this statement Prof. Pearson is using the word 'heredity' in a sense somewhat different from its popular and biological meaning. There is, however, little occasion for surprise in this, for those familiar with his writings will know that the term is used to cover all the statistical relationships between the measurements of related individuals. What is asserted is that these relationships require that when a group of individuals, differing, however little, from the mean of their species, is isolated, so that they and their descendants interbreed without further selection, then the mean of this isolated population will continue to depart further and further from the mean of the population from which their ancestors were originally selected. A diagram on p. 10 of the monograph shows this process in detail. The first generation following isolation shows, indeed, some regression towards the mean of the original population and differs from it by only about 70 per cent as much as its parents. In the second generation, however, the mean has progressed to nearly 95 per cent and, thereafter, the successive means actually exceed that of the foundation stock, and increase so rapidly that by the eighth generation the deviation is nearly seven times as great as it was at first.

For the formulæ from which these astonishing results were derived recourse should be had to the mathematical appendix, where, on p. 23, we find that they are the result of applying a certain recurrence formula, based upon a system of formulæ for the correlations between the averages of different groups of ancestors of the same individual; the numerical values come ultimately from three correlations found in human stature, namely, parental correlation 0·50625, fraternal correlation 0·53367, and marital correlation 0·2804.

Prof. Pearson has been content to apply his recurrence formula numerically, but it is capable of algebraic solution. It appears that the deviation

after n generations will be M times the deviation of the foundation stock, if M is given by the formula

$$M = \frac{a}{b} \cdot \frac{(1/b-1)!}{\{(1+a)/b-1\}!} \cdot \frac{\{n-2+(1+a)/b\}!}{(n-1+1/b)!} \cdot 2^{n/2}.$$

The formula involves two numerical constants, a and b, for which Prof. Pearson's values are $a = 0{\cdot}494155$, $b = 0{\cdot}55916$. It will be noticed that the progressive evolution deduced from this method depends upon two factors, of which one, $2^{n/2}$, representing a doubling in every two generations, has perhaps been introduced through an incomplete allowance for the fact that, with bi-parental reproduction, each individual has 2^n ancestors of the nth degree. The remaining factor

$$\frac{\{n-2+(1+a)/b\}!}{(n-1+1/b)!}$$

increases progressively only when a exceeds b. This is not so with Prof. Pearson's values, which, if the factor $2^{n/2}$ were removed, would thus give a progressive decrease, less rapid than, but equally foreign to biological reasoning as, the progressive increase shown by his values. This trouble disappears, however, if a is equal to b, as it may well be, if the relatively small difference between Prof. Pearson's values be ascribed partly to sampling errors in the original data, and partly to a second but slighter inexactitude in the process of reasoning by which the infinite series of ancestral correlations is deduced from the three correlations actually observed.

The thesis thus derived theoretically is supported both by the author's own experiments and by a reinterpretation of the experiments of others. Although Prof. Pearson writes strongly, when genetical concepts come into view, it may be doubted if he would much rely upon these two sources of information, if his theoretical deductions were once shaken. The personal observations cited are indeed somewhat meagre. It appears that an experiment started twenty-five years ago with the crossing of toy Pomeranians and Pekinese has been continued since with much inbreeding; the experimenter has "been a good deal puzzled of recent years by a progressive tendency to lengthen the leg". The experiment was not concerned with leg length. "But this very ungainly length of leg has been continually obtruding itself, although I have paid no regard to it in mating." Unfortunately, no measurements were taken, and the skeletons were not preserved, so that it is largely a matter of taste whether or not we share the author's deduction: "Given isolation and inbreeding, say from a single isolated pair, then if both members of the pair differ by excess or defect from type—and this by however small a quantity—their offspring by continual inbreeding will progress for this character, and therefore for all correlated characters. This is the idea that came to me from the long-leg progress of my dogs."

The reviewer feels a particular regret that the data on this case are not fuller, for about eighteen months ago he happened to write, in connexion with the biometric effects of recent selection, "Equally, when, as in the development of toy breeds of dogs, selection has favoured diminished size, we should expect to find an excess of recessives tending to increase the average dimensions".

R. A. FISHER.

Food Preservation.

THE practical value of the numerous researches carried out under the auspices of the Food Investigation Board is clearly shown on perusal of the Report for 1929.* The work on meat deals with the influence of quality and pre-freezing treatment upon the appearance or 'bloom' of the meat after thawing, with proper conditions for transport, with the changes occurring in rigor, and with the bacteriology of frozen carcasses. The investigations on fruit include researches on wastage in store, on the chemical changes during ripening and senescence, and on variations in resistance to fungal invasion. Work has been carried out on pig products, fish, the causation of corrosion in tins, and on engineering problems of refrigeration.

The extension of the Low Temperature Research Station at Cambridge has been completed; the Ditton Laboratory at East Malling, Kent, for research on the storage of fruit is nearly ready for occupation, and the temporary buildings of the Torry (fish) Research Station at Aberdeen are in use. Special stress is laid in the Report on co-operation with industry; a combined research with the trade and members of the New Zealand Department of Scientific and Industrial Research and the Australian Commonwealth Research Council is in progress; an exhibit of frozen carcasses of mutton was held at Smithfield, and a small laboratory is maintained at Covent Garden, acting as a liaison with the trade.

As illustrative of the scope of the scientific work of the Board, certain of the researches on meat, fruit, and pig products may be referred to in more detail.

Moran and Smith report that the unpopularity of imported frozen beef is probably chiefly due to its initial poor quality, since the palatability of prime frozen beef compares very favourably with that of prime home-killed Scotch. Another factor of importance is the pre-freezing treatment, since it is during this interval that the changes associated with rigor mortis occur: in this process the consistency of the muscle substance changes, and it appears that the rate of hardening is controlled by the course of the chemical reactions which lead to the post-mortem production of heat. The formation of lactic acid is not directly associated with the hardening. The importance of the rate of freezing, the temperature reached, and the subsequent rate

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1929. Pp. 146. (London: H.M. Stationery Office, 1930.) 2*s*. 6*d*. net.

of thawing in reducing the amount of ' drip ' is now well known (see also Cook, Love, Vickery, and Young, *Austral. Jour. Exp. Biol. and Med. Sci.*, vol. 3, pp. 15 and 81 ; 1926). Vickery has investigated the effects of freezing muscle before and after the onset of rigor, and the freezing of pure sols and emulsions ; Moran has examined the rate of freezing in gelatin gels when supercooled. In the latter case, there is a critical concentration at which the rate changes from that approximating the rate in pure water to a rate only one-hundredth as great. The next stage in the treatment to which the meat is subjected is its transport to the consumer ; and the temperature of transport is governed by the necessity of ensuring the absence of mould and bacterial growth, the slowing down of changes in the fat leading to rancidity, and a certain degree of rigidity of the carcass, when others are stacked upon it. Suitable conditions raise questions of biological engineering which are also dealt with in the Report.

The appearance or ' bloom ' of the meat plays an important part in its value ; it depends on the state of the hæmoglobin of the muscle, of the superficial fat, and of the connective tissue. The change in colour on storage is due to the conversion of the pigment to methæmoglobin and to superficial drying of the surface. Brooks has examined the former in some detail (*Biochem. Jour.*, vol. 23, p. 1391 ; 1929) ; the conversion depends on the presence of oxygen and therefore occurs only in the superficial regions into which it can penetrate ; the rate of conversion, however, is maximal at a pressure of oxygen considerably less than that occurring in air. It is also increased by freezing and thawing. Lea has investigated the chemical changes in the fat during storage ; under ordinary conditions they are too slight to account for any loss of bloom observed. He has also examined the accelerating influence of light upon the development of rancidity, and worked out a new test for this change. The fat is heated with glacial acetic acid, chloroform, and potassium iodide in the absence of air, and finally titrated with thiosulphate solution.

Haines has investigated the bacterial contamination of carcasses in cold store and found it to be practically negligible, although the presence of a flora capable of slow growth at low temperatures on wood and straw was detected.

Callow has examined the curing and freezing and storage of cured bacon. For scientific control it is necessary to estimate the chloride content of the meat ; for this purpose the minced bacon is thoroughly extracted with boiling water, the extract treated with silver nitrate and nitric acid and boiled, the silver chloride filtered off, and the excess of nitrate estimated by Volhard's method (*Biochem. Jour.*, vol. 23, p. 648 ; 1929). He has also adapted the Hanes modification of the Hagedorn Jensen method for estimating glucose (*ibid.*, p. 99) to the estimation of sucrose (*ibid.*, vol. 24, p. 57 ; 1930). In curing, the meat takes up both salt and water, the maximum of water absorbed occurring at a concentration of 4-5 per cent sodium chloride in the meat. Mild cured bacon frozen at $-25°$ C. can be stored successfully at $-10°$ C. for three months.

Brief reference may now be made to some of the investigations carried out on fruit and vegetables. Barker points out that wastage depends on the intervention of a series of factors operating at various stages in the life-history from the orchard to the consumer. Moreover, different fruits, even different varieties of the same fruit, may require different optimum temperatures for storage ; it is therefore very important that the temperature control of the store, for example a ship's hold, should be exact. Kidd, Onslow, and West have continued their investigations of the relationship between duration of life, respiratory activity, and nitrogen content in apples ; the relation between respiratory activity and nitrogen content is direct but roughly inverse with the duration of life. At the same time, the rate of loss of sugar and acid and the potash content play a part in prolonging or shortening the life of the fruit. Haynes and Archbold have continued their work on the metabolism of apples ; improvements in the methods of estimating glucose and fructose have been made ; thus the iodometric oxidation is carried out at 1° C., and the rate of oxidation of fructose as well as the time necessary for the complete oxidation of glucose have been carefully worked out.

Storage life can be divided into three periods : in the first the products of hydrolysis of starch are the materials chiefly respired ; in the second the products of inversion of sucrose are utilised, but the reducing sugar increases at the same time ; in the third, products of sucrose inversion as well as reducing sugar are combusted. The phases of development of the growing apple have also been studied : in the first there is a rapid increase in size accompanied by a slow increase in sugars and the laying down of cell-wall material ; the second is a period of maximum synthetic activity associated with starch-formation and nitrogen-intake ; in the third, synthetic activity declines, the rate of formation of total solids decreases, starch synthesis and acid synthesis cease, and sucrose accumulates.

Bracewell, Hoyle, and Zilva have investigated the antiscorbutic potency of different varieties of apples by means of tests on guinea-pigs, and have found that ' Bramley's seedling ' is markedly more active than all the others, that soil, age of tree, and season have no influence on the activity, and that three months' storage results in only slight loss, cold storage being better than gas storage at a higher temperature (*Biochem. Jour.*, vol. 24, p. 82 ; 1930).

West has noticed that storage life is favourably influenced by a few weeks of warm, dry weather preceding the date of gathering. Tomkins has found that acetaldehyde vapour is absorbed by healthy fruit and apparently utilised : at the same time, the vapour is fatal to fungal spores on its surface and to fungal mycelium. This fact may find an obvious practical application. Horne has found that the susceptibility of apples to fungal invasion is closely correlated with their nitrogen content, and that the resistance changes with the age of the fruit.

Obituary.

DR. E. B. KNOBEL.

EDWARD BALL KNOBEL, who died on July 25 last, was born in London on Oct. 21, 1841. He was educated at Stockwell Grammar School and at the Royal School of Mines, but did not take a university degree; he was given an honorary D.Sc. at Oxford in 1927. He was engaged in business as a manufacturer throughout the greater part of his life, and his work for astronomy could be done only in his leisure hours.

Dr. Knobel's published work began in 1873 with papers containing observations, illustrated by sketches, of Jupiter and Mars. He also invented a photometer and produced two papers on observations made with it. But his work as an observer was terminated by his removal from Burton to London in 1875. There he found an opportunity for studying astronomical bibliography, which determined the main drift of his studies for the rest of his life. In 1876 he presented to the Royal Astronomical Society a "Chronology of Star Catalogues", dealing with all the star catalogues the existence of which he could trace. With unimportant exceptions he had examined them all with his own eyes. To this collection he added a separate collection of catalogues of proper motions and a table of the names and places of stars contained in Aboul Hhassan's first catalogue. He also included notes on errors in texts of Ulugh Beg and Cusa, which, like those in the text of Aboul Hhassan, he attributed to misreadings of Arabic numerals. In the same year Dr. Knobel published a reference catalogue of books and papers on double stars, variable stars, red stars, nebulæ and clusters, proper motions, stellar parallax, and star spectra.

During the next forty years Dr. Knobel produced numerous papers on points connected with star catalogues, including those of Ulugh Beg, Al Sufi, and Al Achsasi, in which he displayed a growing confidence in his reading of Arabic and Persian manuscripts. He also published in 1905 a collection of the observations contained in the Japanese chronicle, the Nihongi, and edited a Chinese planisphere in 1909 with a valuable commentary. But Dr. Knobel's largest works were his editions of the star catalogues of Ptolemy and Ulugh Beg, published in 1915 and 1917 respectively. In each case the work had been begun by the German-American astronomer Peters, who died in 1890 and whose papers passed into Dr. Knobel's hands. In neither case did Dr. Knobel give a critical Greek or Persian text, but the work is based on a careful collation of the manuscripts in different languages for star places and magnitudes, and each star was identified, so far as identification is possible.

