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The Museums Report and National Folk Museums.

IN the concluding paragraphs of Part 1 of the Final Report of the Royal Commission on National Museums and Collections,[1] some outstanding needs in the national museum service are indicated. In the order named there are: an ethnographical museum, a folk museum, an Oriental museum, and a museum of casts. This sequence is not without its significance.

While it may be admitted without question that the Commissioners, in giving first place to the need of an ethnographical museum, have emphasised an almost astounding neglect of opportunity, and what is more, of a duty in an imperial system such as that of Great Britain, they are equally justified in regarding the institution of a folk museum as coming second in importance on the ground of urgency. If it is desirable that a record should be preserved of the daily life of the people in the past—a matter about which there can scarcely be two opinions when once its full significance has been grasped—it is necessary that steps should be taken to give effect to the proposal as soon as possible. Indeed, it is no exaggeration to say that in all probability there is no question upon which the Report of the Commission has touched which calls more insistently for immediate action. Almost day by day it will become more difficult to bring together the material from which such a museum must be formed. The action of the Royal Society of Arts has stimulated public opinion to an interest in the preservation of typical or striking examples of domestic architecture of the humbler sort belonging to the past. But these efforts are limited by a variety of conditions and they are confined to one class of material only. Peasant industries carried on in the cottages and villages of the remoter districts, such as the lace-making and wood-turning of Buckinghamshire, even if artificially stimulated as some have been, are unlikely to survive for very long; articles of obsolescent use will be thrown aside for modern substitutes, and those which have been discarded but preserved by a generation which once used them will be cast out as rubbish when that generation dies out. Recent experience has shown that it is becoming increasingly difficult to find examples of objects which a few years ago were comparatively common in the countryside.

In making its recommendation, the Commission

[1] Royal Commission on National Museums and Galleries. Final Report, Part 1: General Conclusions and Recommendations, dated 20 September 1929. (Cmd. 3401.) Pp. 93. (London: H.M. Stationery Office, 1929.) 2s. net.

has very precisely in mind the type of museum which it would wish to see established. Not only is a museum illustrating the domestic life of the people in the past contemplated; it is also recommended that this should be of the type known as the open-air museum. The report refers to the museums of this kind which have been instituted in Scandinavia and in Holland. These museums, as is well known, consist of a number of typical dwellings of different periods which have been set up in a park, each fitted with the appropriate furniture, utensils, domestic appliances, and objects of peasant art of the period of the dwellings in which they are housed. At present there is nothing of this kind in existence in Britain, and it is recommended that ultimately there should be one each for England, Scotland, Wales, and Ireland, but it is stressed that for the moment the case of England is the most urgent. Herein the Commission does not go beyond the warrant of the facts. Conditions in Scotland, Wales, and Ireland are, and perhaps for some little time will continue to be, more favourable to the preservation of their distinctive peasant culture than they are in England, where local peculiarities are rapidly disappearing before modernising influences, and the population itself is rapidly losing the conservatism which still remains a characteristic of the people in the remoter parts of the rest of Britain.

The Report contemplates a museum which will illustrate the domestic life of the past; but it is clear that such a museum of the folk is capable of an almost indefinite expansion in regard to time, local character, and the nature of the exhibits. To take the last point first. The Commissioners would appear to have had something of the nature of this question in mind when they refer to the advantages of the situation of the open-air museum at Stockholm near the famous 'Northern Museum' which contains "an enormous collection of objects illustrating the history and development of the Swedish people". Now, as it is not probable that our museum will have a similar advantage, this suggests the question: Up to what point can the function of a folk museum be understood to be to illustrate the culture of the people as a whole, or, in other words, where in the social scale must the line of demarcation of 'the folk' be drawn? Does there not come a stage in the time series at which the collections run the risk of being merely of antiquarian interest and of losing much of their educational value as an index of culture if a hard-and-fast line separating the grades of society be laid down? As an example of a practical question that arises, the authorities of the National Museum at Cardiff have included in their folk museum galleries, costumes of the upper classes of the eighteenth century. Their local origin may be held to justify their inclusion there. In a national folk museum in England, their late date alone would determine their exclusion as other collections are available to receive them. Yet when it becomes necessary to adjudicate upon exhibits of an earlier date, which are less generally familiar, provided they are significant of the general level of culture and not of highly specialised character — military, ceremonial, or sumptuary — decision will become increasingly difficult.

An analogous question may arise in connexion with the selection of the buildings it is desired to re-erect to form the museum. Cottages, barns, and the like offer no difficulty, but the church and the manor house were equally an integral part of the life of the countryside, even if not intended for the occupation or sole use of the peasantry. Village crosses, boundary marks, milestones, and the like objects may also, it may be taken, come within the scope of our folk museum.

As regards exhibits distinctively local in character, it may be thought that it is evidently the function of the local museum in the first instance to ensure their preservation. On the other hand, it would be difficult to over-estimate the value to the anthropologist, the historian, and the geographer, of the inclusion of localised series exemplifying, for example, the culture of the Cotswolds, or of the Sussex area with its iron industry of uninterrupted pedigree, extending back to the early days of the working of that metal in England.

In the time series, it may perhaps be found equally difficult to draw the line of demarcation. The end of the Roman occupation affords a convenient starting-point. Yet settled life in Britain does not begin at that date, and if an attempt were made to complete the picture by reconstruction of dwellings and village sites for which there is evidence, there is no logical ground why a further step should not be taken and a lake-village or a hill-fort site, or even mounds and barrows, should not be reproduced.

It may seem that a consideration of these points at this juncture is irrelevant to the recommendation of the Report, which goes no further than to recommend the institution of an open-air museum illustrating the *domestic* life of the people in the past. But the Report has made no attempt to define the scope of such a museum, and it is as well to keep in mind the difficulty of avoiding the expansion of the museum into something much wider than merely

peasant art and industry, cottage utensils, appliances and ornaments, in their appropriate setting of time and space. Both from the educational and the scientific point of view, a museum of the history of our national culture of which the open-air museum formed a part would be the ideal. At present, however, if only on practical grounds and as emphasising the immediate and pressing need, a more restricted conception of the aims of a folk museum must be regarded as holding the field.

One reason, however, why it may be worth while to keep in view the widest interpretation of the folk museum is its relation to the choice of a site. The site should be such as to admit of expansion beyond immediate needs. The Report mentions two possibilities: one, the ground in Regent's Park at present occupied by the Royal Botanic Society, which it is said is to be vacant in 1932; and second, the grounds at Chiswick House, of which the extent is 66 acres. A possibility which has been put forward in the daily press, but is not mentioned in the Report, is the Forest of Dean. As regards the last named, most, we venture to think, will be in agreement with the Report when it says that the site should be in or near London. It is imperative, however suitable the site in other respects, that it should be readily accessible to the largest possible number of students and visitors. As regards space, it should have sufficient acreage to allow for the setting up of a number of peasants' dwelling-houses of various types and periods with gardens when appropriate, say at least ten acres, perhaps even twenty, and provision must be made for administrative offices and the exhibition of smaller objects, amulets, personal ornaments, and the like, which it would not be advisable to exhibit in the dwelling-houses.

It is obvious that such a site will not be easy to find in or near London. At Chiswick House both house and grounds have a marked individuality which does not lend itself to providing an environment adaptable to the character of peasants' cottages, even if the claims of the public under the agreement by which the property has been entrusted to the local authority permitted the cession of a sufficient area of land to the museum. Regent's Park is ideally central in position, and it is doubtful if a better site could be found; but being Crown land in one of London's great open spaces, the suggestion has been criticised on the ground that this land should no longer continue to be enclosed. If, however, the open-air museum were instituted as a part of our national collections and, therefore, open to the public, this objection would lose much of its force. On this aspect of the matter, however, the Report is anything but encouraging. It holds out little hope that the deficiencies to which it directs attention will be met from public funds. Here it again invokes the private benefactor.

An enterprise of the magnitude and importance of an open-air folk museum should undoubtedly be a national concern, but if present financial conditions preclude government action, is there any alternative? The institution of a folk museum is a question of which the urgency has long been apparent. It had been under the consideration of the Council of the Royal Anthropological Institute even before the appointment of the Royal Commission. A committee was formed, which has since been strengthened by the addition of representatives of scientific bodies most actively interested in this matter. A site alternative to those proposed in the Museums Report has been offered to the committee. It possesses many advantages and the price is low. But, clearly, no body of this character could enter upon an undertaking of such magnitude without the assurance of considerable public support, and only in the last resort when all efforts to secure the performance of an obvious public duty by the State had failed.

The Universe.

The Universe Around Us. By Sir James Jeans. Pp. x + 352 + 24 plates. (Cambridge: At the University Press, 1929.) 12*s.* 6*d.* net.

THIS book is an attempt to picture, in language which any intelligent reader can follow, the universe around us, from its greatest to its minutest features. Astronomy has undergone, in the last generation, a peaceful development which is greater than a revolution. It has become universal. The change of base from the solar system to the stars is a greater change than the change from the earth to the sun, and the consequences are not the less momentous because in this case the change has been made without conflict or opposition. That some such change must be taken, at some future time, has been obvious. In the past, guess and forecast have always fallen short of the facts, and in any case they are repugnant to those who value facts and see how the impressive scheme of astronomy has been built up by following the rule of never saying more than we know. But the means of gaining knowledge seemed wholly inadequate to cope with the question. There seemed no hope of getting a trustworthy outline in our time,

or in any other time that we could look forward to. But this is now changed.

The universe, however, must be described not only in terms of stars but also in terms of atoms. It extends like a series of numbers upwards to the very big and downwards to the very little. It extends forwards and backwards in time, as well as in space, and to gigantic as well as to minute intervals of time. We, who have to evolve a picture of this scheme, are literally a mere point, placed somewhere in the middle of it, with literal infinities extending before and after us, beneath us and above us, going out beyond the grasp, or even the intelligible conjecture of sense. Descartes conjectured that God might create the world anew every instant. It would save many difficulties if we could believe. Failing that explanation, we must first invent memory to carry us from instant to instant, and then rationalise its record, and extend it to history and prehistory, and even then, as a geometer would put it, we have only succeeded in drawing a tangent line, whereas our business is with the whole of the curve; and how are we to reach it?

The present book, as Sir James Jeans tells us, had its origin in some broadcast talks. It is an unsatisfactory origin, for the broadcaster, even more than the lecturer, cannot be confronted with what he said last, and is tempted to sharpen his points and exaggerate his emphasis in the effort to 'put it across' in the briefest time, to an unseen, unknown, and very numerous audience. So far as the origin can be traced in the book, it is nothing but a disadvantage, but it amounts to little. The early part of the book is perhaps a little disjointed and breathless. Those who know Jeans's other writings will notice with surprise another feature, an occasional careless phrase. A "celestial pepper pot" is, like the "beautified Ophelia", "an ill phrase, a vile phrase",—so is "opinion is rather in the melting pot". If Sir James Jeans has left these things in his pages, it is only because he could not be bothered to weed them out. That, in fact, is the note of the book, and gives it, in my judgment, some of its impressive force. The many passages of real and spontaneous eloquence in it gain rather than lose from standing side by side with such careless but efficient words. Some of the facts related are fairly familiar to scientific readers, but that could scarcely be avoided if the book is meant for all. The impression left is that of a man who, as we know, has ranged to and fro over the whole of mathematical physics, and has contributed a great deal in different places to the establishment and precision of its ideas, and who now tells us what he thinks of it all, without any catch-penny phrases, without any jokes, as the expression of an intense personal interest, which would be infectious in any case, but is much more so from the knowledge of the competence of the author.

It is worth while to see how it comes that a complete and convincing picture can now be given, answering all the main questions, over an area that seemed a little time ago far too extensive and remote to get any real knowledge of it. Take the scale and extent of the astronomical universe. The material contributed by the great American observatories, especially Mount Wilson, is striking. Nine out of ten of the beautiful plates that illustrate the volume are drawn from that source. Without them, much that is now clear would go unverified. The immense advantages conferred by the great telescopes and the Californian skies are evident.

Material resources, however, are not everything. No one, least of all the astronomers of that great observatory, would make such a claim. The very reason their efforts have been so well directed, and the material they have provided has been so well used, lies in the widespread interest that is felt for these problems in every part of the world, by which, wherever an alert mind was found, it contributed to putting a significant question, and then to threshing out the conclusions from the results that were furnished. Usually this has to be done several times over before people are satisfied. Replace America and Mount Wilson by England and Cambridge, and very much the same is true of the atom. Improved communications of all kinds have enormously increased the speed and efficiency, and cumulative power, of scientific investigation. The outcome as shown in this book is a description which offers answers to almost every physical question we want to put, and one which has been so closely criticised that we cannot believe it can be seriously shaken anywhere.

What, then, is the outcome? The infinitely great and the infinitely little are terms that have been used for a long time, and to speak in the vernacular, 'they didn't cut much ice'. The most remarkable feature of the new cosmogony is that it is queer. At both ends. It is as queer and unintelligible as life and morals have long since been voted, by those who have studied them. Many people have recognised from an early date that the quantum theory was really more disruptive of preconceived ideas than relativity itself. The more we look at it the more inevitable the fact is. We require to

keep two contradictory views in use at once. That does not baffle the theorists, who have brought in matrices, with their two different products as the norm, and reduced it all to calculation. But the price is that we must once and for ever abandon the guidance of our senses; and if this *is* ultimate reality, we do not know what it means, now that we have found it.

Scarcely less bewildering is the view in the cosmic field. We have long since known that the universe presented a spectacle of the degradation of energy. Now that we know, more or less, what the universe is, we see what that statement means. Cosmic rays, derived apparently from the mutual extinction of protons and electrons, are flying in great quantity in all directions. There are some millions of great nebulæ, the nearest so remote that its light takes nearly a million years to reach us. These great nebulæ are gradually collecting from the all-but-void, and each is degenerating into clusters of hundreds of thousands of stars. Each star lives on the extinction of its own matter. The sun, for example, loses four million tons a second ; and out of its year's output, a small fraction of one second represents what we happen to intercept and on which we keep going. The extent of the universe in time and the absence of any significant happening is just as remarkable. What is all this universe for ? Who wound it up ? When ? Why ? Vain questions. The universe did not exist for any of us a hundred years ago, and it will cease to exist in any physical sense even more briefly.

But if these are vain questions, it is far from a vain pursuit to write a book like the present one. Here is the physical outline of the world, and unless our intellect is totally misleading, it cannot be much wrong. Unless we are prepared to assert that it is, everything else must square with this frame. All current beliefs must be overhauled so that they may fit into the picture, and a great many of them, fundamental and otherwise, will suffer severely before the process is complete.

R. A. S.

Discovery and Invention.

A History of Mechanical Inventions. By Prof. A. P. Usher. Pp. xi+401. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1929.) 25*s.* net.