Probably Dr. Knobel contributed even more to astronomy by his long and devoted service to the Royal Astronomical Society than by his publications. Except for the one year, 1922–23, he was a member of its council uninterruptedly from 1876 to his death. He was twice president, 1892–93 and 1900–1; for fifteen years he was treasurer and for ten years secretary, and he will be remembered with gratitude by all British astronomers.

J. K. F.

WE regret to announce the following deaths:

Prof. A. Gullstrand, formerly professor of physiological and physical optics at the University of Uppsala, and Nobel prizeman for medicine in 1911, aged sixty-eight years.

M. Joseph Achilles Le Bel, For.Mem.R.S., formerly president of the French Chemical Society, on Aug. 8, aged eighty-three years.

Prof. J. F. Pompeckj, professor of geology and palæontology in the University of Berlin, on July 8, aged sixty-three years.

Dr. Harvey Washington Wiley, from 1883 to 1912 chief chemist of the U.S. Department of Agriculture, on June 30, aged eighty-five years.

News and Views.

THE lives and labours of those eminent English botanists and naturalist travellers, Sir William and Sir Joseph Hooker, and their connexion with Halesworth, Suffolk, will receive recognition on Aug. 17, through the unveiling of a tablet memorial in St. Mary's Church, Halesworth, a dedicatory duty to be performed by Sir David Prain, a former director of the Royal Botanic Gardens, Kew. The requisite funds for the erection of the tablet were provided by a number of representative scientific institutions, supplemented by contributions from a small band of botanists and others who were contemporary with Sir Joseph Hooker.

SIR WILLIAM HOOKER, born at Norwich on July 6, 1785, was educated there at the grammar school. He died on Aug. 12, 1865, in his eighty-first year, and was buried in the churchyard of St. Anne's, Kew. Here it should be mentioned that his residence at Halesworth comprised the period 1809–1820. The story of the elder Hooker's varied career was mirrored with filial care by his son Joseph in the *Annals of Botany*. Early devoted to ornithology, entomology, and botany, he found a friend in Sir Joseph Banks. On the latter's advice he explored Iceland (1809). From 1820 to 1840 he was Regius professor of botany in the University of Glasgow. A vigorous pedestrian, Hooker, when taking weekly rest at Helensburgh, habitually on Sunday walked to Glasgow—twenty-two miles—to be in time for his eight o'clock Monday morning class. In 1841 he became director of the Botanic Gardens, Kew, remaining in office twenty years. Sir Joseph Hooker, born at Halesworth, on June 30, 1817, graduated at the University of Glasgow in the medical faculty. His scientific achievements, whether as naturalist, traveller in unexplored regions of the world, or as a master of botanical nomenclature, scarcely need recapitulation. His friendships were with men such

as Darwin, Lyell, Huxley, Wallace. He followed his father in the directorship at Kew, became president of the Royal Society, and was an original member of the Order of Merit. Hooker the younger died in 1911, aged ninety-four years.

ON Aug. 19 occurs the centenary of the birth of the distinguished German chemist Julius Lothar Meyer, whose career recalls some of the most famous men of science and some of the greatest scientific achievements of the nineteenth century. The son of a doctor, Lothar Meyer became the pupil of Virchow, Ludwig, Bunsen, Kirchhoff, and Neumann; he succeeded Fittig and was the joint recipient with Mendeléeff of the Davy medal of the Royal Society. Born at Varel in Oldenburg, a province which had already given Mitscherlich to chemistry, Meyer became a student of medicine at Zurich and Würzburg, and it was on the advice of Ludwig that he devoted himself to chemistry. At Heidelberg, where he attended the lectures of Bunsen and Kirchhoff, he counted among his fellow-students Baeyer, Roscoe, Beilstein, and Quincke. Appointed a *Privatdozent* at Breslau in 1859, he undertook the direction of the laboratory of the Physiological Institute and in 1864 published his "Modernen Theorien der Chemie", by which his name was first brought into prominence. Two years were spent as a teacher at the school of forestry at Neustadt, Eberswalde, and in 1868 he was called to Carlsruhe, where for a time his work was interrupted by his care for the wounded of 1870. His final appointment came in 1876, when he was chosen successor to Fittig in the chair of chemistry at Tübingen, and this position he held until his death at Rastede on April 11, 1895. His brother, Oskar Emil Meyer (1834–1909), was the well-known physicist.

THE life of Lothar Meyer was written by his pupil Seubert, while the memorial lecture to the Chemical Society was delivered by Prof. P. P. Bedson in 1896. With great intellectual gifts, Lothar Meyer possessed characteristics which gained for him the esteem and appreciation of his contemporaries. Though his scientific publications embraced a great variety of subjects, his name is best known for the share he had with Newlands in England and Mendeléeff in Russia in the periodic classification of the elements. Speaking of the Periodic Law, Thorpe said: "The first chemist of note to grasp the significance of Mendeléeff's generalisation was Lothar Meyer, who, dealing at the outset with one of the characteristic properties of the elements—viz. their specific or atomic volumes . . . greatly developed the principle of periodicity, representing it graphically in a most striking and suggestive manner, leading up to a classification almost identical with that of Mendeléeff". It was for this work that Lothar Meyer was awarded the Davy medal in 1882. Lecturing three years later, Meyer himself spoke of Mendeléeff's contribution as forming "the coping stone of the building which in the course of years has been erected on the foundation of Döbereiner's Triads, as a work which did not, like Pallas Athene, spring ready armed from the head of a Jove, but has been gradually completed by the slow, painstaking, and often apparently vain endeavours of a whole series of workers".

THE Royal Institution has issued further particulars of the arrangements being made to celebrate the historic discovery by Faraday of electro-magnetic induction, recorded in his diary on Aug. 29, 1831. Jointly with the Institution of Electrical Engineers, the Royal Institution has drawn up a provisional programme for Sept. 21–23 next year. The first day will be devoted to the reception of delegates at the Royal Institution and a Faraday commemorative meeting in the Queen's Hall, the proceedings of which will probably be broadcast by the B.B.C. Following this will come the joint conference of the Institution of Electrical Engineers and allied associations, conversaziones at both the Royal Institution and the Institution of Electrical Engineers, and the opening of a Faraday Exhibition in the Albert Hall. The latter, which will be open to the public for about ten days, will include reproductions and illustrations of Faraday's work, and special exhibits showing the full development of electrical and chemical science and industry which have their origin in his researches. It is further proposed to publish Faraday's diary of his experimental work in full and to issue a souvenir volume. The delegates will also be entertained by the Royal Society. The Faraday celebrations will precede immediately the opening of the centenary meeting of the British Association, which is to take place on the evening of Sept. 23 in the Central Hall, Westminster.

THE purpose of the work of the Rothamsted Experimental Station is, as the director, Sir John Russell, states at the beginning of his recently issued annual report, "to discover the principles underlying the facts of agriculture and to put the knowledge thus gained into a form in which it can be used by teachers, experts and farmers for the upraising of country life and the improvement of the standard of farming". But the results of the work of the large and expert staff engaged in the Rothamsted laboratories and on the experimental plots contain much of scientific interest, especially as regards certain specific problems. The artificial inoculation of lucerne, a process developed in the Bacteriological Department for supplying the nitrogen-fixing organisms, is increasingly used at home and overseas. Study of the relationship of the nodule-organisms to the plant has shown that they do not normally enter the plant until the true leaves begin to form, when the root extrudes a substance, not yet determined, which facilitates their entry. Work on barley indicates the possibility of visualising the relationship between growth and the quality of the grain; and a simple method has been elaborated for estimating the amount of extract obtainable from a given sample of malt, an important aid to the maltster. Experiments with sugar beet emphasise the need of new varieties better suited to English conditions. The roots refuse to respond to schemes of manuring which are successful with mangolds and potatoes, though there is an increase in the leaves.

OF great value to overseas farmers is a process which has been devised at Rothamsted for converting straw and other cellulose-containing plant residues, such as the ' trash ' from sugar-cane plantations, into useful manure. The chemistry of the process is being worked out. The organisms mainly concerned in the decomposition of the straw are fungi, including several Aspergilli and Actinomycetes. An important discovery by the Microbiological Department is that of a group of nitrifying organisms producing nitrites from various ammonium salts, but differing from the previously known forms, *Nitrosomonas* and *Nitrosococcus*, in that they thrive in the presence of organic matter. They are found to be commonly distributed in the soil. In the Plant Pathological Department physiological and genetical work on fungi has been continued. The subject is a complex one. Strains apparently identical in structure and cultural reactions differ markedly in pathogenic properties, and conversely, strains different in structure and cultural reactions have similar pathogenic properties. Two or more strains are frequently intermingled in one host-plant. Progress has also been made in the study of virus diseases, those elusive phenomena which can only be studied in their effects on the infected plant. The activities of the staff are indicated by the inclusion of abstracts of the scientific papers, twenty-seven in number, published during the year. The report may be obtained from the Secretary of the Rothamsted Experimental Station, Harpenden, price 2*s*. 6*d*.

ARCHÆOLOGICAL excavations on the projected line of the new by-pass at Colchester have now been in progress under Mr. C. L. Hawkes of the British Museum since the middle of June. It will be remembered that this work was undertaken by the Colchester Excavation Committee to avert the loss of valuable archæological material by the making of the new road. The area of operations has since been extended owing to the purchase of adjacent land by the Essex County Council for playing-fields, which has been placed at the disposal of the Committee until the end of August. The results obtained to date, of which a report appeared in the *Times* of Aug. 4, are of very great interest, especially in their bearing upon the relations of Britain and the Continent in the century before the Roman conquest. They fully support what was previously known of the importance of Colchester as a centre of British culture and prosperity. It would appear that this low-lying site was an overflow area from the British town, at first not too thickly populated. Then after several decades, at about 10 B.C., it was more thickly settled under Cunobelinus. The site was abandoned at about 47–50 B.C. when the Romans built their Colonia near by on virgin ground. In the ten-acre field, nearer the Roman site and farther from the centre of the Celtic town, the remains are more scattered. The abundant pottery and metal work point to a period of great prosperity in British Colchester for a period of fifty to sixty years before the Roman conquest. With much native pottery and many native brooches is a large proportion of imported ware and ornaments, pointing to a considerable volume of pre-Roman trade with Italy, southern and northern Gaul, Belgium, and the Rhine area. The numerous coins include early Roman types, issues of Cunobelinus himself, the Iceni and native issues from Gaul. The conduct of the excavations has now been taken on by Mr. J. N. L. Myres of Oxford.

THE menacing condition of the South Italian volcanoes is fully discussed by Prof. H. Reck in *Matériaux pour l'Étude des Calamités*, No. 1, 1930. The changes in Vesuvius since 1906 as studied by Malladra and Friedlaender are passed in review and the lava-flows of 1926, 1927, 1928, and 1929 are described with maps. The later eruptions are distinguished not only by the higher temperatures of effusion but also by the greater abundance of the gases and the increase in hydrochloric acid. Vesuvius is clearly heading towards another catastrophic outburst like that of 1906. The villages on the southern flank (Terzigno, etc.) are most likely to be in danger from future flows, if, as is anticipated, the southern walls of the cone are fractured by the accumulating stresses. Areas likely to be overwhelmed with ashes and vapours cannot be predicted, as they will depend on the atmospheric conditions at the time. Etna is also in a slow crescendo of activity as indicated by the 1928 eruption and its unusually high temperature. Although there can be no direct connexion between the volcanic hearths of Etna and Vesuvius, there have nevertheless been numerous coincidences between their eruptions which suggest that both may be affected by common tectonic disturbances.

IT is known that for every kilogram of grain consumed in the world to-day there is approximately a kilowatt hour of energy expended. The grain is a necessity, but some think that the world would be happier without this great expenditure of machine labour. The rapidly advancing mechanisation of labour is, it is thought, tending to make work more monotonous and hence leads to a craving after amusement and to the lowering of the mentality of the race. In an address to the World Power Conference at Berlin, an abstract of which is given in the *Electrical Review* for Aug. 8, Dr. A. F. Enstrom combats this view. In his opinion, the operation of machines instead of dulling the faculties sharpens them. A skilled operator is instantly on the alert when the noise made by his machine alters by a minute amount. His powers of observation are always being exercised. The younger generation seems to grasp with ease how to operate motor-cars and how to look after machinery. Schoolboys even have done valuable research work with home-made radio sets. The great advantage of the mechanisation of labour is that it makes possible an eight hours' day. The labourer has to expend much less muscular effort during the course of it. There is no evidence that this lowers his mentality and he has opportunities for improving his knowledge which his predecessors never had.