"THE history of the development of the inventive faculty", said Mason in his "Origin of Inventions", "is the history of humanity"; while the term invention, used in its plain logical sense, he added, may be applied not only to mechanical devices but also to the processes of life, languages, fine art, social structures and functions, philosophies, formulæ, creeds and cults, all of which involve over and over again the same activities of mind.

Though applicable to the whole range of human endeavour, by common usage invention is associated in our minds with tools, utensils, appliances, instruments, machines and engines, and we all think of the inventor as one who troubles himself with such things. Even with this restricted significance, the history of invention takes us back to the most remote age and into every corner of the world, and opens up as fascinating a study as can be found anywhere else and one that touches life on every side. Between the fashioning of the most primitive knives, needles, snares, weapons, rafts, and shelters, and our complex machinery, our powerful engines, our instruments of refinement and precision, lies the history of material civilisation.

In spite, however, of the interest and importance of the subject, there are few books dealing with it in a critical or general manner. Certain branches of invention have had their historians, and there are a few biographies of modern inventors and reviews of definite periods, but these do not meet the needs of the ordinary reader. It is with pleasure, therefore, we direct attention to Prof. Usher's series of sketches dealing not only with some of the most notable of mechanical inventions, but also with the place of technology in economic history and with the process of invention itself, a process in which the powers of imagination are fully employed. Dismissing the view that the process of innovation is a phenomenon more mysterious than other phases of our mental life, the author discusses the nature and theory of innovation, distinguishes between discovery and invention, and shows how the development of modern experimental science laid the foundation of our modern technology. Writing of the function of the fore-conscious mind in invention, he says :

The inventor, like the artist, lives on the border land between the normal and the abnormal, and, like artists and prophets, finds in his day-dreams a source of gratification and encouragement at the least, and at times a fruitful source of genuine accomplishment.

The opening chapters are as fresh and stimulating as they are unusual in a book on invention, and it may be presumed that we owe Prof.

Usher's psychological studies to the fact that he writes as a professor of economics and not as a technician.

Of inventions themselves we are given chapters on the mechanical equipment of the pre-Christian era, on water wheels and wind mills, water clocks and other time-keepers, the invention of printing, the textile industries, and the production and application of power. Only one inventor has a chapter to himself, this exception being that remarkably versatile genius, Leonardo da Vinci. Famous as an artist and as constructor, there is certainly no ground for the view that his scientific and mechanical capacities were in any way inferior to his artistic powers.

Right throughout the book emphasis is placed on those inventions which, in Prof. Usher's words, exhibited primary synthesis rather than critical revision, and attention is directed to the innovations which led to notable and fundamental advances. The book is well illustrated; authorities are quoted; there is a valuable bibliography and a satisfactory index. It undoubtedly fills a gap in the list of English works on invention and should be valuable to many classes of readers, and especially to those engaged in teaching economic and industrial history.

Pharmaceutical Products.

(1) *Kraemer's Scientific and Applied Pharmacognosy.* Third edition, thoroughly revised by the following named Editorial Committee: Editor-in-Chief, Dr. Edwin L. Newcomb; Co-Editors, Prof. Leasure K. Darbaker, Prof. Earl B. Fischer, Prof. Edmund N. Gathercoal. Pp. xxxvii + 893. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 37*s.* 6*d.* net.

(2) *Handbook of Pharmacognosy.* By Dr. Otto A. Wall. Revised by Prof. Leo Suppan. Fifth edition. Pp. 472. (London: Henry Kimpton, 1928.) 21*s.* net.

(1) DURING the past few years the study of crude drugs derived from the vegetable and animal kingdoms has attracted an ever-increasing amount of attention, and the interest in this branch of knowledge has shown a remarkable revival. Medicinal plant farms, where the changes effected in the constituents of medicinal plants grown under varying conditions can be studied, have been established in increasing number. In that respect Great Britain has shown a tendency to lag behind, due probably to a lack of that public support which is freely given on the Continent. Striking evidence of the interest taken in this subject abroad is shown by the success attending the conferences recently held in Budapest and in Venice by the international association for the promotion of the production of medicinal plants. The authors of "Kraemer's Pharmacognosy" have every justification for the statement they make in the preface that "pharmacognosy must play an increasingly important part in the future of pharmacy and medicine".

Pharmacognosy now involves so much botany, chemistry, pharmacology, and other sciences, that the decision to entrust the revision of the third edition to an editorial board of four members must be regarded as justified. The general plan of the work has been retained, but about fifteen new monographs have been introduced and the size of the volume increased by about 130 pages. The number of drugs discussed is therefore very large; in fact, it might safely be said that the work contains information upon most drugs of importance.

There are numerous illustrations of varying quality, many being good and some indifferent, while in other cases it is rather difficult to find a reason for their introduction.

Organotherapy, vaccine therapy, serum therapy, and protein therapy have of late made notable additions to the armamentarium of the physician, and of these pharmacognosy must take cognisance. Accordingly, the book contains brief allusions to vaccines, sera, etc., and also an account of the collection of pollen for diagnostic and curative use. Under the heading "Animal Drugs" the editorial board says, "Their study is much neglected by students of pharmacy, and more attention should be given them as they furnish some of the most important drugs used by man". In view of this statement, it is rather remarkable that the only animal drugs discussed in the book are cantharides, cochineal, musk, and civet. One would have expected to find descriptions of the thyroid and pituitary glands, which are official in the U.S. Pharmacopœia, of the suprarenal glands, of the pancreas and others, but nothing beyond a mere mention of them in the course of half a dozen lines is to be found. Nor is there any mention of such animal products as cod-liver oil, spermaceti, beeswax, or woolfat.

Possibly these substances were regarded by the editorial board as outside the scope of pharmacognosy, but it is not easy to ascertain whether this is really the case. On page xlv the following state-

ments are to be found: "Pharmacognosy is essentially the study of organic drugs and allied products"; "In a more restricted sense pharmacognosy embraces the study of medicinal plants and their crude products"; "in short, pharmacognosy deals with the properties, identification, sources, and nature of new materials and their products"; "the ultimate aim of the science of pharmacognosy is to obtain a knowledge of the chemical nature and the properties of all commercial products from their origin in nature to the final changes produced in their manufacture". What, then, *does* the editorial board really understand by pharmacognosy?

A careful examination of the accounts of at least the more important drugs reveals deficiencies and inaccuracies that should not occur in a work of this description. The collection of acacia gum and of benzoin, for example, leaves much to be desired; the constituents of benzoin and of ammoniacum do not correspond with the results of recent investigation; cathartic acid still occurs as one of the three active constituents of senna, and so on. Had the authors been acquainted with the thorough examination of santonica made by Wallis and Mowat, they would probably have modified their account of it, but it is remarkable that reference to an English literary source of information is rarely to be found.

The work is one of the best known and probably one of the best of American text-books of pharmacognosy. It contains abundant information, but it would appear that in preparing the present edition sufficient care was not given to revising the text, correcting inaccuracies, introducing the results of recent researches, and generally bringing the work abreast of the progress of pharmacognosy.

(2) This work was originally written to serve as notes in pharmacognosy for students in colleges of pharmacy, in order to relieve them from the labour of taking notes and leave them free to follow the information and explanations given by the lecturer. It would afford, therefore, a skeleton to be clothed later with muscle by the student himself in the course of his post-graduate study. Such a method of dealing with pharmacognosy is by no means new, and while it appears at the first glance to possess advantages, it suffers from the danger that the student may neglect to provide the muscles for the skeleton and content himself with a collection of dry bones, relying chiefly upon his memory instead of upon his understanding.

As the book has now reached its fifth edition and Prof. Suppan has retained this method of dealing with the subject, it must be assumed that the object in view has been attained and that the student has been provided with and uses a condensed outline of pharmacognosy which he can afterwards amplify as opportunity offers. A student seldom makes satisfactory progress in a subject in which he is not interested, and whether this method of presenting it will attract and interest him and stimulate him to further independent inquiry is to be doubted; probably it will not. The information, though given in a very condensed form, is on the whole fairly accurate. Errors are to be found, as indeed they are to be found in all books, but as a rule they are of minor importance.

Numerous illustrations accompany the text and serve their purpose, although some of them lack artistic finish. It is doubtful whether the book will meet with a ready outlet in Great Britain. It is not suited for class work for English students, and is not sufficiently thorough or detailed to be useful as a work of reference.

A "Handbuch" of Zoology.

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. Band 2: *Vermes Amera, Vermes Polymera, Echiurida, Sipunculida, Priapulida.* Lieferung 1, Teil 1. Pp. 112. 12 gold marks. Lieferung 2, Teil 8. Pp. 112. 12 gold marks. Lieferung 3, Teil 2. Pp. 128. 14 gold marks. Lieferung 4, Teile 3 und 4. Pp. 110+18. 14 gold marks. Lieferung 5, Teil 4. Pp. 19-146. 14 gold marks. Band 4: *Progoneata, Chilopoda, Insecta.* Lieferung 6. Pp. 577-672. 10 gold marks. Lieferung 7. Pp. 673-800. 14 gold marks. Band 6: *Acrania (Cephalochorda), Cyclostoma, Ichthya, Amphibia.* Hälfte 1, Lieferung 1. Pp. 112. 12 gold marks. Band 7: *Sauropsida, Reptilia, Aves.* Hälfte 2, Lieferung 3. Pp. 225-336. 12 gold marks. Lieferung 4. Pp. 337-432. 10 gold marks. (Berlin und Leipzig: Walter de Gruyter und Co., 1928.)

SINCE our last reference to this fine "Handbuch", ten parts—1056 pp.—have reached us, and it may be said at once that they fully maintain the standard of the earlier parts both in text and illustrations.

The second volume on a portion of the Vermes is to consist of nine independent parts, five of which have been published during the last twelve months. In this volume the accounts of the Amera—the

flatworms and roundworms—and the Polymera, that is, the Annelida, including the Echiurida, Sipunculida, and Priapulida, will find a place. The description of the Myzostomida has appeared in the first half of the third volume, and the Oligomera—Phoronis, Bryozoa, Brachiopoda, Chætognatha, Rhabdopleura, Cephalodiscus, and Enteropneusta—are to be considered in the second half of that volume. A brief general introduction to the Amera is given in Bd. 2, Lief. 1, Teil 1, by Dr. E. Reisinger, who, in a paragraph on the phylogeny, derives the Gastrotricha and therewith all Nemathelminthes from the Platyhelminthes, particularly the Rhabdocœl Turbellaria. A definition and short consideration of the morphology, development, and phylogeny of the Platyhelminthes are given by Prof. E. Bresslau and Dr. Reisinger, who set aside the theory of the relationship of Ctenophores and Polyclads. They regard the similarities exhibited by the Platyctenidæ and the Polyclads as due to convergence and they consider the Acœla to be the most primitive flatworms. Prof. Bresslau then proceeds to the detailed description (unfinished) of the anatomy and finer structure of the Turbellaria, the alimentary and nervous systems being well described with the help of many excellent figures, the majority of which are from recent memoirs.

Part 8 of the second section of this volume contains a compact account in 112 pages of the Oligochæta by Prof. W. Michaelsen, who has himself added so greatly to our knowledge of this class. His account of the finer structure of the nervous system is, however, disappointing—it gives no idea of the nature and relations of the neurones, and there is no satisfactory description or figure of the funnel of the nephridium of *Lumbricus*. But for much of the anatomy, and for distribution and ecology, and features used in classification, the account is excellent.

In part 2 of the third section, Prof. Otto Fuhrmann deals with the Trematoda—first with the Monogenea (pp. 29), and then with the Digenea, the account of which is unfinished. The text is supported by 171 well-drawn figures illustrating the anatomy and development of a representative series of examples.

Prof. L. Böhmig, in parts 3 and 4 of the fourth section, gives a good account of the structure, physiology, development, classification, and relationships of Nemertines. A figure showing the anatomy of *Malacobdella* would have been useful here. Following is a brief introduction to the Nemathelminthes, which are defined as including the Nematoda, Nematomorpha, and Acanthocephala, and also the Rotatoria, Gastrotricha, and Echinoderida. Dr. Wesenberg Lund's account of the Rotifera begins in this part and occupies the greater part of part 4 of section 5—altogether 120 pages—and, as would be expected from this author, such aspects of the subject as sexual and seasonal dimorphism, the life-cycle and the duration of life, and ecology receive full consideration. Dr. A. Remane's account (unfinished) of the Gastrotricha follows.

In sections 6 and 7 of the fourth volume is the first part of the account of the insects—the Apterygota and the lower Pterygota—by Dr. A. Handlirsch. Ample space is devoted to external features, dimorphism, larvæ and nymphs, fossil representatives, phylogeny, habits, ecology, distribution, and classification, but much more information might have been given on internal anatomy, and in some cases on physiology; scarcely any reference is made, moreover, to the finer structure (histology).

The account of *Amphioxus* (unfinished) by Dr. V. Pietschmann (Bd. 6, Hälfte 1, Lief. 1) includes an excellent description of the anatomy and histology, especially of the nervous system and sense organs. The account of the development is illustrated almost entirely by Hatschek's figures (with the polar mesoderm cells); it would have been well to include some from later investigators. The description and figures of the metamorphosis are inadequate.

In the seventh volume (Hälfte 2, Lief. 3, 4) Dr. E. Stresemann continues his account of the birds, describing the urinogenital system, sperm and ovum, development, hatching, the nestling and its down, the flight feathers, sexual dimorphism, differences in structure between the two sexes, and gynandromorphs. Beginning with the primary germ cells and their migration into the splanchnopleure, the history of the gonad in the embryo in both sexes is traced, and the seasonal changes of the adult gonads are noted. The section on development is relatively short, the author perhaps considering that, in view of Lillie's masterly volume on the subject, brief treatment was permissible. Nests, eggs, social life, parasitism—the case of the cuckoo and others—receive very adequate consideration, and the majority of the illustrations are from recent works and form an excellent support to the text.

The publishers deserve the support and encouragement of all zoologists for their enterprise in producing this comprehensive and valuable "Handbuch".

Our Bookshelf.

Biological Principles : a Critical Study. By J. H. Woodger. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xii + 498. (London : Kegan Paul and Co. ; New York : Harcourt, Brace and Co., 1929.) 21*s.* net.

No doubt most thoughtful biologists deplore the small number of generalisations which exist in their science compared with the ever-increasing masses of unrelated facts reported by workers in field and laboratory. Evidently some attention to fundamental concepts is required, and Mr. Woodger has made an attempt to survey critically the primary suppositions which are involved in biological thought. His book begins with a discussion of the relations between natural science and philosophy, including a vigorous attack upon phenomenalism. Mr. Woodger is for the most part a follower of Prof. Whitehead and the Cambridge school of logicians. The book then gives an account of the principal antitheses of biology (vitalism-mechanism, structure-function, organism-environment, preformation-epigenesis, teleology-causation, mind-body), mediating between them and mitigating the bitterness of their opposition. Finally, the author ventures on a discussion of the future of biology.