THE scientific instrument industry of Great Britain has deservedly a high reputation for the quality of its

products, a reputation which the Institute of Physics has done much to foster through the publication of the *Journal of Scientific Instruments*. Appreciation of its services to the industry is shown by the recent decision of the British Optical Instrument Manufacturers Association to offer an annual prize, to be known as the B.O.I.M.A. Prize, for the best paper appearing in the *Journal of Scientific Instruments*. The prize, which is of the value of ten guineas, is offered for a period of five years, the award being entirely in the hands of the Board of the Institute of Physics. The Board has accordingly decided that in awarding the prize, all papers appearing in the *Journal* during the year will be considered and due weight will be given to (1) originality, (2) scientific value, (3) practical utility to instrument makers or users, (4) presentation. The first award will be made in 1931 in respect of a paper published in the *Journal* during 1930. It is also announced that through the generosity of a member of the Board, it has become possible for the Institute to offer a prize of £5 for the best "Laboratory and Workshop Note" which appears during the year. The donor has guaranteed this prize for a period of five years. These notes serve a useful purpose in acting as the medium through which the devices, special methods, etc., evolved in one laboratory or workshop are passed on to other workers. The first award of this prize will also be made in 1931, in respect of a note published in the *Journal* during 1930.

A SERIOUS obstacle in the development of radio telegraphy and telephony was the difficulty in developing high voltage direct current for supplying the amplifiers of transmission plants, as the necessary voltages vary from 9000 to 30,000. An early solution was to adapt motor generator sets coupled in series so as to obtain the requisite voltage. The large demand led to considerable improvements in their design so that sets can now be built which will give pressures of 15,000 volts. The main drawback to this solution was the comparatively long time required to start the reserve set if anything went wrong. The next solution was thermionic rectifiers, which can be put into use at a moment's notice. The disadvantage in this case was the great expense of upkeep, as their life is limited to about 5000 hours. The most recent and perhaps the best solution is to use mercury arc rectifiers. We learn from the *Brown Boveri Review* for July that this solution has been adopted by Marconi's Wireless Telegraph Co., Ltd., in the firm's research laboratories at Chelmsford. The rectifier and rectifier transformer were designed for an output of 400 kilowatts at direct current pressures of 9000, 10,000, and 12,000 volts. The plant was installed a year ago and has given entire satisfaction. It has a high efficiency, can be started at a moment's notice, and withstands short circuits. Water cooling of the rectifier is not necessary as radiation and convection suffice to lead away the thermal losses. The new large broadcasting station which is to be opened shortly at Warsaw will be equipped with two Brown Boveri rectifiers which will give an output of 500 kilowatts at from 10,000 to 15,000 volts.

THE meetings of the International Electrotechnical Commission which were held on June 27–July 9 in all three Scandinavian countries were very successful, twenty-two countries being represented. The opening meeting was held in Copenhagen, the advisory committees carried out their work in Stockholm, and the plenary meeting took place at Oslo. The committee on nomenclature after considerable discussion adopted the following names for the magnetic C.G.S. units. The unit of magnetic flux was called the 'maxwell' and the unit of flux density the 'gauss'. The unit of magnetic field intensity was called the 'oersted' and of magnetomotive force the 'gilbert'. It will be some time, however, before these names are adopted in text-books in Great Britain. Following the Italian suggestion, a unit 10^8 times as large as the maxwell has been adopted for practical engineering use. It is proposed to call it the 'pro-maxwell'. The committee on the rating of machinery had a long discussion as to the maximum permissible temperature at which machinery and apparatus should work. Engineers consider that a few degrees centigrade in the permissible temperature is of great practical importance. A unanimous decision was ultimately reached. The symbols committee reached agreement on the symbols to be used in telephony, telegraphy, radio communication, and electric traction. It was thought a pity that the standardised symbols are not more widely used by the Press and in industry. The aluminium committee had difficulty in reconciling European and American practice, but some progress was made in this direction. A proposal to standardise 132 kilovolts, which is the British grid pressure, was rejected.

A RECENT *Daily Science News Bulletin* issued by Science Service, Washington, D.C., gives some details about the progress of the plans which are being developed by Dr. Robert Goddard, professor of physics at Clark University, Worcester, Mass., for exploring the atmosphere at high levels by means of rockets. A liquid propellant has been perfected which is said to have many advantages over gunpowder or similar explosives. The rocket continually becomes lighter as it ascends owing to the burning of the propellant. The rockets will be sent upwards from a steel tower at Camp Devens, near Worcester, Mass. As yet only small rockets have been fired, which have ascended to levels of but a few hundred feet. A grant has recently been made by Mr. Daniel Guggenheim for the extension of the experiments, and an influential advisory committee has been appointed in connexion therewith. When it becomes possible to send rockets up to altitudes measured in tens of kilometres instead of hundreds of feet, carefully devised instruments will be added to the rocket with a parachute to bring them safely to earth when the charge is exhausted.

TRIALS of new and improved combine harvester-thresher machines have been arranged by the Ministry of Agriculture at Wellingore, Kesteven, Lincs., through the courtesy of Mr. Geoffrey Nevile. Farmers desirous of seeing these machines in operation may either send the cost of a telegram, or telephone to the

Estate Office, Wellingore (14X5 Fulbeck, Grantham), and they will be informed so far as possible of the exact day or days when harvesting is being carried out. At first it was thought that such machines would be unsuitable in England, since the grain in this country is much more moist at harvest time than is the case in Canada or the United States, where the combine method is widely used. However, judging from last year's experience in the trials carried out by the Oxford Institute of Agricultural Engineering, it seems probable that, although in some seasons a drying plant might be necessary, threshing may be safely carried out after the grain has stood for a day or two in summer heat. This view is supported by experience abroad, and the combined machine is becoming increasingly used in countries with cooler and wetter climates. Given favourable conditions for hire or purchase, the farmer would gain considerably by their general introduction into Great Britain, as not only would the total cost of harvesting and threshing be reduced, but also loss from vermin or mould in the stack be avoided.

THE Balkans correspondent of the *Times* gives an interesting account—in the issue of Aug. 4—of the health reform measures carried out in Yugoslavia during the last ten years. The person to whom most credit is due is Dr. Andriya Shtampar, who was appointed head of the Department of Hygiene in the Ministry of Health in 1919. The sanitary condition of the country was then deplorable, not only as the result of the War but also as the consequence of centuries of neglect, as was shown by the fact that 80-90 per cent of the population were infected with malaria and syphilis, while enteric fever, typhus, and smallpox were extremely rife. Dr. Shtampar's first step was to provide himself with competent assistants, who had to be trained abroad, and then to persuade the government to supply the necessary funds for his reforms. Since 1923, when he was first really able to start work, he has organised three main categories of institutions: (1) central institutes for each of the nine provinces, (2) 80 district health institutes, and (3) about 500 village stations. The central institutes comprise departments of bacteriology and parasitology, social medicine, and sanitary engineering. The district institutes contain departments for mother and child welfare, dispensaries for venereal diseases and tuberculosis, bacteriological laboratories and bath houses. The village institutes consist of a dispensary in charge of a nursing sister, a small health exhibition, and a shower bath. A school of hygiene is attached to the Zagreb Central Institute for the training not only of doctors and nurses but also for instructing the more intelligent peasants in the general principles of hygiene. Dr. Shtampar's work has received liberal aid from the Rockefeller Foundation as well as the strong support of King Alexander. The reduction in epidemic disease as the result of these measures has been most gratifying. During the last two years, there have not been more than a hundred cases of typhus in the country, there has been no smallpox for more than a year, and the incidence of malaria has fallen from 80 to 10 per cent, while there is a good prospect of a healthy generation growing up in formerly disease-ridden areas.

THE following appointments have been made by the Secretary of State for the Colonies: Dr. G. Bryce to be deputy assistant director of agriculture, Nigeria; Mr. B. G. Montserin to be agricultural officer, Trinidad.

THE Royal Microscopical Society, after residing in Hanover Square, London, for some forty years, has removed to new apartments in B.M.A. House, Tavistock Square, Bloomsbury, W.C.1, in which its library and slide collections will be more adequately housed, and where, in addition to the Society's lecture halls, meeting rooms, and offices, a portion of its unique collection of historical instruments will be on permanent exhibition.

AT the Brisbane meeting of the Australasian Association for the Advancement of Science which took place on May 28–June 4, it was decided by the General Council to change the name of the Association to "The Australian and New Zealand Association for the Advancement of Science". The Mueller Memorial Medal for 1930 was awarded to Sir Douglas Mawson for his contributions to Australian geology, associated with which are his achievements in geography and exploration. The first Liversidge Research Lecture under the bequest from the late Prof. A. Liversidge was delivered by Prof. N. T. M. Wilsmore, of the University of Western Australia, the title of the lecture being "Chemical Research and the State".

DR. HAROLD THOMPSON, senior naturalist on the staff of the Fishery Board of Scotland, has sailed for Newfoundland, where he will undertake on behalf of the Government of Newfoundland and of the Empire Marketing Board a survey of the fisheries. This is the first step in the formulation of a scheme having as its object the development on scientific lines of Newfoundland fisheries. The work in contemplation will embrace a systematic and statistical review of the fishery resources with the view of developing methods for the preservation, handling, and marketing of the fish (including brine freezing), and for the utilisation and marketing of surplus fish and fish by-products. The cost of the preliminary survey is being shared equally between the Government of Newfoundland and the Empire Marketing Board.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time teacher for mining courses under the West Riding Education Committee—The Education Officer, County Hall, Wakefield (Aug. 18). A cotton entomologist and an assistant pathologist in the Department of Agriculture and Stock, Brisbane—The Official Secretary, Queensland Government Offices, 409 Strand, W.C.2 (Aug. 20). A lecturer in civil engineering in the University of Birmingham—The Secretary, The University, Birmingham (Aug. 21). A temporary research assistant in civil engineering in the University of Birmingham—The Secretary, The University,

Birmingham (Aug. 21). Principal teachers of, respectively, mechanical engineering, mathematics and physics, and chemistry; also a qualified mechanic for taking care of the plant, and a laboratory steward to take charge of the laboratories at the Technical College, Coatbridge—The Director of Education, Lanarkshire House, 191 Ingram Street, Glasgow, C.1 (Aug. 22). A junior assistant in the department of the War Department Chemist—The War Department Chemist, B.47, Royal Arsenal, Woolwich, S.E.18 (Aug. 23). A lecturer and demonstrator in the pharmacy department of the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham (Aug. 25). A cacao soil research chemist at the Imperial College of Tropical Agriculture, Trinidad—The Secretary, Imperial College of Tropical Agriculture, 14 Trinity Square, E.C.3 (Aug. 30). A lecturer in mechanical engineering at the Norwich Technical College—The Principal, Technical College, Norwich (Sept. 3). An assistant in the Cancer Research Laboratories of the University of Manchester—The Registrar, The University, Manchester (Sept. 7). A demonstrator in chemical pathology in the University of Manchester—The Registrar, The University, Manchester (Sept. 13). A medical man or woman research worker in mental deficiency under the Medical Research Council, the governing body of the Darwin Trust, and the Committee of the Royal Eastern Counties Institution for the Mentally Defective at Colchester—The Medical Superintendent, Royal Institution, Colchester (Oct. 3). A chemical laboratory assistant in the experimental department of the Fine Cotton Spinners' and Doublers' Association, Ltd.—Prof. F. P. Slater, Rock Bank, Bollington, Macclesfield. Assistant masters for engineering subjects and for chemistry at the Smethwick Junior Technical School—The Director of Education, Education Offices, High Street, Smethwick. An assistant under the Directorate of Ballistic Research, Research Department, Woolwich, with several years' research experience in physics—The Chief Superintendent, Research Department, Woolwich, S.E.18. A temporary research assistant in a Government Department, with, preferably, a knowledge of rubber technique and mechanical methods—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1. A temporary laboratory assistant in a Government Department, with, if possible, a general knowledge of chemistry and physics and of rubber manufacture—The Commandant, Experimental Station, Porton, near Salisbury.

Our Astronomical Column.

New Variable Stars in the Constellation Norma.—Arrangements have been made for the interchange of observers between the observatories of Johannesburg and Leyden. Mr. H. van Gent has taken a number of plates with the Franklin-Adams telescope at Johannesburg which were measured at Leyden by W. E. Kruytbosch (*Bull. Astr. Instit. Netherlands*, vol. 5, No. 194). The blink-microscope revealed 25 variables upon them, and afforded sufficient material for plotting the light-curves, which are given in the *Bulletin* together with diagrams of the fields. The second star on the list is an eclipsing variable of the W. Urs. Maj. type. Prof. Hertzsprung suggests, from the long stationary minimum, that either the companion is a white dwarf or that the system contains a third star from which most of the light comes during minimum. There are also some Cepheid variables: *p* on the list has a period of 2·4 days and a large light-range.

Images of Pluto on Yerkes Observatory Plates.—*Astr. Nach.* 5719 contains particulars of the measures of the image of Pluto detected by Dr. F. E. Ross on plates exposed on Jan. 29, 1921 (two plates) and Jan. 6, 1927. The positions are for the equinox of 1930·0. The magnitude of Pluto was estimated as 15 on each date.