Mr. Woodger's very difficult task has been accomplished so successfully that no biologist who really wishes to face fundamental problems should omit to read it. Yet it suffers from three defects : (*a*) it is unnecessarily long, because unnecessarily polemic, especially against text-book statements ; (*b*) it attributes to physiologists, biochemists, and others with whom the author is not in sympathy, opinions much cruder than those they actually hold ; and (*c*) it is insufficiently constructive. Mr. Woodger tends to destroy without replacing. Thus on p. 315 he says, " It will be necessary to devise ways and means for correcting a purely analytical procedure ", but there the question is left, though most biologists would agree as to the importance of the way the parts are related ; the difficulty is to investigate without destroying. Perhaps Mr. Woodger will some day give us a better, shorter, more constructive book, suggesting methods of research better than those now in use, instead of simply pointing out their deficiencies.

The Soul of Manchester. Edited by Dr. W. H. Brindley. (Published for the Manchester Section of the Society of Chemical Industry.) Pp. xi + 280 + 16 plates. (Manchester : Manchester University Press, 1929.) 6*s.* net.

THIS interesting compilation, finely illustrated, commemorates the meeting of the Manchester Section of the Society of Chemical Industry, held in the city this year, and is very welcome. It is in no sense a guide-book, but a critical valuation of the activities—scientific, literary, educational, industrial, and general—of a centre which has long played a conspicuous part, for good and all, in the evolution of human affairs within and outside its borders. Authorities such as Sir Henry Miers, Prof. A. Lapworth, Prof. C. H. Herford, Sir Michael Sadler, Prof. F. E. Weiss, Prof. C. H. Reilly, Dr. Henry Guppy, and others recount success, failures, and future aspirations.

The attractiveness of citizenship lies, doubtless, in its fundamental diverseness. We would like to be told, in similar vein, of the soul of Liverpool, of Sheffield, Birmingham, Bristol, but realise the civic hardihood involved in such ventures. As for London, she must ever stand alone, mother of our cities, in spirit dominant.

The title of the book is fully met in able articles. These include : " The Story of Education ", " The Face of Manchester ", " Chemistry and Manchester University ", " Manchester and Cotton ", " Social Service ", " Manchester and Recreation ". An informing contribution, " Manchester and its Press ", recalls Alex. Ireland, sometime manager of the defunct *Examiner*, who came to Manchester from Edinburgh, where he had been associated with William and Robert Chambers. He was the only man in the country, we are told, in the secret of the authorship of " The Vestiges of Creation ".

Evolution by Symbiosis. By H. Reinheimer. Pp. viii + 141. (Surbiton : Grevett and Co., Ltd., 1928.) 5*s.* net.

IT is not very easy to deal with Mr. Reinheimer in a short notice ; but at the same time one cannot feel sure that he deserves a longer one. This book is but one of a number which he has written, all telling the same story, namely, " that the standards of virtue and vice in the universe depend upon two antitheses : symbiosis and parasitism ; that it is definitely immoral and ruinous, through the whole of nature, for an organism to be parasitic ; that the degree of virtue is the degree in which an organism co-operates or 'gets on' with the universe, living by helping the rest of creation " (p. 8). " Only austerely constituted organisms can hope to enjoy natural immunity from disease " (p. 23). A carnivore is a " semi-degenerate organism " (p. 44) ; " there is but a difference of degree between carnivorism and parasitism " (p. 45) ; " symbiotic cross-feeders [that is, herbivores] are *ipso facto* in due relation with the world of life and thereby best qualified to enter into fruitful, sympathetic and intelligent social intercourse of the most varied kinds " (p. 56), so long as they do not overdo it and become " plant-assassins " (wasteful and destructive herbivores) like the elephant, which is " a typical acromegalic animal in a state of hopeless senescence verging on extinction " (p. 109).

Mr. Reinheimer has produced a great bulk of argument in favour of his views, and it must be admitted that some of his ideas are clearly important, whilst others are at least interesting ; for example, a study of animal nutrition is obviously a necessary part of any comprehensive study of evolution. But Mr. Reinheimer spoils his own case by being peevish with biologists who do not accept his views. " Orthodox biology is written, as I have often said, to suit the perverted digestion of modern society " (p. 51). He has a favourite phrase, " as

I have often shown " ; our objection is that he has *not* shown ; we should be more grateful to him for a single piece of detailed original research bearing on the question of evolution, such as Heslop Harrison's work on the inheritance of melanic varieties in certain Lepidoptera, than for any amount of argument.

Researches in Polynesia and Melanesia ; an Account of Investigations in Samoa, Tonga, the Ellice Group, and the Hebrides, in 1924, 1925. By Patrick A. Buxton. Parts 5-7 (relating to Human Diseases and Welfare). (Memoir Series, No. 2.) Pp. xi + 139 + 27 plates. (London : London School of Hygiene and Tropical Diseases, 1928.) 9*s*.

FEW problems of tropical medicine are more complex than that of the pathology of filariasis ; it is one which for elucidation will require extensive research, carefully planned and properly standardised. Dr. Buxton's contribution to the problem forms Part 5 of the account of the investigations in Polynesia and Melanesia undertaken by the expedition sent out by the London School of Tropical Medicine. It bears the stamp of strictly scientific medical research. The methods and technique adopted are described in minute detail ; statistics are complete and precise ; a well-reasoned commentary concludes the account, and numerous references and cross-references enable the reader to verify readily the evidence on which the author's deductions are based. Considering the conditions under which research work in Oceania is carried out, Dr. Buxton is to be congratulated on the complete and exact nature of this record.

The study in filariasis forms the principal part of the book. Parts 6 and 7 are devoted to a consideration of other human diseases in Oceania, and the effect of European culture on the Samoan. The text is illustrated by a series of excellent photographs.

The Mind of the Savage. By Raoul Allier. Translated by Fred Rothwell. Pp. xiv + 301. (London : G. Bell and Sons, Ltd., 1929.) 15*s*. net.

THIS is the translation of a book which appeared first in 1927 under the title " Le non-civilisé et nous ". The author, during a long life devoted to the study of Protestant theology in the University of Paris, has been closely associated with missionary work, especially in Madagascar. His study of the psychology and sociology of primitive peoples, which has proceeded concurrently with his activity in the administration of missions, has therefore had a strong practical bias throughout, which appears, as the original title shows, in this exposition of his conception of primitive mentality. The main line of his argument is aimed at demonstrating the disastrous and paralysing effect of the belief in magic in all departments of primitive life and activity. One point he brings out of which perhaps too little has been made hitherto, and that is that magic involves not so much the association of ideas as the association of emotions. He ranges himself with Lévy Bruhl and other French psychologists as against the English school. To some at least of the latter school his conclusions will appear too abstract and ' to smell of the lamp '. In other words, his view of the function of magic is external and ignores recent work which has studied it as an integral element functioning in a given social environment. The concluding chapters are practical in their bearing and deal with " A New Philosophy of Colonisation " and the rôle of Christian missions.

Trout Fisheries : their Care and Preservation. By J. C. Mottram. Pp. 186. (London : Herbert Jenkins, Ltd., 1928.) 10*s*. 6*d*. net.

To have the fortune to own or lease trout streams of the first order is the lot of few, and reading Mr. Mottram's book causes one to wish for some such water on which to experiment. Certainly, those who have this good fortune should not fail to study this work, which contains much practical advice ; it should also be in the hands of those who control the many associations which maintain the fisheries of the streams and lakes with which the British Isles abound.

Of special interest is the chapter on trout disease and restocking, in which the author directs attention to recent research on the causes of outbreaks of disease in large populations and the dangers of introducing healthy stock into populations which have already passed through an epidemic, thus incurring the risk of starting the disease afresh owing to the weak resistance of the new blood. The dangers of introducing possible carriers of furunculosis are also stressed, a subject the study of which has recently been taken up by a joint committee under the auspices of the Fishery Board for Scotland, the Ministry of Agriculture and Fisheries, and the Kennet Valley Fisheries Association,

The book is very clearly printed with large type and makes pleasant reading. The insertion of photographs to supplement some of the line diagrams would perhaps have been an improvement.

Medical Adventure : some Experiences of a General Practitioner. By Dr. Ernest Ward. Pp. xii + 291. (London : John Bale, Sons and Danielsson, Ltd., 1929.) 8*s*. 6*d*. net.

THE enjoyment with which many readers of the *London Hospital Gazette* have perused Dr. Ernest Ward's articles will be shared by all who read his book " Medical Adventure ". Written with a literary ability rarely found in medical men, every chapter reveals the author's powers of observing and recording, and, when in lighter vein, his keen sense of humour. His accounts of difficult and amusing situations, of cases common and uncommon, of successes and failures, give a really unique description of a general practitioner's work. His reflections on many problems are most instructive, but are offered with unassuming modesty. To the young practitioner especially this book will prove of great value ; from it he will learn lessons as readily as if he had himself experienced Dr. Ward's adventures.

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.*]

Severe Environmental Mortality among *Abra* (=*Syndosmya*) *alba*, *Donax vittatus*, and other Organisms off the Lancashire Coast.

WHILST walking along the Birkdale sands from Ainsdale to Southport on the Lancashire coast on Nov. 3, I noticed that immense numbers of small molluscs had recently been washed ashore, and as definite observations on environmental mortality are important in connexion with the adaptations of a species to its environment, such occurrences are worthy of record.

The spring tide had begun to ebb as I set out to walk from Ainsdale to Southport along the high-water mark at midday, and my attention was at once attracted by large numbers of tubes of *Pectinaria* and *Lanice* (=*Terebella*) and shells of *Abra alba* (=*Syndosmya*) Wood. The tubes of *Pectinaria* were empty, while those of *Lanice* constituted only the upper portion and, though obviously fresh, like those of *Pectinaria*, were also empty. These tubes occurred along the whole stretch of the sands examined, either in rows or piles, at and near the high-water mark, and the mortality in *Pectinaria* may be estimated to have been of the order calculated for *Abra* below. Probably no or little mortality occurred in *Lanice* owing to the habit of this animal of retreating down its deeply embedded tube at a rapid rate when disturbed. *Pectinaria*, having a cone-shaped tube, cannot retreat in this way and must perforce become exposed when its tube is washed out of the substratum.

Shells of *Abra* were also distributed along the whole of the region of the high-water line from Ainsdale to Southport, either in heaps in stream-lines or in crowded rows along the high-water mark or scattered over a strip of high-water wash-mark varying from about 5 to 10 yards mostly, according to the contour of the high-water region. The shells were entire and fresh, and on the return journey from Southport to Ainsdale it was estimated that from 25 to 50 per cent of them contained either living or recently dead tissue. A sample of the shells with soft parts remaining was examined in the laboratory on the same and following days, when living tissues were found. Living Trematode larvæ were also found in seven or eight individuals out of about 12 or 13 examined, one individual being heavily infected. There can be no doubt, therefore, that the *Abra* as well as the *Pectinaria* and *Lanice* had been washed ashore during a few recent (and spring) tides.

An attempt was made to estimate the number of *Abra* present on the strip of shore examined. In representative areas where the shells were scattered thinly, two counts in about a square foot gave about one in 10 sq. inches. In thicker collections at a typical place at the higher water-line there were about three per 10 sq. inches. In still thicker concentrations of common occurrence there were 20 in 10 sq. inches, and in a typical stream-line collection, of which there were abundance, 25 occurred in 10 sq. inches. Still thicker concentrations occurred where heaps of *Abra*, *Pectinaria*, and *Lanice* occurred to a depth of one to two inches or possibly deeper, but sometimes these heavier concentrations coincided with a sparsely besprinkled high-water zone. On the minimum estimate of a thickness of 14 *Abra* per square foot for a width of only $7\frac{1}{2}$ yards along the high-tide zone from Ainsdale to Southport (fully three miles were carefully examined), it is easy to estimate that approximately 5 million individuals had been recently washed ashore on this strip of coast. But as shells were also found lower down in the tidal zone, and fishes, gulls, and other animals had in all probability fed on them, in addition to the thicker concentrations observed, it is probable that a more likely minimum estimation of the loss would be of the order of 10 million.

While counting the *Abra* it was observed that countless numbers of the spat of *Donax vittatus* (for the identification of which I am greatly indebted to my friend, Mr. R. Winckworth) occurred also along the high-water line, especially in stranded waves of froth. These also occurred with few exceptions along the greater part of the three miles of shore examined. At some points the spat were scattered over the high-water zone, but close observation was required to detect them, as their size ranged from only about 3 mm. to 4·3 mm. No attempt was made to estimate numbers in the heaped-up masses, but 58 were picked up on a halfpenny where they were lying about one deep. In many places masses of them could be picked up in one's fingers. The loss of the spat of *Donax vittatus* may therefore be estimated conservatively as ten times greater than that of *Abra*, and therefore of the order of 100 million on this strip of coast.

As some food-fishes, for example, plaice, devour *Abra*, *Donax*, and *Pectinaria* (see the work of Todd, Petersen, Ford, Ray, and others), the mortality observed represents perhaps a not unimportant loss of potential fish-food, and demonstrates in the case of *Donax* the manner in which the whole spatfall may fail in certain years even after the critical post-larval stage is overcome.

It seems probable that the mortality was due in this case to a certain wave-action set up by a combination of strong inshore winds coincident with spring tides, whereby is produced a strong ground-swell which washes out all organisms in the surface layers of the sandy or muddy sea-bottom. It would appear that this section of the coast is peculiarly liable to disturbance of this kind, as Chaster records immense quantities of the relatively large spiny cockle (*Cardium echinatum*) thrown up alive on the same beach in January 1891 (*Southport Soc. Nat. Hist.*, i. 1892).

J. H. ORTON.

The University,
Liverpool, Nov. 23.

Mechanism in Nerve Centres.

MACCURDY, in his stimulating book, "Common Principles in Psychology and Physiology", has assailed the mechanistic interpretation of reflex function as incompatible with known facts. He concedes that the nerve impulse, as exhibited in the peripheral nerve fibre, may be explicable on a physical basis, but he insists that as soon as we encounter the function of the nerve centre, even as exemplified in the simplest reflex arc, we are forced to recognise the presence of something quite apart from any physical mechanism. He contends that the nerve centre does not merely conduct impulses (as does the nerve fibre) but produces them. MacCurdy further objects to the assumption of physical mechanism in the nerve centre on three specific grounds; namely, a machine "cannot change itself or its functions to meet new conditions; it does not improve its performance with practice; it cannot perform some particular function depending originally on one part, after that part is destroyed".

Much has been written on the differences between conduction in the peripheral nerve fibre and in the

reflex arc which involves the grey matter of the spinal cord or brain (Sherrington, 1906; Forbes, 1929). The most salient differences are those of modification and variability; modification in that the end effect in the reflex corresponds less closely to the initiating stimulus than is the case with the direct excitation of peripheral nerve, for example, when the reflex response is characterised by prolonged after-discharge or by inhibition; variability in that the character of the reflex response is more dependent on blood supply and oxygen, and more subject to change under the influence of drugs or poisons. Yet in the case of both reflex arc and peripheral nerve, the ability to yield a functional response to an external stimulus depends on the existence of an unbroken conducting path of excitable protoplasm.