U.T. 1921.	R.A.	N. Decl.	Aperture. (Inches.)	Focal Length. (Inches.)	Exposure. (Minutes.)
Jan. 29·0896	6h 31m 22·04s	19° 43′ 13·7″	10	50	192
	22·01	13·6			
	22·28	14·1	6	30	192
1927.					
Jan. 6·2500	7 4 3·17	21 13 3·1	3	21	120

The estimated probable error is 1″ for the focal lengths 30 in. and 21 in., somewhat less for the 50-in. focus. The first 50-in. measure and the 30-in. measure were made by Prof. van Biesbroeck using three comparison stars in the Paris Astrographic Catalogue. The other measures were made by Dr. F. E. Ross using the star Berlin *A* 2257 for the 1921 plate, and three Paris Astrographic stars for the 1927 plate. No proper motions were applied. The 1927 position is in good accord with the revised measures of the image obtained at Uccle on Jan. 27, 1927. It is stated that the 1921 images were identified with the aid of the ephemeris of Prof. T. Banachiewicz (*U. A.I. Circular* 284), and the 1927 one with the aid of a manuscript ephemeris by Messrs. Bower and Whipple.

Astr. Nach. 5719 also contains a useful collection of the observations of Pluto obtained in March and April last: they are compared by Dr. C. H. Smiley with an ephemeris which he deduced from the following heliocentric positions and velocities derived by Prof. Banachiewicz for the date March 31·0 and the equinox of 1930·0.

	Daily Change.
$x = -13{\cdot}29363$	$-0{\cdot}0020443$
$y = +35{\cdot}84738$	$-0{\cdot}0017048$
$z = +15{\cdot}41587$	$+0{\cdot}0000824$

The Photo-electric Cell at Berlin-Babelsberg.—*Astr. Nach.* 5713 contains a study by P. Guthnick and R. Prager of early-type stars, the duplicity of which had been detected at the Victoria Observatory by spectroscopic observations by Dr. Plaskett and Dr. Pearce. In five cases light-variation was detected, indicating mutual eclipses. *H.D.* 19820 has minimum masses of 19 and 9 times that of the sun. It is of type *O8*, but its colour is yellow: the other stars on the list are also yellow. *H.D.* 25638 has a period of 1·1487 days from the Berlin observations. Plaskett found a velocity range of 293 km./sec., but did not determine the period. *H.D.* 25639 is also an eclipsing binary, only 18″ from the preceding star, with which it forms the pair Σ485, but the light range is only 0·05 mag. The period is not yet determined.

Research Items.

Smoking in Papua.—Dr. A. C. Haddon, who is investigating tobacco smoking in Papua, communicates to *Man* for August an account by Capt. G. F. N. Zimmer of a method of smoking tobacco hitherto unrecorded, which is in use among bush natives on and to the west of the Fly River in an area including Shortland River and Lake Murray. The tobacco or a native cigarette is inserted in one end of a tube or cigarette holder—a narrow bamboo tube about nine inches long—and this end they place against a glowing log or fire-brand. When the tobacco is thoroughly alight, the end containing the tobacco is placed in the mouth and the other end inserted in the wider end of an arm guard or bracer which has been removed from the smoker's left arm, this end of the bracer being closed by the right hand, the tube going between the smoker's fingers. The narrower end is closed by the smoker's left hand. The bracer, *posiki*, is made of nine slats of wood, about 25 cm. long and tapering from 31 mm. to 25 mm. in width. The slats of wood are firmly lashed on both sides with rattan so as to make a very rigid object. The smoke is blown into the bracer through the tube. The tube is then removed and the smoke inhaled by slightly moving the left hand. This method of smoking is usually employed while hunting or when away from the village. It is in no way a freak, but has been observed on many occasions as a regular method in these circumstances.

Agricultural Rites in Northern Nigeria.—Mr. C. K. Meek describes in *Africa* for July (vol. 3, No. 3) the ceremonies observed by the Bachama of the Benue River in the cult of Nzeanzo, who is enshrined at Fare, a Bala village some seven miles east of Numan. Nzeanzo is believed to be the youngest of five sons of a woman named Venin, who herself receives divine honours in an annual mourning ceremony observed in April. The cult of Nzeanzo is the most honoured among the Bachama. It is in the hands of a kindred at Fare of which the head is called Kisami. He is assisted by a relative, who acts as spokesman on all occasions, and a man of another kindred who prepares the beer and food used in the rites. A woman known as Mbamto acts as intermediary between the god and the people. She is a perpetual virgin who has come from the district of Kona and is regarded as the bride of the god. She is not psychic and if she develops hysterical symptoms she is sent away. The principal festival of the cult is held at the end of April and lasts three days. The king, though not a priest, is regarded as president of all cults and is held responsible for the due performance of all rites. If he should fail in providing gifts at stated periods, any misfortune to the people would be regarded as due to his default. The Fare festival is primarily concerned with the opening of the agricultural year and precedes the sowing of the crops. It is even more important than the thanksgiving rites. Formerly one of the king's children was sacrificed annually during the fertility rites of 'Pilla' carried out at Lamurde. In comparatively recent times, the human victim was replaced by a cow. At Nafaran no one may sow his crops until the priest of the Nafaran cult has carried out certain rites and distributed the seed which he has had under his keeping, and is therefore believed to have magical qualities. Among the Jukun, Kona, and Mbum the seed-corn is distributed by the chief, and is the produce of the royal farm. This was apparently the custom of the old Bachama kings, and to this day the produce of the royal farm is considered the property of the community.

Fauna of South Africa.—Report No. 7, for the year ending June 1929, of the Fisheries and Marine Biological Survey, Union of South Africa, contains, besides general matter relating to the fisheries, several papers in the "Special Reports", amongst which are two of special value. These are Dr. C. H. O'Donoghue's "Opisthobranchiate Mollusca" and Mr. M. Burton's "Description of South African Sponges" collected by the South African Marine Biological Survey. The first is a long, systematic paper on various forms chiefly belonging to the tectibranchs (sixteen species) together with a few nudibranchs (five species). Amongst these are five new species of tectibranchs and three new species of nudibranchs. The examination of such a collection is a thankless task, for all the specimens are preserved and have lost their original beauty, which in life may be marked, and the absence of coloration in most cases makes diagnosis difficult. Nevertheless, Dr. O'Donoghue has managed to extract a large amount of information out of the collection, the radulæ, shells (when present), and jaws serving as valuable distinctive features, and these are fully figured in eight plates. *Euselenops lunicipes* (Cuvier) is specially carefully and minutely described, with details of its anatomy, although only one specimen was present. This is identical with *Neda luniceps* described by Adams and Reeve in 1848. Mr. Burton in his critical survey of the desma-forming sponges abandons for ever the family Lithistidæ, the heterogeneous collection of forms which have hitherto been placed together on account of the similarity of their skeletons being provisionally referred to several different families. Six species are recorded from South Africa, including one which is new. *Lithochela conica*, a new genus and species belonging to the Myxillæ, is also described.

Atlantic Foraminifera.—Dr. Joseph Augustine Cushman continues his valuable series of memoirs on "The Foraminifera of the Atlantic Ocean", the present part (7) consisting of the Nonionidæ, Camerinidæ, Peneroplidæ and Alveolinellidæ (Smithsonian Institution, United States National Museum, *Bulletin* 104, 1930). As in former parts, the species are specially described which have occurred in the waters adjacent to the shores of the United States, including the whole of the Gulf of Mexico and the Caribbean Sea, which is the area chiefly worked by the vessels of the United States engaged in dredging. These families are all represented by simpler and usually smaller forms than in the Indo-Pacific, where some of the species reach to a very large size. The Nonionidæ are most abundant in rather shallow water; three genera occur and numerous species. *Elphidium* is common, also *Nonion* and *Nonionella* in rather deeper water. The Camerinidæ are almost wanting in the Atlantic, the Peneroplidæ and Alveolinellidæ being represented by simpler and more primitive species than in the Pacific. The new species *Peneroplis bradyi* is common in the West Indian region, occurring at numerous stations off the Tortugas and the Florida Keys, at Bermuda and Jamaica, probably replacing *Paneroplis planatus*, which apparently does not occur in the western Atlantic.

Osteology of Pediculate Fishes.—Mr. Albert Eide Parr, in his paper entitled "On the Osteology and Classification of the Pediculate Fishes of the genera Aceratias, Rhynchoceratias, Haplophryne, Laevoceratias, Allector, and Lipactis" (Occasional Papers of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University, No. 3,

1930), discusses the homology of the rostral bone of Rhynchoceratias and describes the new species *Rhynchoceratias longipinnis* with special reference to its osteology. He finds that the median, unpaired rostral bone of this genus which forms the anterior part of the upper border of the mouth, supplying through its denticles or spines the only functional dentition of the upper jaw apparatus, has nothing to do with the mesethmoidal bones of these fishes, but is homologous with the illicium of other ceratoids, representing an extreme phylogenetic modification of the most anterior dorsal fin ray (spine) of ordinary teleosts. The relationships of the other genera are discussed and the family Aceratiidæ divided into two sub-families, the Eurostrinæ, to which *Aceratias* and *Rhynchoceratias* belong, having the dorsal denticles inserted on a well developed rostral bone, and the Cryptorestrinæ, including *Haplophryne* and *Lævoceratias*, in which the rostral bone is reduced or absent.

Iron in Humus.—Some explanation of the beneficial influence of humus substances on the growth of green plants in water culture has been brought forward by C. Olsen (*Comptes-Rendus du Laboratoire Carlsberg*, vol. 18, 1930). The solution of the much-debated question as to whether or not humus is beneficial to plants grown under these conditions centres round the form in which the iron is presented, and the reaction of the nutrient solution. *Lemna* plants grow equally well in a culture solution of *p*H 6·0, whether humus was added or not, provided the iron was given in the form of ferric citrate, but if ferric chloride was substituted for the citrate the addition of humus greatly improved growth. The explanation given is that under neutral or alkaline conditions iron is not available to the plant unless it is in the form of an organic compound such as citrate. The watery extracts of peat contain such complex organic iron combinations, and are therefore useful to the plant for the available iron they provide. In support of this theory attention is directed to the fact that chlorosis is often noticeable in Nature among plants growing on calcareous soil poor in humus, whereas on soils of similar *p*H but containing humus, the symptoms of iron deficiency do not appear.

Geophysics in the United States.—The United States National Research Council has issued (June 1930) the *Transactions* of the American Geophysical Union for both the tenth and eleventh annual meetings (April 1929 and May 1930) in one volume (pp. 314, no price stated). The reports of previous annual meetings (up to that for 1928) appeared about a year after the date of the meetings. The remarkable promptitude of publication of the report of this year's meeting is due largely to the adoption of photolithographic reproduction from typescript for the whole of the material. The result is not quite so readable or pleasing to the eye as printed matter, but the advantage of early publication seems to outweigh this drawback, in view of the necessarily mainly ephemeral interest of the reports and papers, which deal largely with matter published more fully elsewhere. The Union meets as a whole and in seven sections; the reports and papers numbered 54 (at the 1930 meeting) and cover a wide range of important and interesting topics in geophysics.

Magnetic Data from Mauritius.—Miscellaneous Publications of the Royal Alfred Observatory, No. 8, is devoted to a summary and discussion by the director, Mr. R. A. Watson, of "The Disturbed and Quiet Day Variations of Magnetic Force at Mauritius, 1916–26". The inclusion of quiet and disturbed day inequalities in the monthly bulletin of the observatory is not possible, and their collection and discussion for an 11-year period in this publication is therefore of special value and interest. The outstanding feature of the results is the manner in which disturbance is almost entirely confined to *H* (horizontal force). In *D* (declination) and *V* (vertical force) the inequalities are almost unmodified by disturbance, whereas in *H* both the type and the range of the inequality are entirely different on the two sets of days, quiet and disturbed. Even on international quiet days *H* usually shows some small disturbance, and though world-wide disturbances are in general considerably less intense at Mauritius than in latitudes 50° or more, small disturbances (in *H*) are more frequent at Mauritius, so much so that it is usually difficult to select one day in any given month as a typically undisturbed day.

Turner Valley Oilfield, Alberta.—Western Canadian oil possibilities have certainly derived stimulus from the developments on the Turner Valley oilfield, Alberta, of which Mr. E. H. Cunningham Craig gave some account to the Institution of Petroleum Technologists recently. In fact, it is not too much to state that if American interests in the oil potentialities of the Rocky Mountain region have flagged somewhat from the non-discovery of a second Salt Creek Oilfield, they have certainly been reanimated by the results of the last six years' work at Turner Valley, where geological conditions are closely allied to those in the relevant Rocky Mountain States. The Turner Valley anticline was first proved a producing structure by the drilling of the Royalite No. 4 oil-well some five years ago, and since then other producing wells have been completed. Significant interest attaches to this well, as it produced filtered oil and wet gas in considerable quantity; its present output is more than 500 barrels of light gasoline per day. It may be recalled that Alberta has in the past been specially noted for its enormous reserves of natural gas, chiefly of a dry character, with comparatively little oil; so that the Turner Valley developments are of more than usual importance. Some fifteen miles of the structure have been proved and other areas outside Turner Valley have been and are being prospected. The source of this oil and gas has revived the old controversy of upward or downward migrated oil. On one hand there is the possibility of derivation from Palæozoic (Devonian) horizons, and, on the other, from the Jurassic or lower Cretaceous. The author favours the latter source and inclines to the view that the parent oil rocks are of Kootenai age (base of Lower Cretaceous) with subsidiary possibilities in the overlying Dakota Sandstone. He dismisses the possibility of Palæozoic origin on the chief count of probable escape and loss of oil during the lengthy geological period intervening between the critical formations, during which considerable orogenic movement and accompanying erosion were accomplished. On the other hand, there is no doubt that the chief reservoir rock is a dolomitic limestone of pre-Jurassic age; so that, if the "stratigraphically downward migration" theory is proved, which we cannot easily admit on the basis of the facts so far presented, a most important principle, applicable to many other limestone fields in the world, is thus established.