It is not clear to the physiologist why, if the principle of mechanism be admitted in the case of the nerve fibre, it should be denied the more delicate, but no less material structures in the nerve centre where the fibres branch and form an intricate network of intermingling ramifications.

Let us consider the several objections to a physical interpretation of reflex function. First, the contention that a physical mechanism cannot produce impulses may be answered in various ways. A telephone system may be likened to the nervous system, the inert wires resembling the peripheral nerve fibres, and the central exchange corresponding to the nerve centre. The switching of the incoming call to the proper line has until recently required a conscious operator, but now this function is performed by machine switching (widely used in America), an intricate mechanism without consciousness. A simpler case, and one perhaps resembling more closely the mechanism in the nervous system, would be a junctional point where fire, approaching along a train of gunpowder, initiates several fires in branching trains of powder. There would be no essential difference between the simple train and the branching train of powder, except in the mere fact of branching. The extensive spread of reflex effects evoked by stimulation of a single sensory nerve need not demand any more vitalistic explanation than such a branching of the conducting paths. Even the spontaneous initiation of impulses by the respiratory centre has a physical counterpart in the spontaneous, rhythmic disturbance on the surface of an iron wire immersed in nitric acid, described by Lillie (1928).

The second point is the contention that a machine cannot change its function to meet new conditions. This is met by reference to the toy beetle which walks to the edge of a table and, finding itself unable to go farther in that direction without falling off, turns and continues its exploration on another course. A more practical, if less spectacular, example is found in the stabiliser of an aeroplane, which automatically causes the plane to resume level flight when its course has been altered by a gust or 'air pocket'.

The contention that a machine cannot improve its performance with practice is at once refuted by the familiar fact that a new automobile improves in the performance of its function during the first 500 miles travelled.

As to the last contention, relating to the replacement of damaged parts, an ingenious mechanic might devise a number of ways in which a machine could be made to change automatically from one mode of operation to another in consequence of the failure of some of its parts; for example, a steam pipe might be provided with an automatic valve which, if the pipe burst, would divert the steam through another pipe. Electrical devices which perform essentially this function are actually in use in electric railways.

Hull and Baernstein (1929) have described a mechanism made of polarisable cells and thermal regulators, which imitates a dozen different functions characteristic of the central nervous system. Indeed, if we grant to the evolutionary process in Nature but a small fraction of the ingenuity proved by the demonstrable facts of anatomical arrangement, we shall grant ample possibilities for the use of physical method in the attainment of reflex function.

The attempt to find a point at which the activity of the nervous system breaks away from physical law is due to the desire for a solution of the conflict between determinism, toward which physiology tends, and free will, which the testimony of our subjective experience leads us to accept. Any attempt to escape from the dilemma by postulating a non-physical function in the synapse or reflex junctional point, is temporising and inadequate as a solution of the central riddle of philosophy; the postulate is arbitrary and, as is shown above, is not at all demanded by the nature of reflex function. Indeed, there is no good reason to suppose that the function of any part of the nervous system, viewed as a series of physical events, should be assumed to depart in any way from physical law (cf. Forbes, 1929). That which defies physical understanding is the arrangement and integration whereby the physical events become the vehicle of those elements in subjective life to which physical interpretation in itself offers no clue.

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The Energetic Efficiency of Photosynthesis.

IN a recent paper (*Proc. Roy. Soc.*, B, **105**, p. 1) G. E. Briggs discusses critically the determination of the radiant energy which is actually absorbed by the chloroplast pigments of the living cell. He considers that my own researches (*Ann. de Physiol.*, t. 1, p. 47; 1925) upon this subject do not provide accurate data for the determination of the relative efficiency in different parts of the visible spectrum, and that for three reasons:

(1) Because the filters used transmitted an undetermined amount of infra-red radiation.

(2) Because the calculation of energy absorbed lacks a satisfactory basis.

(3) Because the efficiency may have been limited by the rate of supply of carbon dioxide.

In a later work (*Jour. de Physique*, t. 7, p. 33; 1926), which would seem to have escaped Dr. Briggs's attention, upon this subject, I have shown that these objections are unfounded. In this research the following points were established:

(1) When the layer of water before the filter was largely increased (to 50 cm. instead of 4 cm.) in order to limit the amount of infra-red radiation, the efficiency is only very slightly altered.

(2) It is possible to calculate exactly the fraction of the radiant energy actually absorbed by a thin thallus of *Ulva*. The expression for the absorbing power deduced theoretically by Langevin and experimentally verified by me, for a thin layer of material which absorbs a part of the radiation and diffuses another part, is

$$a = \frac{2}{1 + \sqrt{1 + \frac{K'}{K}} \coth \frac{\mu l}{2}}, \quad . \quad . \quad (1)$$

where K is the absorption coefficient and K' the

diffusion coefficient of the material, $\mu = \sqrt{K(K+K')}$, and l is the thickness of the layer. This expression, for the case of *Ulva*, as appears on developing it in series, gives values agreeing within two per cent with those calculated from the relation

$$a = 1 - \frac{\left(\frac{I_1}{I_0}\right)_v}{\left(\frac{I_1}{I_0}\right)_d}, \quad . \quad . \quad . \quad (2)$$

where $(I_1/I_0)_v$ is the transmission ratio by the green thallus, $(I_1/I_0)_d$ the same ratio for the decolorised thallus, I_0 being the incident intensity, I_1 the transmitted intensity.

Incidentally, it is to be noted that owing to the thinness of the *Ulva* used in my experiments $(I_1/I_0)_d$ is nearly unity ; hence the expression

$$a = \left[1 - \left(\frac{I_1}{I_0}\right)v\right]\left[1 - \frac{\log\left(\frac{I_0}{I_1}\right)_d}{\log\left(\frac{I_0}{I_1}\right)_v}\right] \quad . \quad (3)$$

deduced on the assumption that the living cell behaves as a homogeneous mixture of two substances which both absorb the light, gives a value not very different from the value calculated from equation (2). It is easy to show that the discrepancy in the most unfavourable conditions, when the *Ulva* is not very thin, attains ten per cent, and the discrepancy of the ratio of absorbing powers for two regions (red and green) of the spectrum four per cent.

The formulæ do not agree in the case of a green leaf. The essential reason for their agreement in the case of *Ulva* is the thinness of the thallus, but the values of the average absorbing power in different spectral regions also serve to reduce the discrepancies.

(3) The intensity of the radiation in my experiments was very low, nearly 10^{-3} cal./min. cm.^{2}. The carbon dioxide content of the sea water was nearly 10^{-5} mol per litre ; and, in so far as it is permissible to compare *Ulva* and *Chlorella*, it results from Warburg's work that at this concentration of carbon dioxide, the rate of supply of carbon dioxide does not limit the rate of photosynthesis. As appears from the published data, the concentration of carbon dioxide remaining after irradiation was either the same (respiration exactly compensating for assimilation) or decreased to a minute extent.

In conclusion, it will be apparent from what has been said that Briggs's criticism of my experiments is completely unjustified. With regard to the theoretical discussion of the photochemistry of photosynthesis, I agree with Briggs. I have myself already suggested that a number of quanta varying with the frequency of radiation may be acting in photosynthesis. On the assumption that the energy to be furnished by radiation in order to break down a molecule of carbon dioxide is equal to the heat of the reaction $CO_2 + H_2O = O_2 + \frac{1}{6}C_6H_{12}O_6$, two quanta are exactly sufficient when the wave-length is 500 $m\mu$. With shorter wave-lengths the efficiency would be smaller, because some fraction of the absorbed energy would be wasted. With larger wave-lengths the efficiency would also be diminished because the absorption of three quanta would be necessary, and some fraction of the absorbed energy would also be wasted. Direct experiments to test the theory are unfortunately not easy, since the accuracy required is very high with respect to the present state of the technique, and, above all, on account of the living nature of the material.

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A Phenomenon of the Oscillating Arc.

SINCE the experiments of the late Mr. Duddell, at the beginning of this century, it has been well known that a carbon arc fed from a direct current circuit, and with a condenser and inductance in shunt, will oscillate at a frequency which is determined chiefly by the product of the inductance into the capacity of the condenser. Much work has been done, especially in Germany, on the conditions producing these oscillations, but it does not appear to have been noticed that such an arc will oscillate violently when the shunt circuit *contains no inductance whatever*.

Experiments which we have made recently show this phenomenon to take place whether a carbon arc is used in air or a Poulsen arc in coal gas. The frequency of the oscillation (for given capacity and supply voltage) is determined by the resistance in series on the direct current side, just as in the well-known example of a neon lamp. The following table gives particulars of a series of experiments made with an open arc between solid carbons.

OSCILLATIONS WITH CONDENSER ONLY ACROSS THE ARC.

Direct feed current in amperes (mean) .	1·6	1·9	2·15	3·0	3·1	5·6
High frequency current in amperes R.M.S. .	8·6	9·4	10·7	15·0	15	22
Arc volts R.M.S. . .	65	60	65	55	50	50
Resistance volts . .	190	192	185	175	180	180
Feed volts . . .	250	250	250	225	225	220
Capacity in μF. . .	5	5	5	20	40	40
Feed resistance in ohms	119	101	86	58	58	32
H.f./d.c. . . .	5·37	4·95	4·98	5·0	4·84	3·92
Frequency . .	1890	2280	2520	1800	940	1080

The very large ratio of the r.m.s. high frequency current to the d.c. feed is particularly interesting. Oscillograms taken of these discharges show the comparatively small current charging the condenser through a comparatively long period, the conductance of the arc gap meanwhile gradually increasing and the pressure rising, until breakdown of the arc gap occurs. The discharge which follows this is very large and very rapid ; so rapid, in fact, that it is difficult to get an oscillograph the natural period and damping of which will record faithfully the occurrence.

As an instance of such observations on an arc 1 mm. long, the current charging a condenser of 216 μF. through a feed resistance of 31·6 ohms, and with a d.c. p.d. of 215 volts, averaged 1·76 amperes, lasting for 40×10^{-4} seconds. The maximum discharge current was 126 amperes, and the time of discharge about 5×10^{-4} seconds.

Besides their scientific interest, these experiments are of practical importance to engineers, inasmuch as they show how a cable on any system (which has considerable capacity and little inductance) may cause violent disruptive effects if the insulation gives way at any point.

WILLIAM CRAMP.
A. P. JARVIS.

The University, Edgbaston,
Birmingham, Nov. 18.

The Tides of the Upper Atmosphere and the Heights of Meteors.

IN NATURE of April 27, 1929 (vol. 123, p. 642), it has been mentioned that an examination of the two maxima of the frequency curve of the heights of the bases of the aurora led to the conclusion that at 70° latitude the mass of air situated above 100 km. over the ground at ebb-tide is equal to the mass of air situated above 106 km. at flood-tide.

Since then an attempt has been made to investigate the same subject by considering the heights of meteors. The material used is due to the Danish private

astronomer Torvald Køhl (*Oversigt over det Kgl. Danske Vidensk. Selsk.'s Forh.*), and it consists of 142 measurements of the lowest observed points of meteors (*limes inferior*). The material, obtained in latitude 56° N. during the years 1875–1917, is very accurate, the mean error of the heights being less than 1 km.

The mean height of the *limes inferior* depends on the mass of air above this limit. Therefore, if the tides of the upper atmosphere have no phase-difference in relation to the tidal forces (which is nearly the case at ground level), the mean height of the lower limits may be expected to vary in the following manner :

$$h = h_0 + l \cos 2t$$

where h_0 is the mean height and l the amplitude of a variation depending on the moon's hour-angle (t). The material has been divided arbitrarily into two parts, and then each of these parts is divided in accordance with the moon's hour-angle, namely :

(1) flood-tide : $-30° < t < 30°$ and $150° < t < 210°$;
(2) $+0$: $30° < t < 45°$, $135° < t < 150°$, $210° < t < 225°$ and $315° < t < 330°$;
(3) -0 : $45° < t < 60°$, $120° < t < 135°$, $225° < t < 240°$ and $300° < t < 315°$;
(4) ebb-tide : $60° < t < 120°$ and $240° < t < 300°$.

The following table gives the mean values of h in kilometres :

Years.	Flood-tide.	+0	−0	Ebb-tide.
1875–1902	87·7	90·6	81·0	79·9
1904–1917	92·7	88·6	78·8	82·8
Whole period	89·3	89·4	79·6	81·6

From these values are found : $h_0 = 85{\cdot}0 \pm 1{\cdot}2$ km. ; $l = 5{\cdot}5 \pm 1{\cdot}9$ km., thus :

$$h = 85{\cdot}0 + 5{\cdot}5 \cos 2t \text{(km.)}.$$

Assuming from theory that, on an average, the meteors will be extinguished when they have passed through the same mass of air, the expression for h shows that the mass of air situated above 90·5 km. at flood-tide should be equal to the mass of air situated above 79·5 km. at ebb-tide. The corresponding values formerly found by the investigation concerning the aurora were 106 km. and 100 km., respectively. Taking into consideration that the former phenomenon is observed in latitude 56° and refers to heights about 85 km. above the ground, while the latter phenomenon is observed in latitude 70° and refers to heights about 103 km., a fair agreement between the two results will be found.

A further examination of other and if possible more numerous observations of lower limits of the meteors would be of importance for the investigation of the tides of the upper atmosphere. J. EGEDAL.

Geofysisk Afdeling,
Meteorologisk Institut,
Köbenhavn, Nov. 2.

The Oxidation of Acetaldehyde by Oxygen.

IN the course of experiments which have been carried out during the last two years on the photochemical oxidation of acetaldehyde, an observation has been made which does not seem to be recorded in the literature. It has been found that when pure liquid acetaldehyde is shaken at ordinary temperature with oxygen in daylight or in the dark, a rapid absorption of gas occurs and a peroxide is formed. 2 c.c. of liquid aldehyde, shaken for one minute with oxygen, absorb more than 1 c.c. of gas, and on adding the liquid to a solution of potassium iodide, iodine is liberated equivalent to about 8 c.c. of n/100 thiosulphate solution.

The formation of peroxides under these conditions from other aldehydes has long been known, and Bäckström (*Medd. K. Ventenskapsakad.* Nobel-Inst. 6, No. 16) has recently investigated the chain mechanism of peroxide (benzoperacid) formation in the case of benzaldehyde. Bäckström assumed that the photochemical rate of peroxide formation is proportional to the light intensity. Mr. Chatwin, working in this laboratory, has shown that the rate of benzoperacid formation is more nearly proportional to the square root of the light intensity.