Ionised Regions of the Upper Atmosphere.—Some fresh investigations of the upper air by wireless methods, which differ chiefly from earlier ones in the use of short waves and in the multiplication of the number of receiving stations, are described by Prof. E. V. Appleton, J. A. Ratcliffe, and A. L. Green in two papers in the July issue of the *Proceedings of the Royal Society*. These now show conclusively that

even relatively long waves (400 metres) occasionally pass through the lower ionised layer (the *E* region) at night when it is at a height of approximately 100 kilometres, and are then returned from the *F* region, which has a greater concentration of electrons, and is approximately two to three times as high. With shorter waves (100 metres) the penetration of the *E* layer occurs frequently, the waves being returned from it usually only in the middle of the day, when it is still at a height of approximately 100 kilometres. The equivalent height of the *E* layer for 400 metre waves varies very little with the angle at which they are incident upon it, and there is likewise little variation in the reflection coefficient, to explain which it is suggested that there is a zone below the *E* layer which causes considerable attenuation of the waves, without, however, deviating them. The receiving station at King's College, London, at which many of the interference records have been obtained, is distant only 18 kilometres from the transmitting station at Teddington.

Collisions Between α-Particles and Helium Atoms.—The solution of the problem of collision between two particles which act upon each other with forces varying as the inverse square of the distance between them is the same in quantum mechanics and in classical mechanics, unless the particles are identical. In this case an important additional term appears in the quantum theory expression for the probability of scattering, and it is possible to decide between the old and the new theory by experiment. A test of this nature, in which the number of particles projected through 45° by slow α-particles passing through helium is measured, is described by Dr. J. Chadwick in the *Proceedings of the Royal Society* for July. An annular type of scattering apparatus was used, with a strong polonium source, and a zinc sulphide detecting screen. The number of particles deviated was definitely greater than would be expected on classical theory, and for the slowest particles used, of range about 1·2 cm. in air under standard conditions, was close to the number predicted by quantum theory. A fundamental theoretical assumption which is verified by this result is that the helium nucleus has no spin or vector quantity associated with it, and that its field of force is spherical.

Measurement of Candle Power of Electric Lamps.—The measurement of the candle power of lamps is one of the most difficult problems that physicists have to solve. The probable error of the routine tests of comparing the candle powers of incandescent lamps by visual methods in the factory are of the order of at least 2 per cent high or low. This is due not to carelessness but to the real difficulty which every observer has in judging when two surfaces have the same brightness or when two shadows have the same intensity. This is apart altogether from the difficulties arising in determining the mean intensity of the light emitted and from those arising from differences of colour. In a paper communicated to the May number of the *Journal of the Institution of Electrical Engineers*, Mr. Winch, of the G. E. C. Research Laboratories at Wembley, describes a photo-electric photometer for the commercial measurement of incandescent electric lamps. It seems to us that this instrument will go an appreciable way in meeting the commercial demand for higher accuracy combined with very rapid measurement. Whilst the eye must, of necessity, be the ultimate source of reference, there seems reason to believe that in the near future commercial photometry will, in general, be carried out photo-electrically. As an experiment, lamps were measured in the ordinary photometric way and the work done was equivalent to having five observers working for four days, without taking into account the time taken in making calculations. The same series of tests when carried out photo-electrically by one observer took four hours. The method is capable of being developed so as to obtain higher accuracy and also so as to obtain spherical integration with one reading.

Turbo-Vapour-Compressors for Refrigeration.—Among the Selected Engineering Papers chosen to be published in pamphlet form by the Institution of Civil Engineers is one by Dr. H. Mawson on "Turbo-Vapour-Compressors and their Application to Refrigeration". While reciprocatory compressors have been developed for refrigeration, turbo-compressors have not received serious consideration, and in the paper an attempt is made to consider the thermodynamic and practical possibilities of this type. Fundamental equations which are applicable to liquids, gases, and vapours are applied to the flow of fluids through a centrifugal compressor; the choice of a fluid for centrifugal compression between definite temperature limits is considered and the performance of a sulphur dioxide turbo-compressor for a given temperature range is examined by the aid of the p/I chart. Outlines of the design of a sulphur dioxide centrifugal compressor of definite duty for the same temperature range are given, together with a general arrangement of the compressor, and, finally, centrifugal and reciprocating compressors are contrasted, and the possible application of the former to central-station distribution of fluids under pressure for refrigeration is also considered.

Metal Carbonyls.—The *Journal of the Society of Chemical Industry* for June 13, 20, and 27 contains a most interesting article by Dr. Robert Mond on the metal carbonyls. The early experimental work which led to the discovery of the first known member of the group, nickel carbonyl, in 1890 by Ludwig Mond and C. Langer, and the subsequent investigations (in which Dr. Robert Mond played an active part) leading to the discovery of the other metal carbonyls, are described. The properties of the carbonyls and their actual and possible technical uses are next considered, and a full bibliography of the literature is given. The Mond Nickel process, which is a very important technical application of the properties of nickel carbonyl, is dealt with at some length. These three papers constitute an important and authoritative addition to chemical literature.

Sorption of Gases by Charcoal.—The June number of the *Journal of the American Chemical Society* contains a paper by McBain and Britton on the sorption of gases and vapours by charcoal under great pressure (up to 60 atm.) The experiments were completed in 1927 at the University of Bristol. The gases used were nitrogen, nitrous oxide, and ethylene, and the temperatures used were above and below the critical temperatures. It is claimed that the results enable a decision to be reached between rival views as to the nature of sorption by charcoal, that the Langmuir conception that only such molecules are sorbed as are in direct contact with the molecules holding them is correct, and that the Saussure-Polanyi conception of a compressed film is not supported by the experiments. In this connexion, however, it should be mentioned that the same issue of the journal contains a paper on the adsorption of water and benzene vapours on manganese dioxide, by Foote and Dixon, in which it is stated that Polanyi's theory is in agreement with the data, so that the question cannot be regarded as settled.

Geology in Great Britain.

THE welcome innovation introduced last year of issuing the "Summary of Progress" of the Geological Survey in two parts is continued, one part being devoted to an account of the routine work of the year, while the other serves as a medium for the publication of a series of papers on subjects of special interest. Students are thus enabled to purchase at a reduced price the second part of the "Summary" without having to pay for the section dealing with administrative matters. Part I.[1] contains the annual report of the Geological Survey Board and of the Director. Seventy-five maps were published during 1928, together with fourteen memoirs, most of which have already been noticed in our columns (NATURE, Aug. 10, 1929). The reports of the district geologists contain many records of interest. Fieldwork was largely concentrated on the revision of the coalfields, but in Shropshire the Longmynd has been invaded afresh and a provisional classification of some of its puzzling formations is offered, while in the Lake District the relations of the Skiddaw slates, the Borrowdale volcanic series and the Carrock Fell complex are being actively attacked. The new survey of the Orkneys has yielded a fine suite of fossil fishes and plants from the Old Red Sandstone. On the petrological side, it is announced that the Tertiary igneous rocks of Ardnamurchan exemplify in a most striking way the phenomena of ring-dyke intrusion and present many important facts bearing on magmatic differentiation. Hybridisation is thought to be responsible for the reproduction of the tonalitic and monzonitic types of the central complex. Publication of full details is promised in the near future. An interesting account is given of the successful experiences of the geophysical party.

The work of the geophysical party is described at greater length in Part 2.[2] The first two papers are by W. F. P. M'Lintock and J. Phemister, and deal respectively with gravitational surveys over the buried channel of the Kelvin at Dumtry, near Glasgow, and over the Pentland fault near Portobello. The results clearly demonstrate that the method may be usefully employed to supplement boring evidence, and that in practice it is both cheaper and quicker than drilling. Sir John Flett contributes a masterly investigation of a lamprophyre dyke on the west side of Loch Lomond. The dyke is of unusual significance because of the variety of its inclusions. In so far as these provide an indication of the nature of the underlying rocks, they suggest that the sequence of formations from the Highland border northwards is a descending one; as this is not the sequence usually adopted, the suggestion may have very far-reaching consequences. T. H. Whitehead describes a presumably Arenig rhyolite occurring near Pontesford Hill in Shropshire between Ordovician and Longmyndian rocks. The remaining papers are devoted to the Coal Measures or their fossils. W. B. Wright describes the zonal succession around Manchester; R. Crookall gives an invaluable and well-illustrated summary of the stratigraphy and flora of the Bristol and Somerset coalfield; Emily Dix and J. Pringle describe various forms of *Xiphosura* from the South Wales coalfield; and T. Eastwood discusses the *nips* and *rock-riders* (interruptions in the continuity of coal-seams) of the West Cumberland field.

The district described in the Oswestry memoir[3] is represented on Sheet 137, which covers parts of Shropshire, Denbigh, and Montgomery. Ordovician formations come to the surface in the west and pass under successively later deposits, Silurian, Carboniferous (including Coal Measures), and Triassic, the latter outcropping in the east. Glacial drifts overspread the eastern half of the area. The controlling structural feature is the great anticlinal uplift of the Berwyn Hills, which enters the north-western quarter from the west. In the south-west this gives place to a synclinal depression. The tectonic features are ably discussed in relation to the larger area of which the district forms a part. There are also chapters dealing with the Palæozoic igneous rocks (albitised derivatives from an andesite magma) and with the mineral products and water supplies.

The memoir describing Sheets 320 and 321[4] will serve as a valuable guide to the geology of a popular coastal district, since it deals with Hastings, St. Leonard's, and Bexhill, and the ancient towns of Rye and Winchelsea. The solid geology is restricted to the Purbeck and Wealden, but topics of unusual interest, ranging from palæontology to sedimentary petrology, are by no means limited. The account of the superficial deposits is notable for the inclusion of a valuable description of Dungeness, a great dumping ground of beach-shingle, drifted alongshore from the chalk cliffs and flint deposits west of Eastbourne, and deposited where the interplay of tidal currents produces an area of relatively slack water.

The next memoir[5] to be noticed (Aldershot and Guildford, Sheet 285) describes an area of south-eastern England which is a favourite residential district of great geological interest and topographic charm. The Surrey Hills, composed of the Lower Greensand beds, present some of the most beautiful scenery in England. To the north of these, across the middle of the area, run the North Downs. The geology thus embraces a representative series from the Lower Cretaceous upwards. Attention is given to the evidences of early man with special reference to their distribution in the river terraces.

The country around Sudbury (the "Eatanswill" of Pickwick and his friends) is described by Prof. Boswell[6] in a memoir explanatory of Sheet 206. The geological setting is of great simplicity. Chalk underlies the whole area, but on account of the thickness of the Tertiary cover and the glacial deposits, it crops out only on the lower flanks and in the bottoms of the larger valleys. The glacial deposits are, however, far from simple. Here are found some of the finest sections of drift in Great Britain; they have been intensively studied in recent years by Gregory, Marr, Boswell, Slater, and others. This memoir is further notable for its clear account of the history of the local river systems.

Mr. E. J. Lovegrove has carried out attrition tests on some 460 samples of road-stones and his results are summarised in a recent memoir,[7] together with supplementary results on water absorption, hardness, toughness, and cementing value. Notes on the petrographical characters and their bearing on the behaviour of the specimens are added. Samples of all the stones referred to are conserved in the Museum of Practical Geology, together with a complete set of microscopic sections. The memoir is made easily available for use by the inclusion of an index to localities and a glossary of rock names and definitions. There are four excellent plates of photomicrographs with descriptions facing each plate, an arrangement worthy of special commendation.

Dr. Alex. Scott has written a report[8] in which for the first time the ball clays of the south-west of England—one of the most important raw materials of the pottery industry—are systematically dealt with. The term 'ball-clay' is applied to plastic clays which when fired in an oxidising atmosphere to the tempera-

ture of certain pottery ovens (*c.* 1150°–1200° C.) have a white or nearly white colour. The name refers only to the original method whereby the clay was obtained in Dorset and Devonshire, and not to any particular property. The memoir gives a complete account of the geological relations, mineral and chemical characters, and physical properties. There are numerous analyses and results of tests and a glossary of terms uxed by the clay miners.

Continuing the county series of memoirs in which the sources of underground waters are described in detail, the Derbyshire memoir[9] has been issued. It gives an admirable short account of the geology of the county, illustrated with a clear map and sections. Details are given of the local sources of supply from springs and wells, with many particulars of the strata recorded from wells and borings. A number of analyses of Derbyshire waters are supplied, and reference is made to the medicinal waters of Buxton and Matlock Bath.

[1] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part I. Pp. iv+99. 2s. net.

[2] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part. II. Pp. vi+128. 3s. net.

[3] Explanation of Sheet 137: The Geology of the Country around Oswestry. By C. B. Wedd, Dr. B. Smith, W. B. R. King, and Dr. D. A. Wray. With contributions by T. C. Cantrill and Dr. H. H. Thomas. Pp. xix+234+4 plates. 5s. 6d. net.

[4] Explanation of Sheets 320 and 321: The Geology of the Country near Hastings and Dungeness. By H. J. Osborne White. Pp. xii+104+6 plates. 3s. net.

[5] Explanation of Sheet 285: The Geology of the Country around Aldershot and Guildford. By H. G. Dines and F. H. Edmunds. With a Chapter on Palæontology by C. P. Chatwin. Pp. xiv+182+5 plates. 4s. 6d. net.

[6] Explanation of Sheet 206: The Geology of the Country around Sudbury (Suffolk). By Prof. P. G. H. Boswell. Pp. x+74+2 plates. 2s. net.

[7] Attrition Tests of British Road-stones. By E. J. Lovegrove. With notes by J. Allen Howe and Sir John Fleet. Pp. viii+84+5 plates. 3s. net.

[8] Special Reports on the Mineral Resources of Great Britain. Volume 31: Ball Clays. By Dr. Alex. Scott. Pp. x+73. 2s. 6d. net.

[9] Wells and Springs of Derbyshire. By J. V. Stephens. Pp. viii+155. 4s. net.

London: H.M. Stationery Office.

Descendants of the *Bounty* Mutineers.

IN 1923, Dr. Harry L. Shapiro visited Norfolk Island for the purpose of making a series of observations on the Pitcairn Islanders, the descendants of the English sailors who survived from the mutiny of the *Bounty* in 1790 and the Tahitian women with whom they settled on Pitcairn. The Islanders removed to Norfolk Island in 1856, but some of them afterwards returned to Pitcairn. These latter Dr. Shapiro was prevented from visiting by stress of weather. The results of his observations on Norfolk Island, together with a summary of previously recorded observations of the settlement, have been published in Vol. 11, No. 1, of the *Memoirs of the Bernice P. Bishop Museum* of Honolulu.

The special interest of the anthropometric measurements depends upon the fact that they represent hybrids of two well-distinguished stocks with a long history of inbreeding. In stature the male hybrids are distinctly taller than either parent stock. The women, however, reach but do not exceed the mean for Tahitian and English. Both male and female have inherited the longer head-length of the English; in head-breadth both have inherited a head mid-way between English and Tahitian, the latter being the greater by 6-7 mm. in the male. In face breadth both sexes again show an intermediate position, the male being slightly more than the English average. In face height the males are not significantly different from the Tahitians; the females are intermediate. The hybrid males have inherited a narrow forehead which resembles the Tahitian. Other features in which the Islanders show an intermediate position are nose height (males), nose width, fronto-parietal index, and zygomatico-frontal index. The cephalic index is much nearer the English than the Tahitian, which is prominently brachycephalic, and the nasal index, though distinctly greater than the English index, approximates more nearly to it than to the Tahitian.

In eye colour, the pigmented eye of the Society Islander is dominant over the unpigmented eye, but the males have a greater percentage of blue eyes than the females. The epicanthic fold is rare among the hybrids. The unexposed skin colour of the hybrids is intermediate to the medium dark-skinned Tahitians and the relatively fair-skinned English. The exposed skin colour among the hybrids is as dark as the exposed skin of the Society Islanders. The dark hair of the Tahitian is dominant over the light hair of the English, and curved hair over straight hair. The males are also more hairy than the Tahitians. The variability of the Islanders is less than in either parent stock.

Recent Work on Vitamin D.

III.

Occurrence.

ALTHOUGH cod-liver oil is the richest natural source of vitamin D, it is clear that most animals must obtain their supply from other food or by the exposure of their body surface to the sun's rays. E. M. Hume, N. S. Lucas, and H. H. Smith (*Biochem. J.*, vol. 21, p. 362; 1927) have shown that irradiated 'cholesterol' can cure rickets in the rat or rabbit when lightly rubbed into a small area of depilated skin almost as efficiently as direct irradiation of a similar small depilated area. These results afford experimental proof that exposure of the skin to a suitable source of light will result in the production of vitamin D in the exposed area, whence it will be transferred to the body tissues to exert its function.

J. L. Leigh-Clare (*ibid.*, vol. 21, p. 368; 1927) has examined the diatom *Nitzschia closterium* for vitamin D and has found it to be absent even when the organism was grown in sunlight. Up to 0·4 gm. was given as a daily dose to rats maintained on the rachitogenic diet. It appears, therefore, that the cod must obtain its vitamin D from plankton or smaller fish, since it is unlikely to be sufficiently exposed to sunshine itself (unless, of course, it possesses the power of synthesising it in the absence of the sun's rays). The absence of vitamin D from this organism may be compared with the poverty of green land plants in it. M. H. Roscoe (*ibid.*, vol. 21, p. 211; 1927) has found small amounts in spinach: its effect was more obvious in rabbits than rats, since relatively larger amounts could be consumed by the former animal. S. G. Willimott and F. Wokes point out, however, that administration of spinach involves at the same time an increase in the consumption of calcium and phosphorus: they therefore examined an ether-acetone extract of the dried leaves (*ibid.* p. 887). Twenty-five mgm. of the extract, equivalent to 6 gm. fresh spinach, were sufficient to prevent xerophthalmia

and produce nearly normal growth, from its content of vitamin A, in rats on a high fat diet: only slight signs of rickets were observed, but the fæcal *p*H became alkaline. On a low fat diet 100 mgm. extract daily failed to shift an alkaline fæcal *p*H to the acid side of neutrality, although cod-liver oil quickly brought about such a reduction. They conclude, therefore, that at a level supplying a fair amount of vitamin A, vitamin D could not be demonstrated.

It appears probable that green foodstuffs contain little vitamin D, but the amount can be increased by exposure to ultra-violet light. For the production of milk containing more than minimal quantities of the vitamin, it is best to add cod-liver oil to the cow's diet, although summer green stuffs and exposure of the animal to sunlight also raise the vitamin D content of the milk to some extent.

It is of some interest that vitamin D has also been found to be present in ergot of rye, although it might possibly have been inferred since ergosterol is an important constituent (E. Mellanby, E. Surie, and D. C. Harrison, *Biochem. J.*, vol. 23, p. 710; 1929). The authors, however, found that mushrooms, which also contain ergosterol, contain no vitamin D and that exposure of ergot to sunlight does not increase the vitamin content, although irradiation with a mercury vapour lamp does so to a slight extent. The experiments were carried out on puppies maintained on a diet deficient in vitamins A and D. The calcifying factor had the properties of vitamin D in that it was soluble in alcohol and ether and withstood saponification.

D-Hypervitaminosis.

With the preparation of vitamin D synthetically from a pure precursor, attention was soon directed to the question as to what effects, if any, the administration of large doses of the vitamin might have upon the tissues of the body. Some previous work had shown that large doses of cod-liver oil or its concentrate (that is, the unsaponifiable fraction) might have deleterious effects upon rats, but it was not possible to attribute such to the presence of a vitamin, since other substances occur in both the oil and its concentrate. In irradiated ergosterol, on the other hand, there are only present compounds formed from it, with probably some unchanged ergosterol. If, therefore, any toxic effects seen bear a relation to the known effects upon the body of vitamin D and, further, if their intensity is proportional to the amount of vitamin present, it is reasonable to attribute these effects to the vitamin itself: unless, however, a very close parallelism between toxicity and potency is observed, there always remains the possibility that another substance may play some part in producing or even mitigating any deleterious effects observed.

It is impossible here to do more than refer to a few of the papers published on this subject: some of the earliest work was carried out by Pfannensteil and Kreitmair and Moll: in Great Britain two groups of workers have devoted some attention to it (L. J. Harris and T. Moore, *Biochem. J.*, vol. 22, p. 1461; 1928: vol. 23, pp. 261 and 1115; 1929: Harris and C. P. Stewart, *ibid.*, vol. 23, p. 206: W. E. Dixon and J. C. Hoyle, *Brit. Med. Jour.*, vol. 2, p. 832; 1928: Hoyle and H. Buckland, *Biochem. J.*, vol. 23, p. 558; 1929: Hoyle, *Lancet*, vol. 1, p. 734; 1929: and *J. Pharm. Exp. Therap.*, vol. 38, p. 271; 1930).

When rats are given a synthetic diet containing all known nutritive factors, to which are added daily 10 mgm. or more of irradiated ergosterol, the animals show loss of appetite, with failure to grow or loss of weight, diarrhœa, and skin lesions: death ensues in a few weeks. The amount which must be given daily to produce these effects varies: Harris and Moore found 0·1 per cent in the diet of ergosterol irradiated in alcohol lethal, whilst 0·025 per cent of similar material or of oil-irradiated ergosterol prevented growth. Dixon and Hoyle found that 0·2 per cent in the diet of ergosterol irradiated in oily (cocoa-butter) solution, giving an average daily consumption of 17 mgm., prevented growth in half-grown rats, whilst 11 mgm. daily gave little retardation. (The daily consumption in Harris and Moore's experiments was about 10 mgm. with 0·1 per cent in the diet.) Smaller doses of irradiated ergosterol, for example, 0·001 per cent in the diet, or 0·1 per cent ergosterol, heated ergosterol or over-irradiated ergosterol in which the potency had been almost entirely destroyed, had no deleterious effects on growth. In later experiments, Hoyle found that about 26 mgm. daily of oil-irradiated ergosterol caused some loss of weight but was not lethal in young adult rats, whereas 20 mgm. of ergosterol irradiated in alcohol caused death in a short time. He therefore considers that oil-irradiated is less toxic than alcohol-irradiated ergosterol, whilst Harris and Moore consider that the two products are equally toxic: it is possible that the discrepancy may be due to differences in vitamin D potency of the materials used, or to differences in the constituents of the synthetic diets.

In addition to the deterioration in the general condition of the animals noticed above, slowing of the heart has been observed and an increase in the inorganic phosphate and calcium of the blood. In addition, irradiated ergosterol produces a marked diuresis but without any increase in the total phosphate or chloride output. Post-mortem, the pathological changes vary in general with the toxicity as disclosed by the effect on growth, except that time is required for their development, so that early death may be accompanied by few lesions, whilst a prolonged maintenance on a low dose may produce as marked changes as a shorter existence upon a high one. The general condition is one of emaciation, with atrophy of the spleen and thymus: in addition, calcareous deposits are found in the kidneys, blood-vessels, heart muscle and the walls of the gastrointestinal tract. The calcification of the walls of the aorta is often particularly striking; the deposits appear to be laid down at first in close connexion with the elastic fibres; on macroscopic examination the tube is brittle and inelastic. Similar sclerosis occurs in the vessels of the heart and kidneys. These changes are not found in animals on non-toxic doses of irradiated ergosterol, or given large doses of ergosterol, or heated or over-irradiated ergosterol. Dixon and Hoyle found that the only lesions in their rats given 11 or 17 mgm. oil-irradiated ergosterol daily were calculi in the urinary tract, frequently accompanied by hydronephrosis and also some degree of fatty change in the kidneys.

The nature of the diet has a marked influence upon the toxicity of irradiated ergosterol: on a natural diet of bread and milk, 20 mgm. of alcohol-irradiated material daily had little effect upon the growth of young rats although producing cessation of increase in weight in the case of young adults. Pathological lesions were correspondingly absent or slight. It is possible that this is due to a lessened intake of calcium and phosphorus on the bread and milk diet (Harris, *Lancet*, vol. 1, p. 237; 1930), although Hoyle considers that this result should be compared with the lower toxicity of oil-irradiated material found by him and that it is in favour of the toxic factor and vitamin D being different substances. It might be suggested that early death is due to a different substance from vitamin D: and that the sclerosis observed in relatively long time experiments is produced by the vitamin and leads later to a fatal result.

It may be pointed out that the toxic amounts of irradiated ergosterol in these experiments contain from 10,000 to 100,000 times what may be called the physiological dose of vitamin D. In healthy adult men, Havard and Hoyle found that 8 mgm. daily for three weeks in winter failed to raise the blood inorganic phosphate or serum calcium and had no toxic effects (*Biochem. J.*, vol. 22, p. 713 ; 1928). Hess and Lewis, however, found that 2·5-5 mgm. daily in rachitic infants, whilst curing the disease, might lead to an excessive rise in the blood phosphorus and calcium.

In conclusion, brief reference may be made to a paper by Harris and Moore in which it is shown that the requirement of the rat for vitamin B is increased *pro rata* with increase in the intake of vitamins A and D in the form of a cod-liver oil concentrate. The amount of vitamin D consumed was below the level which had previously been found to be toxic (when given in the form of irradiated ergosterol), whilst the amount of vitamin A taken was up to 25,000 times the minimum dose. It is considered that the 'vitamin balance' is probably between vitamins A and B, although the possible action of other unidentified substances cannot be excluded when both sources of the vitamins contain other materials.