We have obtained similar results for acetperacid formation when gaseous acetaldehyde and oxygen are exposed to ultra-violet light. The reaction rate is high, indicating a long chain mechanism, and is approximately proportional to the square root of the light intensity, proportional to the aldehyde concentration, and independent of the oxygen concentration. These facts can only be explained by a mechanism of the following type :

$$1.\ A + h\nu \longrightarrow A^+$$
$$2.\ A^+ + O_2 \longrightarrow AO_2^+$$
$$3.\ AO_2^+ + A \longrightarrow A^+ + AO_2$$
$$4.\ 2AO_2^+ \longrightarrow ?$$

That is to say, the chain mechanism given by reactions 2 and 3 must be assumed to be terminated by the reaction 4 to explain the observed kinetics. This otherwise improbable mechanism is rendered possible by the great length of the reaction chains.

We are now carrying out experiments on the oxidation of acetaldehyde in solutions, and full details of all the measurements will be published when further results are obtained. E. J. BOWEN.
E. L. TIETZ.

Physical Chemistry Laboratory,
Balliol and Trinity Colleges,
Oxford.

New Phenomena in a Sounding Dust Tube.

I HAVE found the clear photographs of the antinodal ring of dust in a Kundt's tube which were published in NATURE on Nov. 9, p. 724, by Prof. Andrade and Mr. Lewer of special interest inasmuch as, while using a rod excited tube and *Kieselsäure* powder, I observed (*Phil. Mag.*, vol. 7, p. 523, March 1929) an antinodal cloud and stated that " the antinodes are marked almost as definitely as the nodes ". As the dust was photographed when the note had ceased, a photograph as detailed as that of Prof. Andrade and Mr. Lewer was not obtained, although a ring-like grouping at the antinode is clearly suggested in Fig. 7 (c′) (l.c.).

I have observed that the striæ tend to lean over towards the nearest antinode and, in the photograph published in NATURE, it may be seen that this tendency is marked to a minor degree. Also in my paper I pointed out that the figures depend largely on the powder used, and it would be of interest if, in their fuller account, Prof. Andrade and Mr. Lewer state the material they employed and the diameter of their tube.

Like Crofutt (*J.O.S.A. and R.S.I.*, **14**, p. 431, May 1927) I have used a valve oscillator to obtain striæ, and I was—before my experiments had to be temporarily suspended some months ago—photographing the figures kinematographically. The results of this investigation I hope to publish in due course. and, in the meantime, I look forward with interest to the contribution Prof. Andrade and Mr. Lewer have promised to make to this fascinating subject.

ERIC J. IRONS.

Department of Physics,
East London College, London, E.1,
Nov. 19.

'R 101.'

By Prof. R. V. SOUTHWELL, F.R.S.

AT dawn on Saturday, Oct. 12, 'R 101' was taken from her shed at Cardington and brought, without difficulty or delay, to her anchorage at the mooring mast. The week-end was devoted to tests of her engines and ballasting equipment; but on Monday, Oct. 14, with fifty-two people on board, she left the mast and cruised for about 5½ hours over the home counties and London. Such tests and measurements as could be made during the flight indicated that the airship fulfils in every way her designers' expectations; with three engines running at cruising power, an average air speed of about 58 miles an hour was maintained.

On Friday, Oct. 18, a second flight was made. Air speeds well in excess of 60 m.p.h. were attained, and again the manœuvre of 'coming to the mast' presented no difficulty, although it took longer on this occasion, because the airship was found, on nearing ground level, to have an unexpectedly high 'lift' (or buoyancy). Between her first and second flights 'R 101' had been subjected at the mast to winds of considerable strength and variability, accompanied by sudden changes of temperature: her behaviour gave no grounds for anxiety, and seems to justify (so far as it goes) the preference which the Aeronautical Research Committee has expressed for this scheme of mooring in comparison with others that have been proposed. As I write, 'R 101' lies again in her shed, having left the mast to make room for the Burney airship 'R 100', due to arrive from Howden.

So for the first time since 1921, when failure of a girder resulted in the total loss of 'R 38', an airship designed and constructed in Great Britain has been seen in flight. Naturally 'R 101' has aroused great interest, and the merit of her initial achievements has been admitted even by journals which, a month ago, were fulminating at once against the mistakes of her design and the impenetrable secrecy by which those designs had been surrounded. Optimism is once more in the ascendant, and sanguine predictions are being made regarding 'R 101', 'R 100', and their successors.

The danger of such optimism is that, being a plant of very rapid growth, it is liable to wilt in the chill of even a temporary set-back; therefore I cannot feel that true service is rendered to the cause of airships by suggestions that all their difficulties have been overcome. The *Times* (which almost alone among our daily papers has maintained a rational and consistent attitude towards 'this airship business') put the matter clearly in a sentence of its leader of Oct. 15: "After all, R 101 is admittedly experimental". Four years ago I stressed the same aspect in an evening discourse to the British Association[1]: "I wish that the public could be induced to see this airship construction as a great adventure: the goal, ability to fly to India, in comfort and without change, in the space of 100 hours; the problem, to design and construct a ship of vast capacity, with little help from past experience, by sheer hard thinking and hard work." Then I was pleading for (what has not been accorded) suspense of judgment on the new designs until their problems should have been worked out. Now, when 'R 101's' designers are receiving the plaudits they so richly deserve, it is still the aspect of adventure that I should wish to stress; but now for the reason that, counting too confidently on success, we may slacken in determination to surmount the difficulties that remain.

In 1925, only main outlines had been decided in the design of 'R 101'. I shall try to state briefly, first in what respects I consider that the anticipations of those days have been realised, and afterwards, in what respects the available evidence seems to me to be either negative or incomplete. I need scarcely add that my views carry no weight of authority, and are based on no exclusive information; my contact with 'R 101' has been solely in relation to technical problems of stress calculation, except in so far as I have been permitted by the kindness of the staff at Cardington to watch the progress of their work.

In my discourse to the British Association I ventured to defend the policy of the Air Ministry which, after four years' stagnation in airship construction, was then embarking on the adventure of ships just twice as large as any that had been built previously. I had been speaking of the "dimensional handicap"—equally ruthless in its pressure on birds and aeroplanes—which "makes our problem harder when we go to greater size", and I had said: "I do not say that we have yet reached a limit in respect of size of aeroplanes: new materials, new principles of construction and, above all, new types of engine may relieve the pressure of the laws which I have been discussing. All that I am concerned to show is that this pressure will be merely 'postponed'". But, as I went on to show, the airship, which relies for its 'lift' upon its buoyancy, "experiences a relatively insignificant dimensional handicap in the stresses which it has to sustain. . . . By doubling every dimension, we obtain an airship which will carry eight times as much load, and can withstand winds of the same strength as before." Its parallel in Nature (according to my argument) is to be found, not in the bird, but in the whale.

I urged, further, that a certain advantage can in fact be expected to accrue from increased size. "Suppose that we took an existing airship (R 33, say) and decreased every dimension by two. According to dimensional theory it could still fly and it would have adequate strength, but in reality its construction would have become impossibly flimsy. . . . Conversely, by increasing the size, and employing material of stouter gauge, we lessen the importance of corrosion, . . . we render possible methods of construction which were not practicable

[1] Brit. Assoc. Reprint No. 19.

before, . . . and we lessen the chance of accidental damage." I think it may be said, speaking generally, that these contentions have been sustained. 'R 101' is robust; the scantlings of her steel girders are such that full advantage could be taken of experience gained in the construction of metal spars for aeroplanes; and simple joints could be provided by which the ship was assembled rapidly, as though from the elements of a vast 'Meccano' set. What this means in simplicity of construction can be realised from Fig. 1, in which two typical joints are compared,—one from 'R 101', the other of 'Zeppelin' construction, and both fulfilling almost exactly the same purpose. The 'Zeppelin' joint involves a large amount of hand riveting *in situ*: in 'R 101', finished members are assembled by a mere insertion of bolts and nuts.

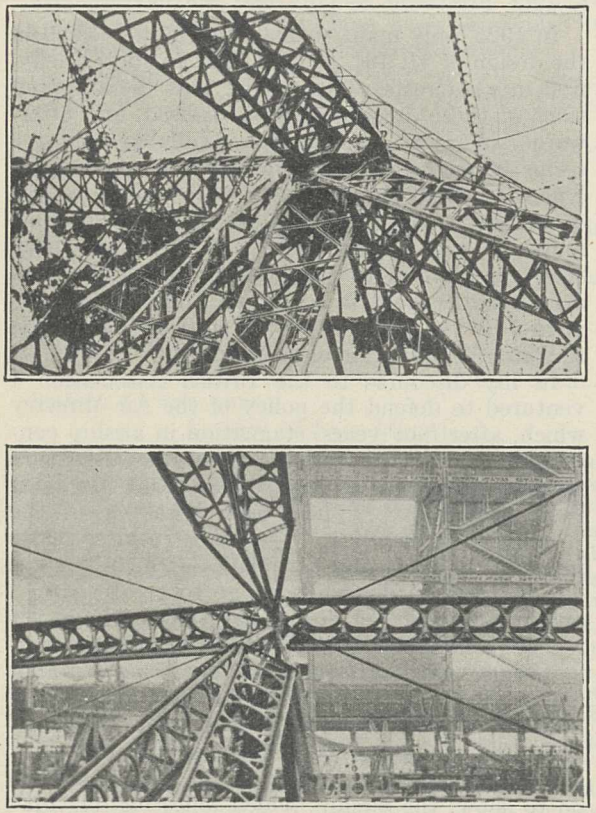

FIG. 1.—Typical joints, above, of 'Zeppelin' construction, below, from 'R 101'. Royal Air Force official: Crown copyright reserved.

In one respect, admittedly, the advance to greater size was an advance into the region of the unknown. It is a commonplace of aerodynamical theory that model tests, in the present state of knowledge, afford no certain indication of the characteristics to be expected in the full-scale. Therefore at the National Physical Laboratory, when we based on such tests our recommendations in regard to shape of hull, we were careful to make only guarded estimates of resistance (that is, of speed), and to emphasise that the amount of 'balance' suggested for the control surfaces might prove on trial to be either insufficient or excessive. We believed that our estimate of speed would prove to be conservative, and that the hull would be satisfactory in respect both of stability and control; but we hesitated to base quantitative figures on models which had perforce to be made on a scale of about 1/20 inch to 1 foot, and Cardington accordingly decided to provide 'Servo-motor' auxiliaries for working the controls, in case these should prove 'heavier' than was expected.

According to the *Times* report of Oct. 16, 1500 h.p. sufficed in the first trial to give the airship a speed of 58 m.p.h. It may be deduced with practical certainty (since the power required will vary as the cube of the speed) that with her five engines giving 700 b.h.p. each (the figure contemplated originally) 'R 101' could have developed a speed of 77 m.p.h.,—which is slightly in excess of her estimated speed. Recourse to the Servo-motor gear was not found necessary (if this holds good at full speed the gear may be removed, and then about ½ ton will be added to the useful 'lift'), and the stability of the ship was reported to be entirely satisfactory. Thus the trials, so far as they go, give no support to those critics who upbraided the temerity of our decision to recommend a shape considerably less elongated than those of past German airships. I have never been able to understand the reasoning which convinced them (quite independently of any question of 'scale-effect') that the new shapes must prove specially difficult to control; on the structural side it should be obvious that the hull (which is a girder, serving to transmit the concentrated loads of the passengers and engines) must benefit by being made relatively short and deep. Perhaps they failed to visualise the meaning of a 'fineness-ratio' of 5·5: as Fig. 2 indicates, the shape of 'R 101' is short in comparison with earlier ships, but it is not appropriately described as 'plump'.

Space does not permit a description of the many ingenious devices which Col. Richmond, the chief designer, and his small band of assistants have incorporated in their design. The interested reader may be referred to the *Journal of the Royal Aeronautical Society*, August 1929, for a full description, and I must be content here to express the unqualified admiration I have learned to feel for their work—an admiration which will persist even if (as I do not expect) 'R 101' is ultimately pronounced to be a failure. I turn now to the other side of the picture—the problems which still await solution.

The Achilles' heel of 'R 101', so far as it is possible to judge at present, is her power plant. No one is to blame for this circumstance, but it cannot be denied, and it is very serious. Designed to carry five engines of 700 b.h.p., 'R 101' can at present count only on four, and these will not develop continuously more than about 600 b.h.p. each.[2] So her designed power has been reduced by more than 30 per cent, and the 77 m.p.h. which she should attain at full power is replaced by a figure slightly under 68: against a head wind of 60 m.p.h.

[2] See letter from the Editor of *Aircraft Engineering* in the *Times* of Oct. 23, and lecture on "The Machinery Installation of 'R 101'" (T. R. Cave-Browne-Cave) in the *Journal R. Ae. Soc.*, March 1929.

she can make good only 8 ground miles per hour, instead of 17. Moreover, the engines are *heavy*. They weigh 7 lb. per h.p. 'dry'—a figure about twice as high as that which Mr. Chorlton, their designer, considers to be possible now, and was believed to be possible when the design of 'R 101' was started. Five tons will be added to the useful load if and when these hopes are realised.[3]

The 'troubles' which have led to this result were enumerated by Wing-Commander Cave-Browne-Cave in his lecture to the Royal Aeronautical Society: torsional resonance of the crankshafts (a fault which is difficult to remedy at a late stage in design) has necessitated increased weight and delayed the fitting of "variable pitch airscrews"; the aluminium crankcases gave trouble (as originally designed) and have been replaced by steel. Wing-Commander Cave remarked that "none of the major troubles has been due to the engine working with heavy oil". In a strictly technical sense this statement is true, but in the wider aspect it may be misleading; for the decision to use heavy oil meant that special engines had to be designed *ab initio*, whereas, had petrol been the intended fuel, engines of tried reliability could have been incorporated.

Let me say at once that I consider the Air Ministry's decision, based on its determination to aim at 'safety first', to have been in every way right and wise. Airships in Great Britain have still to win public confidence, and a disaster sustained by either of the new ships would probably result again (as in 1921) in a total cessation of construction. The difficulty that has arisen is solely a matter of time: *a new engine, working on a relatively novel principle, takes longer to perfect than an airship hull.*

In the original project, 'R 101' was planned to run on heavy fuel oil, using engines which were to be developed from a marine type weighing about 100 lb. per b.h.p. The high flash-point of the fuel would eliminate the danger of fire occurring in tropical temperatures; greater distances could be flown on a given weight of fuel; and the cost of fuel would be largely reduced. In 'R 100' the same objectives were to be attained by the use of engines burning a mixture of paraffin and hydrogen, —thus utilising gas which otherwise would be valved, and so wasted. The latter engines have not materialised, and 'R 100' is, for the present, to burn petrol after all: 'R 101', as we have seen, has attained her objective, but at a serious cost in loss of speed.