University and Educational Intelligence.

APPLICATIONS are invited for the following research scholarships at the Huddersfield Technical College : The Joseph Blamire's Research Scholarship for research in colour chemistry (value £100 a year, with remission of fees), and the British Dyes Research Scholarship for research in colour chemistry (value £75 a year, with remission of fees). Forms of application can be had from the Secretary of the College.

ROBERT BLAIR fellowships have been awarded to Mr. Cyril H. Bowden and to Mr. Philip Carpenter. These fellowships, which carry a grant of £450, are the most valuable scholarship awards in the gift of the London County Council. Mr. Bowden has been engaged upon research work in the physical chemistry department of the Imperial College of Science, and proposes to study chemical engineering at the Massachusetts Institute of Technology, U.S.A. Mr. Carpenter, who is an associate of the Royal School of Mines, proposes to visit mines in the United States to study the principles and practice of the flotation process for separating minerals from their ores, with a view to the value of its application on the large copper field now being opened up in Northern Rhodesia.

FROM the University of Cambridge we have received summaries of dissertations approved for the Ph.D., M.Sc., and M.Litt. degrees during 1928–29, as follows : in science 44, in the humanities 12, total 56. By departments the dissertations are thus distributed : departments of the faculties of biology 22 (biochemistry 6, geology 6, botany 4, zoology 3, physiology 3), chemistry 9, agriculture 6, mathematics 4, physics 3, English 4, classics 3, modern and mediæval languages 2, economics and political science 1, history 1, moral science 1. The preponderance of science, especially biological science, is remarkable. So likewise is the fact that of the 56 candidates 34 were drawn from other universities in every quarter of the globe, namely, from London (4), Wales (4), Manchester (2), Sheffield, St. Andrews, Glasgow, Aberdeen, Berlin (moral science) Lausanne (mathematics), Budapest (biochemistry), Pisa (chemistry), four universities in the United States of America (English, modern and mediæval languages, chemistry, and physiology), two Canadian universities (history and agriculture), four Australian universities (botany, geology, biochemistry, English, chemistry), New Zealand (botany, geology, physics), South Africa (chemistry), and Bombay (zoology).

IF the number of doctorates conferred in the sciences be proportionate to the advance of the frontiers of knowledge, there has been a notable acceleration in the progress of science in the United States during the past ten years. 1928–29 is the tenth year for which particulars of such doctorates have been compiled by the Research Information Service of the American National Research Council, and its recently published bulletin on the subject shows a steady increase from 330 in 1919–20 to 1025 in 1928–29. The University of Chicago alone created 99 new doctors last year, Wisconsin 66, Johns Hopkins 62, Columbia 61, Cornell 60, Minnesota 53, California 50, Ohio State 48, Yale 47, Harvard 40, fifty-one other universities 439. Of greater interest than the list of conferring universities is the list of subjects in which the degrees were conferred. This discloses the portentous fact that, excluding chemistry, which is in a class by itself, accounting for nearly a third of the total number, more doctorates (112) were conferred in what has only barely established its claim to recognition as a science, namely, psychology, than in any of the other sciences. The universities chiefly responsible are : Iowa (15), Ohio (13), Chicago (10), Columbia (9), Cornell (9), Minnesota (8), Wisconsin (6), and Yale (6). The titles of the theses indicate in many instances the schools of psychological doctrine in which the writers are interested, and a very large proportion of them are attempts to solve practical educational problems. Next to psychology come, in the order given, physics, zoology, botany, mathematics, geology, physiology, engineering, pathology, agriculture, and bacteriology.

THE report of the work of the Petroleum Department of the Sir John Cass Technical Institute for the session 1929–30 is now available, and shows that satisfactory progress has been made in all sections. The close of the session to which the report relates marks the completion of the third triennium of the activities of the department. The courses provided embrace lectures on general technology of petroleum, bulk transport and distribution of petroleum products, introduction to the chemical and physical properties of petroleum ; properties, applications, and examination of petroleum, and its applications to engineering. There is also a preliminary course in elementary physics, chemistry, and mathematics, as a basis of introduction to the subject of oil technology for those who have little or no knowledge of first principles. The total number of class entries for the session was 160 as compared with 145 last session, student hours showing an increase from 2153 to 2876. The report, as in previous years, gives no indication of the syllabus of the lectures offered, so that it is not possible to form an idea of the precise ground traversed in the several courses. While a report is naturally not intended to constitute in itself a prospectus, at the same time these annual reports of the Petroleum Department of the Institute have always seemed to us rather bald statements, and the inclusion of a little more internal detail is desirable ; for example, the names of all the lecturers who have contributed to the work, results of any particular research which may have been inspired by the Institute, some mention of the companies whose representatives have attended courses, any particular departures from or modifications in routine designed to keep the curriculum up-to-date, plans for the future, and so on : all this is of direct import not only to the School itself, but also to those for whom it so adequately caters.

Historic Natural Events.

Aug. 17, 1876. Electrical Phenomena near Weymouth.—At Ringstead Bay, near Weymouth, Dorset, during a sultry afternoon, on ground above the cliffs, a number of globes of light were seen of the size of billiard balls, extending from a few inches above the surface to a height of 7-8 ft. They slowly rose and fell vertically, sometimes within a few inches of the observers but always eluding the grasp. The number of these objects varied from twenty to 'thousands'. No sound accompanied the display, but at 10 P.M. there was a thunderstorm.

Aug. 17, 1929. Shyok Glacier Floods.—Near its source the Shyok River, a tributary of the Upper Indus, flows through a narrow valley, into which the Kumdan Glaciers protrude. At times the glaciers advance to the opposite wall, completely blocking the valley and damming the river. This occurred in 1928 and 1929, when the ice dam was 1000 yards long and more than 400 feet high. The force of the great volume of water broke through the barrier on Aug. 17, 1929, and a disastrous flood followed. At Khalsar, where the river runs through a narrow gorge, it rose rapidly to 93 ft. above the normal level, and by 8 P.M. on Aug. 18 the flood, travelling about 20 miles an hour, had raised the level by above 50 ft. at Attock, 600 miles from the dam. Owing to the system of warnings which had been arranged, the losses of life and property caused by the flood were comparatively small.

Aug. 18, 1631. Aurora.—The account of the search for the North-West Passage by Capt. Luke Foxe in His Majesty's Pinnace *Charles* contains an entry made on Aug. 18 at the mouth of the Nelson River, Hudson Bay: "This night 10 were many Pettiedancers". Mr. W. J. Healy of the Provincial Library, Winnipeg, explains that the term 'Dancers' or 'Merry Dancers' is a local name for the aurora borealis.

Aug. 18, 1923. Typhoon at Hong Kong.—The centre of a violent typhoon passed within 14 miles of Hong Kong. On Aug. 18 the calm centre had a diameter of seven miles, outside which the winds had a velocity of more than 100 miles per hour, while a gust was recorded, after correction for instrumental error, of 127 miles per hour. This was at the time the highest wind velocity ever recorded autographically.

Aug. 19, 1867. Thunderstorm over London.—After a day of intense heat one of the greatest London thunderstorms began at 9 P.M., and continued until 5 A.M. next morning. The lightning was continual, and the thunder scarcely ceased. Rain fell in torrents, accompanied by a violent wind and in some places by hail. The storm was very violent in all parts of Surrey and in some parts of Sussex and Berkshire.

Aug. 19, 1880. Typhoon.—This disturbance, known as "The Great Typhoon of 1880", originated to the east of the Liu Kiu islands on Aug. 19–22. On Aug. 24–27 it travelled north-eastward along the east coast of Japan, doing great damage.

Aug. 19, 1889. Cloudburst in Japan.—The Kii Peninsula, on the south of Nippon, was the scene of a deluge of rain unequalled in the history of Japan. On Aug. 18, a typhoon approached the south coast, and during Aug. 19 crossed the inland waters to the Sea of Japan, causing a southerly gale over the Kii Peninsula. Heavy rain was experienced on Aug. 18, and on Aug. 19 the rain was so violent and continuous that a considerable area was devastated. At Tanabe the fall was 14·5 in. on Aug. 18, and 35·5 in. on Aug. 19, the latter quantity falling in 17 hours. During a period of four hours from 2 P.M. to 6 P.M. the fall amounted to 14·25 in. and near by 9·5 in. fell in two hours. The observer reported that in the mountains of the interior the rain was even heavier. The Izugawa, a tiny stream only eleven miles long, became a devastating torrent. The lower part of Tanabe was deeply flooded, while a stream south of Tanabe rose 50 feet in two hours. Hundreds of thousands of trees were washed out to sea, forming temporary dams in the valleys which added to the flooding; 1502 lives were lost and 400,000 persons were ruined.

Aug. 19, 1924. Heavy Rain in British Isles.—During a thunderstorm in the early morning, a total of eight inches of rain fell in five hours at Brymore House, near Cannington in Somersetshire. In the twenty-four hours ending at 9 A.M. the fall amounted to 9·40 in., the second largest recorded in the British Isles. It appears that two or three thunderstorms followed one another in rapid succession. After the storm hailstones lay on the ground to a depth of three or four inches, but were not especially large.

Aug. 21, 1852. Eruption of Etna.—A violent eruption of Etna, that lasted more than nine months, began on this day. Streams of lava flowed from craters in the Val del Bove, on the south-east side of the mountain, one stream advancing towards Zaffarana and another threatening La Macchia and Giarre. The total volume of lava was estimated to cover an area 6 miles long and 2 miles wide to an average depth of 12 ft.

Aug. 23, 1923. Sandstorm at Khartoum.—During a violent sandstorm at Khartoum the wind reached a velocity of 62 miles per hour. Many large trees were blown down. During storms of this type the dust is raised to a height of about 3000 feet, and advances across the ground like a solid wall ten or twenty miles in length.

Societies and Academies.

LONDON.

Geological Society, June 25.—**J. E. Richey**: Tertiary igneous complex of Ardnamurchan. The district is chiefly noteworthy on account of its intrusive rocks, and only small outliers of the widespread Tertiary plateau basalt-lavas are preserved. The types of intrusion include volcanic vents piercing the basalt-lavas, and largely filled with acid and trachytic fragmental materials; minor intrusions, including cone-sheets, chiefly quartz-dolerite, and dykes; and plutonic masses, nearly all gabbro or dolerite, occurring mainly as ring-dykes. The above, excepting the dykes, are arranged in concentric series around three different centres, marking three foci of igneous activity which functioned successively. It is suggested that the three complexes are successively more deep-seated, due, presumably, to the growth of an overlying volcanic pile. The regular ring-patterns marked by the intrusions are of more especial interest and constitute evidence of the formation of annular or arcuate fissures that are considered here, as in Mull, to have resulted from localised stresses set up in the roof of an underlying magma-reservoir.

PARIS.

Academy of Sciences, June 23.—**Bigourdan**: The Observatory of Cagnoli in the rue de Richelieu.—**Ernest Esclangon**: The determination of an orbit, planet or comet, by three observations, taking into account the perturbations caused by other planets.—**Léon Guillet** and **Marcel Ballay**: The influence of reheating on the electrical resistance and resistance to shearing of the tempered aluminium-silicon alloys.—**Louis Roy**: The propagation of waves on isotropic elastic surfaces with three parameters.—**André Nessi** and **Léon Nisolle**: A machine for calculating by means

of a planimeter the integral of the product of two functions.—T. Popovici: Convex functions of one real variable.—Georges Bouligand: The figuration of imaginary points and the theory of functions.—Michel Fekete: Series of factors keeping the class of a Fourier's series.—Luigi Fantappié: The extension of a theorem of M. Hadamard to series of multiple powers.—F. E. Myard: An absolutely general mode of linkage of two axes of rotation in space.—Nicolas G. Perrakis: The sensitometric study of a new panchromatic plate. A study of a Guilleminot panchromatic plate, with special reference to the interpretation of photographs of the solar corona taken on similar plates.—André Marcelin and Mlle. S. Boudin: Stratifications coloured by sublimation. A description of the technique necessary to obtain crystals suitable for microscopic examination.—René Lucas: The mutual influence on their absorption bands of the chromophore groups of a molecule.—J. Aharoni and Ch. Dhéré: Study of the influence exerted by the exciting rays on the fluorescence spectrum of etioporphyrin. The structure of this spectrum from the infra-red to the ultra-violet.—L. Goldstein: The distribution of potential and charge in a diatomic molecule.—Lespieau and Bourguel: Chemical constitution and the Raman effect: ethylenic hydrocarbons. As regards the Raman effect, the double bonds of the benzene nucleus give the same effect as ordinary ethylene double bonds; both are characterised by the line 1600. The Raman spectra of six hydrocarbons of known composition have been studied and the results applied to the verification of the structure of a new double ring hydrocarbon, phenyltrimethylene.—G. Arrivaut: The formation of a violet copper alloy, Cu_2Sb. This has been prepared by the action of a 10 per cent solution of antimony chloride containing some free hydrochloric acid upon finely divided copper.—Maurice François: The rational preparation of the bromides and chlorides of mercurammonium. Crystallised dimercurammonium bromide and dimercurammonium chloride.—M. Tiffeneau and Mlle. Jeanne Lévy: The affinity capacity of the piperonyl radical, $CH_2O_2C_6H_3$.—Urion: The decomposition of divinylglycol by various catalysts: 1-methylal-1-cyclopentene.—H. Colin and P. Ricard: The glucides and the glucidic derivatives of the brown Algæ.—H. Lagatu and L. Maume: Observation, by leaf diagnosis, of the influence of temperature on the mode of nutrition of a plant.—Emile Saillard: Adsorption in the sugar industry.—A. and B. Chauchard: Sleep produced in fishes by compression of the brain.—D. Bennati and E. Herzfeld: The action of formaldehyde on neuromuscular excitability.—P. Sédallian and Mme. Clavel: The use of flocculated diphtheric toxin in the preparation of antidiphtheric serum. Other conditions being the same, and with some reserve as regards individual reactions of animals, experimental proof is given that the toxin precipitated at *p*H 4·7, brought into solution in a suitable volume of peptone solution, furnishes an antigen of at least equal value to that of the total toxin.—H. Simonnet and G. Tanret: The calcification of the lung in the healthy or tuberculous rabbit by larger doses of irradiated ergosterol.—S. Bratianu and C. Guerriero: The phagocytic power of the epithelial cells of the mammary gland.—Mlle. G. Cousin: The endoparasitic development of the ectoparasitic larva of *Mormoniella vitripennis*.

CAPE TOWN.

Royal Society of South Africa, May 21.—P. R. v. d. R. Copeman: Changes in the composition of oranges during ripening (Part 2). Changes in soluble solids. The percentage of soluble solids in the juice and the weight of soluble solids per fruit both increase during ripening. The changes follow the course of an autocatalytic reaction. During the final three weeks the effects of transpiration become dominant and the percentage soluble solids show an abnormal increase. Spraying with lead arsenate mixtures does not produce any significant change in the amount of soluble solids.—B. Farrington: The life of Vesalius by Boerhaave and Albinus. A translation of the preface by Boerhaave and Albinus to their edition of the works of Vesalius. It contains a brief history of anatomy from the earliest times until its revival in Italy in the beginning of the fourteenth century. It gives a more extended account of the work of the Italian pioneers; and then establishes the epoch-making importance of the work of Vesalius. The career of Vesalius is treated in considerable detail and with many lively biographical touches. This preface of theirs is not now readily accessible in Latin, and has not before been translated into English.—A. Zoond and G. Rimer: The mechanism of equilibration in *Xenopus Lævis*. An analysis of the function of the eyes and the labyrinthine organs in connexion with equilibrium and the response to rotation. Whereas extirpation of eyes and labyrinths abolishes completely the response to rotation on a turntable, eyed labyrinthless animals do respond to such rotation by definite muscular movement. This response is still maintained when the animal is rotated in total darkness. The same phenomenon is recorded also for *Rana*.—A. Zoond: Dermal photoreceptivity in *Xenopus Lævis*. *Xenopus* is negatively phototropic and response is not in any way affected by the removal of the eyes, the eyeless animals reacting to light in the same way as the eyed. Immersion in 1 per cent cocaine solution for six minutes completely abolishes the sensitivity to light of the eyeless animals, although the spinal reflexes are not impaired. These observations demonstrate the presence of photoreceptive elements in the skin of *Xenopus*.

CRACOW.

Polish Academy of Science and Letters, Mar. 3.—W. Seislowski: The radiation of semi-conducting cells.—D. Doborzyński: The dielectric constant of liquid bromine.—K. Kostanecki: The course of the cæcum of the great bustard, *Otis tarda*.—F. Rogoziński and Mlle. M. Starzewska: Experimental rickets. The influence of ultra-violet light on the mineral metabolism and on the composition of the bones. Experiments on the white rat prove the favourable action of irradiation on the retention of calcium and of phosphorus.—L. Monné: Comparative researches on the structure of the Golgi apparatus and of the vacuome in the sexual and somatic cells of some gastropods (*Helix*, *Paludina*, *Cerithium*).—St. Ciechanowski: (1) Study of tar cancer tumours. (2) The influence of the anatomical structure of the region exposed to tar on the appearance and development of tar tumours.—K. Sciesiński: The influence of the species of the rabbit on the appearance and development of tar tumours.—St. Ciechanowski and K. Sciesiński: Pregnancy and tar tumours. The influence of the intensity of the local agent on the formation and development of tar tumours in the rabbit.—R. Weigl: The nature and forms of the micro-organism of exanthematic typhus.—R. Weigl: The methods of active immunisation against exanthematic typhus.—L. Hirszfeld and Mlle. W. Halber: The serological unity of cancers.

April 7.—T. Banachiewicz: First orbit of the trans-Neptunian star.—A. Wilk: Discovery of a new comet.—Wl. Gorczyński: Values of the intensity of the solar radiation measured on board different vessels

on the Atlantic and Indian Oceans.—E. Chauvenet and J. Dawidowicz: Zirconyl oxyiodides.—K. Dziewoński, Cz. Baraniecki, and L. Sternbach: A new method of synthesis of colouring matters of the thioindigo type. Syntheses in the naphthalene group.—J. Kuhl: Contribution to the knowledge of the Trembowla grits in the neighbourhood of Mogielnica (Eastern Little Poland).—Mlle. C. de Kleist: Phytosociological researches on the peat bogs of the region of the dunes of the right bank of the Vistula in the neighbourhood of Warsaw.—Z. Grodiński: The development of the blood vessels in the anterior extremities of *Amblystoma mexicanum*.—J. Zacwilichowski: Researches on the innervation of the wings of insects.—L. Hirszfeld and Mlle. W. Halber: Deviation of the complement by the serum of cancer patients and of pregnant women with alcoholic extract of cancers.—Z. Zakrzewski: Researches on the production of the principles stimulating the growth of normal tissues by sarcomatous cells in culture *in vitro*.

MELBOURNE.

Royal Society of Victoria, June 12.—John Clark: New Formicidæ; with notes on some little-known species. Fourteen species and one genus are described as new. The ants described by Kirby in 1896, collected by the member of the Horn Expedition to Central Australia, have been revised. Of the twelve species mentioned by Kirby, five now stand as apparently valid species.—Alan P. Dodd: New Hymenoptera Proctotrypoidea from Victoria. Six new species are described, belonging to the families (1) Scelionidæ and (2) Belytidæ. The genus *Xenotoma* is here recorded for the first time from Australia.—Alan Coulson: Notes on the Jurassic Rocks of the Barrabool Hills, near Geelong, Victoria. Fossil plants, of which a list is given, were discovered in a mudstone band intercalated with basal boulder beds. The flora indicates a Lower Jurassic age. The pebbles of the boulder beds are Ordovician spotted slate, quartzite, quartz and mica schist, Heathcotian (Up. Cambrian) epidiorite, and Lower Palæozoic granite. Two faults have affected the Jurassic beds.

SYDNEY.

Linnean Society of New South Wales, May 21.—C. P. Alexander: Observations on the Dipterous family Tanyderidae. A preliminary description of the immature stages of the family Tanyderidæ. The material consists of larvæ and pupæ of a North American species, *Protoplasa fitchii*, from the Gaspé Peninsula of eastern Quebec, Canada. More than half the known species of the family are from Australasia, which is the great centre of distribution of the family.—H. L. Jensen: The genus *Micromonospora* Orskov, a little-known group of soil micro-organisms. Morphological and biological description of nine strains of the practically unknown genus *Micromonospora*, which appears to be of common occurrence in Australian soils.—A. Jefferis Turner: Revision of Australian Oenochromidæ (Lepidoptera). Part 3. This completes the revision of the family. In this part twenty genera and forty-seven species are dealt with, one genus and six species being described as new. Keys are given for the determination of the species of *Oenochroma* and *Derambila*.

VIENNA.

Academy of Sciences, May 22.—G. Machek: The linear pentacene series (19). The constitution of the bi-derivatives of pentacene-diquinone.—M. Kohn and E. Gurewitsch: The 2, 5-dichlor-hydro-quinone-dimethyl-ether.—M. Kohn and S. Fink: Chlorination of *p*-amido-phenol. 35th. Communication on bromophenols.—K. Przibram: Recrystallisation and coloration of rock-salt.—G. Ortner: Recrystallisation of compressed rock-salt. M. Blau and E. Rona: Application of Chamie's photographic method to reactions and electrolysis of polonium.

Official Publications Received.

BRITISH.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 15: Preliminary Spinning Tests on Mixings of Indian and American Cottons using Ordinary and High Drafts. By R. P. Richardson and Dr. A. James Turner. Pp. 21. (Bombay.) 1 rupee.

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 4: October, November, December, 1929. By Ernest A. Hodgson. Pp. 51-65. (Ottawa: F. A. Acland.) 25 cents.

A Summary of Data relating to Economic Entomology in the British Empire. Prepared for the Third Imperial Entomological Conference by Dr. S. A. Neave. Pp. 23. (London: Imperial Institute of Entomology.) 2*s*. 6*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 41: Study of the Polysaccharides. Part 3: Acetamide as a Polysaccharide Solvent. By Dr. J. Reilly, Dr. Reinhold Wolter and P. P. Donovan. Pp. 467-473. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Memoirs of the Asiatic Society of Bengal. Vol. 11, No. 3: The Palæography of the Hathigumpha and the Nanaghat Inscriptions. By R. D. Banerji. Pp. 131-146+plates 17-23. (Calcutta.) 4.8 rupees.

The Half-Yearly Journal of the Mysore University. Vol. 4, No. 1, January. Pp. 144. (Bangalore.) 2 rupees.

Education, India. Pamphlet No. 26: Note on Education at Jamshedpur in Bihar and Orissa. By G. E. Fawcus. Pp. iii+8+2 plates. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10*d*.

Journal of the Indian Institute of Science. Vol. 13A, Part 10: Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.) Part xi: New Methods of Disease Transmission and their Significance. By M. Sreenivasaya. Pp. 113-117. (Bangalore.) 12 annas.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1929. Pp. 227+18 plates. (Bristol.)

Queensland. Department of Mines: Queensland Geological Survey. Publication No. 278: The Queensland Upper Palæozoic Succession. By J. H. Reid. Pp. 96. (Brisbane: Anthony James Cumming.)

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1929 to 31st March 1930. Pp. 22+6 plates. (London: H.M. Stationery Office.) 4*s*. 6*d*. net.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, July. Pp. 391-473+xlii. (London.)

Harper Adams Agricultural College, Newport, Shropshire. Advisory Report No, 5: Report of the Advisory Department, 1929-1930. Pp. 32. (Newport.)

Ministry of Agriculture and Fisheries. The National Mark. Second edition. Pp. 11. (London: Ministry of Agriculture and Fisheries.) Free.

FOREIGN.

Annales de l'Institut Henri Poincaré: recueil de Conférences et mémoires de calcul des probabilités et physique théorique. Vol. 1, Fasc. 1. Pp. 74. (Paris: Les Presses universitaires de France.) 35 francs.

Transactions of the San Diego Society of Natural History. Vol. 6, No. 4: Upper Eocene Orbitoid Foraminifera from the Western Santa Ynez Range, California, and their Stratigraphic Significance. By W. P. Woodring. Pp. 145-170+plates 13-17. 50 cents. Vol. 6, No. 5: A new Race of Gilded Flicker from Sonora. By A. J. van Rossem. Pp. 171-172. 10 cents. Vol. 6, No. 6: New Species of Mollusks. By Fred Baker and V. D. P. Spicer. Pp. 173-182+plates 18-19. 25 cents. (San Diego.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 69: Die retrograden periodischen Bahnen um die beiden endlichen Massen im Problème Restreint, mit direkter absoluter Bewegung (Klasse *l*). Von Elis Strömgren. Pp. 31. (København: Bianco Lunos Bogtrykkeri A.-S.)

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1929. By Dr. H. A. Tempany. Pp. ii+19. (Kuala Lumpur.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 93: Some Supplementary Records to Muschler's Manual Flora of Egypt; including many Species collected by Mr. G. W. Murray. By N. Douglas Simpson. Pp. iv+59. 6 P.T. Bulletin No. 94: The Angular Leaf Spot of Cotton in Egypt. By Dr. Tewfik Fahmy. Pp. 5+7 plates. 5 P.T. (Cairo: Government Publications Office.)

Collection des travaux chimiques de Tchécheslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 7, Juillet. Pp. 441-488. (Prague: Regia Societas Scientiarum Bohemica.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 82. The North American Retinellae. By H. Burrington Baker. Pp. 193-219+plates 9-14. 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+plates 15-19. (Philadelphia, Pa.)

Bulletin of the Bingham Oceanographic Collection. Vol. 3, Art. 4: Scientific Results of the Third Oceanographic Expedition of the *Pawnee*, 1927. Teleostean Shore and Shallow-water Fishes from the Bahamas and Turks Islands. By Albert Eide Parr. Pp. 148. (New Haven, Conn.: Peabody Museum of Natural History, Yale University.)