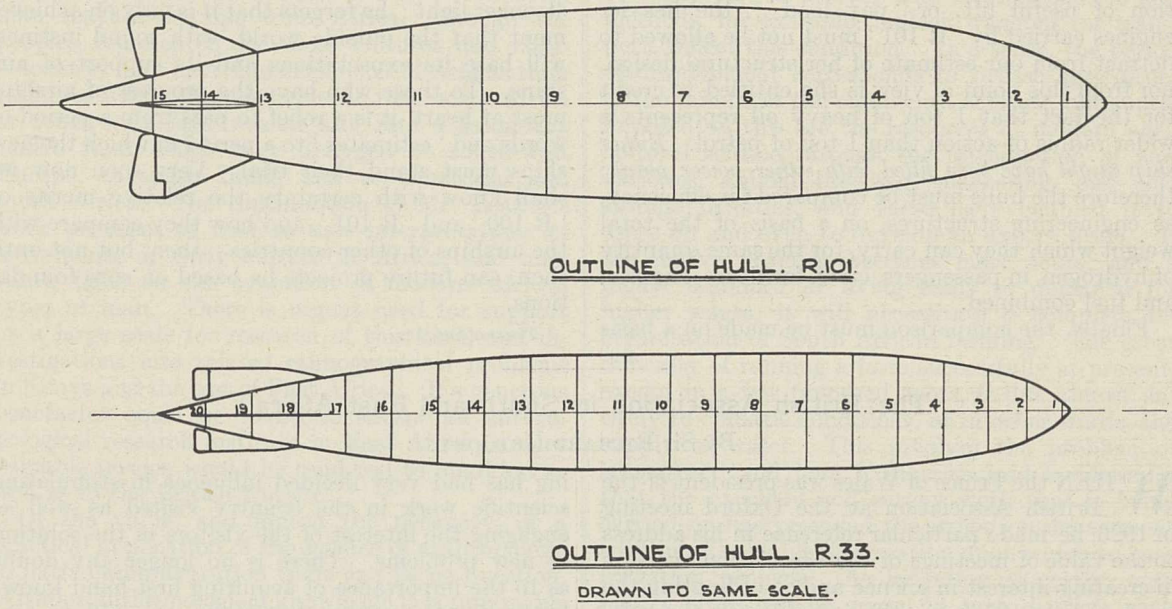

FIG. 2.—Outlines of hull of 'R 101' and 'R 33'. Royal Air Force official: Crown copyright reserved.

The consequence is that these two airships, originally intended to be exactly comparable and so to test the relative efficiency of 'official' and independent commercial design, are not directly comparable to all. 'R 100', with her six Rolls-Royce engines, can count on 4200 b.h.p.,[4] but she cannot (according to the standards originally imposed) safely be flown in the tropics. 'R 101' is safe to fly as regards fire risk, but her depleted speed introduces an element of danger of another kind, and in really strong winds her captain will have anxieties for which her designer is in no way responsible. From the scientific point of view one must regret that she, too, has not been equipped to run on petrol, as a temporary expedient, until such time as her heavy-oil engines have been brought more closely into accord with their intended performance. A year spent in temperate climates—on flights planned with a view to the accurate measurement of speed, controllability, hull stresses and the like—would yield knowledge

[3] See Mr. Chorlton's letter in the *Times* of Oct. 19.

[4] "The World, the Air and the Future" (Burney), p. 210.

of incalculable value regarding the merits of the new designs, and would enable the flights to Egypt and to India to be planned with greater confidence. Both airships are experimental, and the experiment ought not to be hurried at any cost in added risk.

As matters stand, comparison is still possible, but it must be made with care: relative figures, if given without full explanation, may be entirely misleading. Thus, in regard to speed, the measured performances of the two ships must be 'corrected' (according to the cube law which expresses the power-speed relation) in order that their hull resistances may be compared on a basis of equal power; the fact that they carry widely different power plants is (speaking scientifically) an irrelevant circumstance which this procedure will serve to eliminate. Similar remarks apply to the question of useful lift, or 'pay load'; the heavier engines carried by 'R 101' must not be allowed to detract from our estimate of her structural design, nor from this point of view is she entitled to credit for the fact that 1 ton of heavy oil represents a wider radius of action than 1 ton of petrol. *Either ship might have been fitted with either power plant*; therefore the hulls must be compared for efficiency, as engineering structures, on a basis of the total weight which they can carry, for the same quantity of hydrogen, in passengers, crew, furniture, engines, and fuel combined.

Finally, the comparison must be made on a basis of figures ascertained in actual flight, not on estimates. How easily the latter may be in error is indicated by the remark that at least a ton of dust had settled on 'R 101' during her time of waiting in the shed.[5] Useful lift can be *estimated* only as a (relatively) small difference between two large quantities: when the hull is air-borne it can be *measured* with certainty. Estimates, it is safe to say, have been the curse of airships: so hard to check, when airship flights are as infrequent as solar eclipses; so easily modified to suit the thesis of the moment, whether sanguine or condemnatory.

The enthusiast, whose millenium is always five years ahead, can seldom resist the temptation to detract from actual achievement, in order that the advantages of his new project may be displayed in stronger light; he forgets that it is only on achievement that the outside world, with sound instinct, will base its expectations and its support of airships. To those who have the progress of airships most at heart, it is a relief to pass from a period of words and 'estimates' to a period in which the new ships must stand their trial. Very soon now we shall know with certainty the relative merits of 'R 100' and 'R 101', and how they compare with the airships of other countries; then, but not until then, can future projects be based on sure foundations.

[5] *Times* of Oct. 14.

The British Association in South and East Africa.[1]

By Sir RICHARD GREGORY.

WHEN the Prince of Wales was president of the British Association at the Oxford meeting in 1926, he made particular reference in his address to the value of meetings of the Association overseas in creating interest in science and co-ordinating the work and results of scientific investigators throughout the Empire. "Nothing but good", he remarked, "can follow from personal contact between scientific workers in different parts of the Empire. Nothing but good can follow from their researches if they add, as gradually they must add, to the wider knowledge of the Empire not only among the workers themselves, but ultimately among the whole body of informed Imperial citizenship; not only in the overseas territories, but also at home."

As one of the main functions of the British Association is to bring home to the public the significance and value of science to human life, nothing now would seem more natural than to extend these activities occasionally to fields of the Empire overseas and not to confine meetings to the British Isles. More than half a century elapsed, however, from the foundation of the Association before the first overseas meeting was held at Montreal in 1884. Since then meetings have been held twice in South Africa, once in Australia, and in Canada again in 1897 and 1909, and every meeting has had very decided influence in stimulating scientific work in the country visited as well as engaging the interest of the visitors in the solution of new problems. There is no longer any doubt as to the importance of acquiring first-hand knowledge of our overseas territories, or need to emphasise the good that results from personal contact between workers in various parts of the Empire. Co-operation and co-ordination are essential to avoid waste of effort and secure rationalisation in science, and the British Association is greatly assisting progress towards this end by its overseas meetings.

The world has to look to tropical agriculture for a large part of its food supply and raw materials in the future, and to ensure that this will be forthcoming it is essential that the fullest scientific knowledge should be available and used to protect crops from the pests which continually assail them in tropical countries. In Africa in particular, the facts to be faced and the problems to be solved are set forth most convincingly in the Report of the Parliamentary Commission of Inquiry to East Africa in 1924 and in Mr. Ormsby-Gore's report on the four British West African territories in 1926. One of the most gratifying features of the former report was the recognition of the economic value of scientific guidance to such countries. Mr. Ormsby-Gore was chairman of the East African Commission, and he had the advantage of co-

[1] From an address on "Science and the Empire" given on Dec. 3 at a meeting of the Royal Empire Society in co-operation with the British Association, following upon the recent meeting of the Association in South Africa.

operation with a scientific colleague, Major A. G. Church, secretary of the Association of Scientific Workers. The two reports emphasise the urgent necessity for applying the methods and results of science to the problems of tropical development, both in administration and production.

The meetings at Cape Town and Johannesburg afforded an opportunity for comparative study of man in Africa and Europe, and resulted in valuable discussions on material archæology and physical anthropology of Africa. The resemblance of the Stellenbosch type of stone implement to the Acheulean type in south-west Europe, of the majority of the rock paintings in South Africa to those of eastern Spain, and of skulls like those recently obtained by Mr. Leakey in Kenya, approaching the European in type, suggest that early man reached Europe from Africa. Though the peoples represented by these cultures and characteristics may have had some part of Asia as their primeval home, there is evidence that north Africa or south-west Asia was at any rate a secondary centre from which they diverged to south-west Europe, to south India, and to equatorial and south Africa. The continuation of Mr. Leakey's work promises to lead to new interpretations of movements of early culture in Africa, and may throw light on the evolution of modern African types of man. There is urgent need for support on a large scale for research of this kind, and investigations into related ethnographical problems in Kenya and the rest of East Africa. If a generous benefactor could be found to endow an anthropological research institute in East Africa, a very valuable service would be rendered to mankind as well as to the British Empire.

Of the value, and indeed the necessity, of a practical application of the science of anthropology in native administration there can be no question. Without anthropological knowledge it is impossible to predict what will be the effect of interference with any native custom, even though on one hand it may seem repugnant to European ideas, or on the other of so trivial a character that its repression may seem a matter of no importance. Anthropology, studying each custom and each belief as it functions in a given social environment, traces it through its various ramifications in the whole cultural complex, and is thus able to show the consequences throughout the whole social fabric when any attempt is made to modify or suppress that particular custom. The attempt to advance the status of native women in South Africa by abolishing the 'bride price' failed through misunderstanding and imperfect knowledge of the facts. Until the custom was reinstated there was no stability in family or tribal life. Another example of a measure introduced with the best of intentions and having only the well-being of the native in view, but which failed through lack of knowledge, is afforded by the order issued in one of our dependencies to destroy all rats with the object of stamping out plague. To carry out this order effectively the roofs of native huts had to be taken off. To the surprise of the officials of the health service, this was the cause of great resentment among the natives. On inquiry, however, it was found that as a matter of religious custom the unroofing and re-roofing of each hut made the sacrifice of a goat incumbent upon the owner. A knowledge of anthropology would have averted the creation of what might have been a serious situation. It must indeed be understood that the development of a backward people along natural lines demands from an administrator an intensive study of their customs, their religions and modes of thought, guided by a training in the methods of anthropological science.

Another aspect of the 'native problem' is that of agricultural development. South African agriculture is essentially based upon unlimited supplies of cheap native labour, and the implements and methods, for example, bullock waggons for transport, reflect this condition. In a sense, the period of development corresponds to British agriculture in the middle of the eighteenth century, but superimposed on this are the resources of modern agricultural science through the introduction of new varieties, animal breeding, marketing, and cold storage facilities, and these have enabled it to carry on and even to develop an export trade. If the native problem becomes more acute, and a higher standard of living leads to demands for higher wages, it will necessitate a complete reorganisation of South African farming. The great difficulty of running a farm successfully at present, except in a few favoured spots, is due almost entirely to climatic conditions, or in other words, the supply of water. This involves the problem of irrigation; and here it may be said incidentally that the excellent soil survey work that is being carried on has provided the irrigation department with most valuable information upon which to base irrigation projects. As irrigation is costly, only luxury crops can be grown in such districts with hope of financial success; hence the concentration on citrus fruits. It is improbable, however, that South Africa can ever export enough to control our markets, and attention should therefore be devoted to high-grade supplies, which means drastic grading of fruit prior to export. The wine industry is most promising, and the Empire Marketing Board should do more to make its products better known in Great Britain.

The afforestation schemes in different parts of South Africa, and the rapid development of sugar-cane and wattle growing in Natal, are particularly noteworthy. As the recent debate in the House of Commons showed, one of the subjects with which almost every country is at present preoccupied is the question of the future supplies of softwood timber, and foresters are in consequence interested in all efforts to increase softwood production. In South Africa the percentage of land under forest is very low, and the indigenous softwoods, although they produce good timber, are slow growing, and difficult to establish on the veld, hence of little value in the extension of forest area. South African foresters, however, have shown enterprise in seeking for tree species which will grow well

under the various conditions in their country, and from the large number which they have tried, they are now carrying out extensive afforestation with pines from the Monterey Peninsula in California, the Mediterranean Basin, the slopes of the Himalaya Mountains, the Canary Islands, Mexico, and Central America. For hardwood production Australian species, particularly *Eucalyptus*, are being used. The results of this work will be of assistance to foresters who have to deal with similar conditions in different parts of the Empire, and the publication of the papers prepared by the South African foresters for the British Association meeting will disseminate the knowledge so far obtained. This experiment on the creation of an entirely new forest complex raises forest problems of great diversity and interest in soil biology, pathology, and methods of tending the plantations, and the discussions between the European and South African foresters resulted in the pooling of the knowledge at present available, and suggested lines for future investigation.

Farther north, for example in Northern Rhodesia, forestry is only beginning to be developed. The first step is the survey and stock-taking of the indigenous forest resources, and this necessitates the identification of the many different tree species. Even in a country such as Nyasaland, where a forestry service has been developed for some time, owing to pressure of administrative duties, work of this kind remains to be done. Assistance in both colonies was given by a systematic botanist, Dr. J. Burtt Davy, during his visit to Africa.

In both South and East Africa the crying need of the moment is for workers to name the plants. The visitors were told in South Africa, and the same thing is true of East Africa, that if a botanist set to work on any square mile of the country, probably he would find at least one new flowering plant that had no name, and probably more than one. Certainly it is true that whatever interests the botanist may start with when he leaves the mother country for Africa, he is soon driven by circumstances to turn aside from a primarily physiological or other inquiry in order to ascertain what is the correct name of the plant with which he is working. This is the first need on the scientific side, but it is also true on the practical side. It is of prime importance in relation to problems in regard to poisoning of stock. Veterinary officers in Northern Rhodesia took visitors to districts and pointed out probably the plant itself, certainly the group of plants, which are responsible for producing certain symptoms in the stock grazing in that area. This they have been able to do for several years past, but they were still unable to give a name to the plant that is the cause of their trouble, and as a consequence they are no nearer an understanding of the means of eradicating the trouble, and they have no idea of the extent of the plant's distribution, its season, etc. One of the crying needs of the botanical side is more help on the systematic side.

One thing that the home botanists ought to do, therefore, is to supply the workers in this systematic field in the new country. Africa with its own active university departments, all of which have heads alive to the botanic needs of the country, will soon supply its own workers in this field. At present it needs the resources, however, of the old country. As a matter of fact, one of the ironies of the situation is that as nearly all the original work upon the Cape flora has been done by European botanists, the only places where the African plants can be named with certainty at present is in the home country in touch with the big British and European herbaria. There is, quite possibly, room for a greater development of systematic work on this type of plant material in connexion with Kew or with the Natural History Museum at South Kensington.

There are thirteen separate sections of the British Association concerned with different departments of science, and each of these held meetings at Cape Town and Johannesburg. Mr. O. J. R. Howarth, secretary of the Association, has been good enough to furnish me with the following summary of the scientific programme of the meetings:

"In Cape Town and Johannesburg there were some 350 addresses, lectures, papers, and discussions in all. Of these, fully one-third were on specifically South African topics, and many of them were contributed by South African scientific workers. To mention only a few as examples—the chemists dealt with essential oils from South African plants, with recently discovered nitrate deposits in South-West Africa, and with the chemistry of gold extraction. The geologists were concerned in very large measure with the geology of the sub-continent: they not only heard papers on it, but studied it widely in the field, co-operating with the International Geological Congress (which coincided with our own meeting) in order to do so. Geologists, zoologists, and botanists combined to discuss the debatable subject of the lost continent of Gondwanaland.

"A large part of the zoological and botanical programmes had a definitely South African bias, and both sections benefited by exhibits and demonstrations arranged for the instruction of the visitors. The discussion organised by the Sections of Zoology, Botany, and Physiology on 'The Nature of Life' was opened by our most distinguished South African member, General Smuts. The Section of Geography, under the presidency of the Director-General of the Ordnance Survey, Brigadier Jack, devoted an important part of its programme to the progress of surveying and cartography in South Africa; and it studied a whole series of aspects of human environment, such as the effects of relief of the land upon settlement, economic development under desert conditions, water-supply, soils, and so forth. It also joined the Section of Education in discussing the teaching of geography, with special reference to South African schools and universities.

"The Economics and Anthropological Sections united to consider economic competition between advanced and backward peoples, and covered a wide field of South African economic problems. The Engineering Section dealt appropriately with

refrigeration, road and rail transport, town planning, irrigation, and mining machinery. The Anthropological Section, it need scarcely be said, was in its element: chief among many features of topical interest it received Miss Caton-Thompson's report upon her excavations at Zimbabwe and other sites in Southern Rhodesia, carried out at the instance of the Association, and confirming the medieval origin of the buildings in the face of romantic ideas as to their much greater age. The physiologists and engineers jointly considered problems connected with the ventilation of deep mines on the Rand and elsewhere. The psychologists contributed their results associated with some of the population problems of South Africa. The Educational Section devoted itself almost wholly to South African topics: and lastly, the Agricultural Section had the unique opportunity of meeting jointly, in Pretoria, with the Pan-African Agricultural and Veterinary Congress."

There can be no question as to the stimulus which consideration of these and other subjects has given to science in South Africa, or in the interest which has been created among the visitors in the scientific and economic problems of the country. Everywhere the scientific staffs, research workers, and planters were eager to get into touch with visitors possessing intimate knowledge of their subjects, and to seek advice as to deductions to be drawn from work in South Africa or suggestions for further activities. The foregoing general survey represents not only personal conclusions as to the place of science in the development of the Empire, but also the views of competent authorities upon specific problems in South and East Africa. Among those with whom I have had conversations or correspondence, and to whom I am indebted for information, are Prof. H. J. Fleure, Mr. E. N. Fallaize, Dr. B. A. Keen, Dr. H. M. Steven, and Prof. J. H. Priestley. We all aim to advance progress and promote human welfare, and many of us are convinced that this can be attained only by scientific guidance. Upon statesmen and administrators is the responsibility of seeing that this guidance is rightly regarded and effectively used.

Obituary.

DR. J. C. MELVILL.

DR. JAMES COSMO MELVILL, of Meole Brace Hall, Shrewsbury, well known as a conchologist and botanist, who died on Nov. 4, was born in London on July 1, 1845, and was the son of James Cosmo Melvill, Under-Secretary of State for India, and the grandson of Sir James Cosmo Melvill, F.R.S., chief secretary of the East India Company. He was educated at Harrow and Trinity College, Cambridge, and entered the business of his uncle, Edward Hardcastle, travelling in North America, where he had opportunities for studying natural history and making collections. He later joined the firm of Messrs. G. and R. Dewhurst, of Manchester and Preston, serving as a director for many years.

While at Harrow Dr. Melvill published, in conjunction with the Hon. F. Bridgeman, "The Flora of Harrow". In later years he accumulated and arranged three-quarters of the known plants of the world. The greater part of this fine herbarium, containing many valuable plants and including some obtained by Charles Darwin during the voyage of the *Beagle*, was presented to the Manchester Museum in 1904. The remainder, which consist of the grasses and ferns of the world, together with about a third of the known seaweeds, will shortly be added to the others at Manchester.

Dr. Melvill began to collect shells at the early age of eight, and during his lifetime this collection grew to be the largest known in private hands, comprising 22,500 species. He described more than 1000 new species of mollusca, by himself or in collaboration with others, including the late Robert Standen. His conchological contributions are very numerous, and comprise descriptions of species from South Africa, the Persian Gulf, the Arctic and Antarctic regions. He joined the Conchological Society in 1880, and was president in 1889 and again in 1895–96, on each occasion delivering an excellent address. He was an original member of the Malacological Society (founded in 1893) and was its president at the time of his death.

In addition to botany and conchology, Dr. Melvill took a keen interest in British insects and made quite a large collection. He was a member of the Linnean, the Zoological, the Entomological, and the Manchester Literary and Philosophical Societies, being president of the last in 1897–99. For many years he was on the Court of Governors and the Council of the University of Manchester. He was a member of the Manchester Museum Committee, being chairman for several years. During his residence at Meole Brace Hall, he was honorary curator of the Shrewsbury Museum and served as president of the Caradoc Field Club.

An all-round naturalist, Dr. Melvill's knowledge of the mollusca was masterly, and on the occasion of the Victoria University conferring upon him the D.Sc., Prof. Lamb remarked: "It is chronicled of Solomon that he spake of trees, from the cedar that is of Lebanon, unto the hyssop that springeth out of the wall, but it is not recorded that he also knew by heart all the shells from the Arctic Circle to the Persian Gulf. That double weight of learning was reserved for the accomplished systematist, Mr. Cosmo Melvill, and those who know him will testify with what gracious modesty he sustains it."

J. WILFRID JACKSON.

WE regret to announce the following deaths:

The Hon. Sir John Cockburn, K.C.M.G., president of the Child Study Society, who was premier chief secretary in 1889–90 of South Australia, on Nov. 26, aged seventy-nine years.

Mr. Francis A. J. Fitzgerald, head of the Fitzgerald Laboratories, Niagara Falls, and president in 1916 of the American Electro-Chemical Society, on Oct. 26, aged fifty-nine years.

News and Views.

JEAN BAPTISTE PIERRE LAMARCK died one hundred years ago, on Dec. 18, in his eighty-sixth year—a master of zoology whose work and thoughts gave fresh impetus to the progress of biology in his day, and in ours still enliven the unsettled controversy concerning the heritability of 'acquired' characters. Lamarck was a systematist, and in these days when systematics is apt to be despised among the multiplying branches of zoology, it is well to be reminded that it was on his experience in the discrimination of species that his great achievements were based. The earliest of these bore upon the classification of animals. He investigated the rich fauna of fossil mollusca in the Tertiary beds of the Paris basin, discovered that different species were distinctive of different beds, and gave at once an auspicious start to the palæontology of invertebrates and a lusty push to the stratigraphical conception of geological formations which his contemporary Werner had inaugurated. For the first time, he proposed a reasonable division and grouping of the invertebrate animals, which, apart from the insects, Linnæus had bundled into a hotchpotch of 'Vermes'. It was characteristic of Lamarck that his mind kept revolving the greater problems raised by his detailed work. Thus the satisfaction with which he at first regarded the linear arrangement of his classification of the animal world gave way to doubt, and ultimately was replaced by the modern conception of a branching genealogical tree—a change of view which says much for the openness of the naturalist's mind at an age at which professors are nowadays compelled to retire.

EVOLUTION was in the air during the latter half of Lamarck's life, and close reasoning, founded upon a grasp of systematic detail and sequence, enabled him to make a notable advance. He thought that changing environment influenced the habits of animals as changing wants might influence habits, and new habits meant the adaptation of old structures. The crux of his position lay in his assumption that adaptations thus acquired by an individual became, without more ado, part of the stock-in-trade of its progeny. No theory has swung more completely between the poles of belief and unbelief than Lamarck's assumption of the heritability of 'acquired' characters. At the first it was assumed without proof, and was held for years as being self-evident. Weissmann gave it a blow from which it has not yet recovered, and, for years after Weissmann's analysis of the 'eighties, few zoologists of standing but regarded the transmission of acquired characters as being not only unproved but also theoretically impossible. Fortunately, modern views are more elastic, and Lamarckism in a modified form has again its supporters amongst zoologists as well as botanists.

THE gale that set in over the south-west of England on the night of Dec. 6 last rose to hurricane strength in the early hours of Dec. 7, and a gust of 108 miles an hour was recorded. Much damage is reported both to shipping and also inland. It bore a striking resemblance to the storm of Mar. 8, 1922, which also gave a gust of 108 miles an hour and reached its climax at about the same hour of the morning. Slightly higher speeds have been recorded in other parts of the British Isles: 109 miles an hour at Dunfanaghy (Donegal) on Jan. 28, 1927, and 110 miles an hour at Quilty (Co. Clare) on Jan. 27, 1920. The gale of Jan. 28, 1927, was in many respects the most remarkable of the four, in that it yielded gusts of more than 100 miles an hour, not only in Ireland but also in Scotland, and the average speed actually exceeded 80 miles an hour for a time at Dunfanaghy. Winds of this strength are very rare outside tropical hurricanes and tornadoes. One might be tempted to regard them as very nearly the extreme limit of what can be achieved by a fast-moving secondary depression, in which the air motion can often be resolved into a more or less complete circular whirl and a motion of translation, generally from west or south-west, the resultant wind being very strong where the two components are in the same direction, that is to the south or south-west of the centre. But it is doubtful whether this is the case. Sir Napier Shaw, in his well-known work on weather forecasting, mentions a gale associated with just such a fast-moving secondary that blew down hundreds of trees in Cambridge between 2 P.M. and 4 P.M. on Mar. 24, 1895. This gale may be within the recollection of some of our readers. It was doubtless considerably more severe than the recent gale, and equally destructive storms have been recorded.

THE Barton power station of the Manchester Corporation and the proposed Battersea power station of the London Power Company are good illustrations of the difficulties inherent in working large steam stations, some of which electrical engineers and chemists are now successfully overcoming. The Manchester station is attacked because it is located in open country and the fumes emitted were deleterious to vegetation. The Battersea power station is to be built in urban surroundings and near important public buildings. By appealing against the injunction made against it by the Court of Appeal, the Manchester Corporation has gained a year during which it must abate the nuisance. The successful experiments carried out at the Grove Road Station showing how sulphur fumes can be eliminated from flue gases are very promising. According to a White Paper issued by the Ministry of Transport (Cmd. 3442, London: H.M. Stationery Office, 6*d*.), the Government Committee states that the possibility of eliminating nearly the whole of the sulphur gas present in the fumes has been proved. It desires, however, that a more definite explanation of the mechanism of the oxidation of sulphurous to sulphuric acid should be forthcoming before it can report on the practicability of the process. We are surprised that the opponents of the Battersea power station do not suggest some other site and give figures to prove that it is practicable. The problem of supplying London with electricity is not an easy one. The demand now exceeds 400,000 kilowatts, the capital involved is very large,

the prosperity of many industries depends on cheap electric power, and the comfort of hundreds of thousands of citizens is involved. Purely destructive criticism is not helpful. It is easy to put spokes in the wheel of progress. Our sympathies are entirely with those chemists and engineers who are doing their best to mitigate the objectionable components present in the fumes arising from the combustion of fuel.

AT a meeting of the Royal Anthropological Institute on Dec. 3, Mr. A. Leslie Armstrong described an archæological expedition undertaken this year with the object of exploring caves in Rhodesia, and in view of the meeting of the British Association in South Africa. The cave of Bambata is situated near the summit of the mountain of that name, the highest in a group of typical granite hills lying on the south-east verge of the Motopo Hills. Through the work of the Rev. Neville Jones of Hope Fountain, and Dr. Arnold of Bulawayo, in 1918, the cave was known to contain important deposits and a frieze of wall paintings. Work was commenced here by the expedition early in June. The relic bed proved to be nearly 20 feet in thickness, and provided for the first time in South Africa a definitely stratified sequence of cultures. At the base was a Lower Palæolithic stratum, more than three feet in thickness, containing *coup de poing* of South African Acheulean (Stellenbosch) facies. This was succeeded by a deep deposit of typical Mousterian character, above which, through a thickness of more than twelve feet, was a distinctive culture exhibiting Capsian affinities, but with Mousterian tendencies or survivals. Burins were abundant in this culture, also a distinctive point, the gradual development of which was traced from a pure Mousterian point, by well-defined stages, into a slender point of almost Solutrean technique. The upper layer of the deposit contained implements of microlithic form which are apparently ancestral to the Wilton culture of the Cape. The Mousterian zone was found to include definite intercalations of Capsian layers, separated and covered by layers of normal Mousterian character. This suggests the contemporary presence in this area of the two races before the Neoanthropic influence became dominant. At the Victoria Falls it was possible to correlate the Lower Palæolithic cultures contained in the residual gravels of the Zambezi River, with definite stages in the cutting back of the river gorge. The results demonstrate the great antiquity of Palæolithic man in South Africa.

STUDENTS of psychic phenomena will find much to interest them in an article entitled " Spirit Hunting in the South Seas ", which is contributed by Prof. B. Malinowski to the *Realist* for December. In it he describes a manifestation by Tomwaya Lakwabula, a famous spirit-seer of the village of Oburaku in the Trobriand Islands of Melanesia, which came under his personal observation. It has always been a question how far the medicine man or shaman has availed himself of imposture in the manifestation of his powers or how far they were due to the effects of hysteria, auto-hypnosis, or some similar abnormal psychic state. It is evident that Prof. Malinowski is something of a sceptic, at least in regard to certain points in the medium's operations. It would appear that there are two classes of seers. A minor class, and even this is not indeed numerous, visits the spirit world for short periods and receives visits from the spirits, who bring messages and foretell the future. The second class consists of the great seers who occur but rarely in the history of the people. This latter class falls into prolonged trances, not in secret as among the first class, but in the eyes of the multitude. It was one of these prolonged trances which came under Prof. Malinowski's observation, lasting for more than a week. The call to this trance comes, the natives believe, from the spirits themselves.

THE first manifestation of the spirit-seer's powers which Prof. Malinowski saw was at the mortuary wake of the chief, when after the nervous twitchings usual in such cases, the seer broke into song in a voice which was not his own but was recognised by the natives as that of the chief, and in a language which was not that of the natives, but was said to be of the spirit world. Immediately afterwards the poles and platform at the grave were violently disturbed. This, it was said, was caused by the spirit of the chief trying to return to the body. During the prolonged trance, seances were held nightly, when the villagers gathered round the hut in which the medium's body lay extended on a couch visible from the door, and attended by his daughter. Although the seer at these seances sang both in his own and in an altered voice—on one occasion there were at least two changes, and once there took place the materialisation of a small bunch of betel nuts—no messages were delivered until the sixth or seventh night. These messages dealt with practical affairs—the disposal of a canoe, the arrangements for the periodical ceremonial feast to be celebrated in memory of the deceased chief, and so forth. The voice in which these messages were delivered was not that of the chief, but of a man who was said to have been dead for some time. When the trance was over the seer appeared to be much emaciated, perhaps only natural as his food had been supplied by the spirit world, though Prof. Malinowski has his doubts on this point. He looked tired, and his mind at first seemed quite vacant ; only slowly did his mental faculties return to normal. The whole account is extremely interesting, and although the very practical and apposite character of the messages from the spirit world arouses some suspicion, it seems a genuine case of an abnormal personality, possibly exploited with some skill.

THE undoubted power of the cinema as an influence in education has not, as yet, been harnessed in Great Britain. Other countries, notably Russia, Germany, France, and the United States, have elaborated formulæ for the employment of the motion picture ; but we have lagged behind. Considerable expectations are, therefore, to be attached to the work of a commission of inquiry appointed by a conference of scientific and educational societies and institutions which was held on Nov. 27. In April of this year the Association of Scientific Workers took the lead by calling a preliminary conference, which appointed an organising committee. This committee acted in conjunction with the British Institute for Adult Education in drafting the report to

be presented and in calling the second conference. The report proposed the formation of a representative commission and defined its terms of reference with such breadth as to include an inquiry into the various aspects of mechanical visual and aural aids in education, films in relation to the general education and culture of the public, and the establishment of a central organisation to co-ordinate work, both research and informatory, on the motion picture in relation to general and specialist education. The constitution of the commission insures that its findings will be received with respect. The members include Prof. W. A. R. Ainsworth, who represents the Board of Education; Mr. J. W. Brown; Mr. A. C. Cameron; Major A. G. Church; Mr. E. Salter Davis; Mr. J. Fairgrieve; Sir Richard Gregory; Sir Benjamin Gott; Mr. G. T. Hankin; Mr. F. A. Hoare; Sir Percy Jackson; Dr. C. W. Kimmins; Colonel J. M. Mitchell; Prof. J. L. Myers; and it has power to co-opt additional members.

MR. ALAN E. MUNBY read a paper to the Royal Institute of British Architects on Nov. 18, on the design of science buildings. He made a strong plea for greater efficiency in building, and pointed out that a little extra expenditure often meant a disproportionately great increase in technical completeness. One of the great difficulties of the architect lies in the absence of any consensus of opinion on the part of educationists and men of science as to the appropriate equipment for specific subjects, and Mr. Munby suggested that some generally agreed outline of requirements might be formulated without undue difficulty As to the buildings themselves, the adoption of a unit will often simplify construction and assist in the allocation of space, but the architect must constantly bear in mind that the whole design must grow up together, and that the fixed fittings must be laid out on the plans, suitably spaced, at a stage to prevent the embarrassment of the general contractor by subsequent changes. After a consideration of the chief technical details, Mr. Munby stressed the importance an architect should attach to acquiring a thorough understanding of the highly specialised objects aimed at; only so can he be in a position to deal intelligently with the various schedules of requirements that may be placed before him and to give them proper amplification in detail. Otherwise, we feel that sympathy would certainly be due to the professor who told Mr. Munby that he would much rather have an architect who knew nothing about science buildings than one who thought he knew something.

THE Annual Forest Report for Finland, 1927, recently published, depicts the wonderful progress which has been achieved in the introduction of a scientific management into the forests in the ten years since she established her independence during the period of the Kerensky Government in Russia in 1917. Apart from the notable position Finnish timbers have obtained in the European soft wood export trade (she exported 1,283,000 standards of sawn material during the year), there are other important directions in which Finland has been dealing with the forestry question from the point of view of the economic necessities of the country as a whole. Finland is mainly a forest country; out of a total superficial area of 14,151,052 hectares, the forest and waste lands cover 13,449,387 hectares. Any effective administration of the country must therefore inevitably be intimately bound up with a proper management of the forests. That this fact has been thoroughly appreciated the Report well displays. Laws have been introduced which afford protection to areas both in the north and on the seaboard and the islands, where disafforestation would lead either to denudation of mountain slopes or to the serious results of exposure to wind and storms.

THE question of the management in Finland of communal forests (namely, areas owned collectively by villages, etc.), and of those belonging to the Church and other bodies, has been met by placing the management in its main principles under the Forest Department. Another law has enabled the latter to maintain supervision over privately owned forests. The owners are not permitted to exploit their forests without making arrangements for re-stocking the areas felled; the extent of the fellings made in any one area is also limited by sylvicultural principles. Commissions in each district, consisting of forest officials, are responsible for the supervision, and purchasers of the materials to be felled on areas they buy have to submit to the Commissions an estimate of the amount of material they expect to fell. Thus a check has been instituted against over-felling on one hand, and on the other against leaving unregenerated a felled area. It is said that the private proprietors realise to the full the importance of this law and have readily fallen in with its requirements. Four forest schools are maintained and a research institute. The work undertaken by the professors and assistants in the latter is already becoming well known and will achieve results of lasting importance to Finland. It is a wonderful record for ten years.

THE brilliant success of the Deutsches Museum in Munich, in pushing to its furthest limits the use of motion in adding to the attractiveness of exhibits, has suggested similar developments in other countries. The latest project of the kind is a great scheme for a Museum of Science and Industry in Chicago to "reveal the technical ascent of man". According to Science Service, Washington, D.C., it is proposed to build in Jackson Park a replica in stone of the old Fine Arts building of the World's Exposition of 1893, which is still standing. The new building will cost 5,000,000 dollars, will be fitted for the exhibition of technical and scientific collections, and will possess about 400,000 square feet of floor area. Mr. Julius Rosenwald has endowed the Museum with 3,000,000 dollars, to be spent on exhibits and equipment, but it is surmised that, as in Bavaria, municipalities, the great industries, and private individuals will hasten to add to the completeness of the stock-in-trade of the Museum. Work is to proceed at once, and by 1933 the building ought to be completed and open to the public, although the wise decision has been taken that no attempt will be made to rush the collection and arrangement of exhibits. If the Deutsches

Museum be taken as a standard, the collections may ultimately be worth some 30,000,000 dollars.

THE Report of the meetings of the International Commission on Illumination, held in the United States in September 1928, is a volume of nearly 1300 pages with 18 pages of index. The subjects discussed included street lighting, glare, car headlights, daylight and artificial illumination of works and schools, standards, methods and appliances for photometry, diffusing and signal glasses, colorimetry, vocabulary, units and symbols. The principal decisions are given on pp. 9–20, and some of them are subject to further consideration after reports from the various national committees. The vocabulary is fixed so far as French and English are concerned, but the German, Italian, and Spanish terms have still to be determined. The c.g.s. units are to be used; symbols are to be: F, luminous flux; I, luminous intensity or candle power; E, illumination; B, brightness; R, luminous radiance; and L, quantity of light. The Geneva code for interior illumination is to be retained for the present and statistics for street lighting by modern methods are to be compiled. The proper method of specifying a coloured glass or a diffusing material is indicated, and plans outlined for setting colorimetry on an international scientific basis.

THE Multiple Industrial Fellowship on Portland Cement of the Mellon Institute of Industrial Research and the Eastern Face Brick Manufacturers' Association have recently inaugurated a broad scientific study of the problems of bricklaying. So many factors are involved in the construction of a brick wall that it is necessary to limit the investigation to combinations of variables most likely to occur in actual practice. The project has been under discussion for a considerable period of time; experiments were begun by Dr. F. O. Anderegg, senior industrial fellow at the Mellon Institute, and his assistants only after a satisfactory programme had been worked out. At the present time more than three hundred experimental brick walls or panels have been erected in order to find the most suitable combinations of materials and workmanship. The following problems are being investigated: the rate of absorption and total absorption of moisture by brick; the surface characters of brick; the merits of different cementing materials, ranging from pure lime to pure cement, and of various sands and mortar pigments; the effect of varying the type of backing, both as to material and size of unit; the results of variation in workmanship, including pointing, tapping, and the filling of head-joints; the effect of variation in design, involving a study of coping and parapet construction, of capillary contact, of condensation, and of elasticity; and the behaviour of mortar with reference to the other variables in all types of climatic conditions. All results of these studies are to be published for the benefit of those interested in building construction.

WE record the foundation of a new scientific society, the Gesellschaft für Völkerkunde, which was formally constituted on Oct. 1 with a hundred and sixty members. Though organised on a German-speaking basis, its membership is open to ethnologists of all nationalities. There is an entrance fee of 3 marks and an annual subscription of 5 marks for 1929, and of 3 marks for subsequent years. A quarterly journal entitled *Ethnologische Studien*, of which the first (a double number) has already appeared, is published on behalf of the Society by the Verlag Asia Major, under the editorship of Prof. Fritz Krause, Director of the Ethnological Museum at Leipzig and the first president of the Society. The journal will include ethnological papers in German, English, and French. Members have the privilege of obtaining the journal as well as the *Ethnologische Anzeiger* and *Anthropos* at a reduced price. The address of the Society is, Museum für Völkerkunde, Johannisplatz, Leipzig, C.1. Further particulars may also be obtained from J. H. Driberg, 8 Tavistock Place, W.C.1.

IN the autumn issue of the *Fight against Disease*, the quarterly journal of the Research Defence Society, it is announced that a committee has been formed, with Lord Dawson of Penn as chairman, to perpetuate the memory of Henry Hill Hickman, who died in 1830, and was the first to suggest the use of oral inhalation for the production of anæsthesia during operations. This committee has received sufficient support to enable it to restore Hickman's tombstone and to place a memorial tablet in his native church of Bromfield, Shropshire. It is also hoped to be able to present his portrait to the Royal Society of Medicine and to establish a Hickman memorial medal for work of merit in anæsthesia. Donations may be sent to Dr. Cecil Hughes, 8 Cumberland Mansions, W.1.

THE July number of the *Transactions* of the Mining and Geological Institute of India contains the address of the newly elected president, Mr. F. L. G. Simpson, which was devoted to a review of the mineral production of India for the forty-five years from 1880 compared with that of the rest of the world, the detailed figures upon which his statements were based being given in a series of tables appended to the address. He shows, for example, that within the period named, the weight of coal produced in India has been increased twenty-one times, whereas in Great Britain during the same period it has only been doubled, and in the whole of the rest of the world has been increased three times. The tables referred to form a convenient summary of the mineral production of India over the period with which Mr. Simpson dealt.

THE Right Hon. Lord Cornwallis, chairman of the Kent County Council, has consented to act as president of the forty-first Congress and Health Exhibition of the Royal Sanitary Institute, to be held at Margate on June 21–28, 1930, and the following as presidents of sections: Dr. Andrew Balfour, Section A. (preventive medicine); Sir Henry Maybury, Section B. (engineering and architecture); Lady Howard de Walden, Section C. (maternity and child welfare, including school hygiene); Sir John Moore, Section F. (veterinary hygiene).

MESSRS. Henry Sotheran, Ltd., 43 Piccadilly, W.1, have just circulated another part of their well-known "Price Current of Literature". Its number is 816, and, as usual, it contains very valuable bibliographic notes with reference to many of the works listed. The catalogue is in the front rank of those which reach us, and should certainly be seen by collectors and librarians. The present part gives particulars of nearly 3000 books relating to mathematics, astronomy, physics, and philosophy, including the famous Newton Library.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical assistant in the testing department of an Admiralty establishment at Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Dec. 17). A junior engineering assistant under the Corporation of Kingston-upon-Hull—The City Engineer, Guildhall, Hull (Dec. 18). An assistant pathologist for work in connexion with the radium 'bomb' treatment of cancer at the Westminster Hospital—The Secretary, Westminster Hospital, Broad Sanctuary, S.W.1 (Dec. 21). A pathologist and bacteriologist at the Cumberland Infirmary, Carlisle—The Secretary, Cumberland Infirmary, Carlisle (Dec. 31). A research fellow in the Department of Glass Technology of the University of Sheffield—The Registrar, The University, Sheffield (Dec. 31). A junior scientific officer in the Air Ministry's Scientific Research Pool, primarily for work at the Royal Aircraft Establishment—The Chief Superintendent, R.A.E., South Farnborough, Hants (Jan. 1, quoting A. 397). A lecturer and organiser in horticulture in the Department of Agriculture, the University, Leeds—The Registrar, The University, Leeds (Jan. 6). A director of the Apia Observatory—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Jan. 25). A chief agricultural officer in Sind, under the Director of Agriculture, Bombay Presidency—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 31). A whole-time secretary to the School of Oriental Studies—The Director, School of Oriental Studies, Finsbury Circus, E.C.2 (Mar. 10). A junior assistant under the Directorate of Ballistics Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An assistant agricultural officer under the Kent Agricultural Committee—The Chief Agricultural Officer, Sessions House, Maidstone. A scientific assistant at the Imperial Bureau of Plant Genetics—The Director, Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge.

Our Astronomical Column.

Recent Fireballs.—Mr. W. F. Denning writes : "On the first few nights of the present month brilliant meteors were unusually abundant, and several of them were of startling lustre though without detonations. On Dec. 2 at about 6 P.M. a fireball gave a brilliant display over the south of England. Another followed about four hours later, and a third, which lit up the whole countryside, blazed out just as the morning twilight came on Dec. 3. This object passed from south-east to north-west over England and gave a vivid flash at its disappearance, quite dazzling in its intensity. About half a dozen other fireballs made their appearance between Dec. 2 and 5, and the curious fact in connexion with them was that they apparently had their derivation from different systems. About sixty observations have come to hand descriptive of these objects, and when further data come in it will be possible to compare them and make certain deductions as to the heights, velocities, and directions of the various meteors concerned.

"It is a pity that these fireballs are seldom correctly described. Few people possess a good knowledge of the constellations, and so it happens that casual observers are seldom able to describe a meteor's path in the sky with accuracy."

Commensurabilities of Periods of Planets and Satellites.—L. W. Topham contributes an article on this subject to the *Observatory* for November. He points out that there are very numerous cases in the solar system of close approximations to commensurability. The best known is the 2 to 5 ratio in the periods of Jupiter and Saturn ; also the period of Neptune is nearly twice that of Uranus ; among the satellites there is a relation between I, II, III of Jupiter ; and in those of Saturn the periods of Tethys and Dione are nearly twice those of Mimas and Enceladus. He thinks it is reasonable to conclude that these relationships have some cosmogonic cause. He suggests that the satellites originally existed as clouds of corpuscles round their primaries ; once a condensation was formed in these, other condensations might be set up, by resonance or some similar process, at distances where the period bore some simple relation to that of the first condensation. This would involve the conclusion that the relations originally held exactly, and that the cloud of corpuscles acted as a resisting medium, which was densest near the primary, so that the periods of satellites in this region were relatively more shortened than those of the more distant ones. This suggestion is shown to accord with many of the relations that he has noted in the article.

Auroræ.—*B.A.A. Journal*, Vol. 40, No. 1, contains a report from Mr. W. B. Housman on the observations of auroræ from July 1928 to June 1929. The greater number were observed by Mr. A. Johnson at Haroldswick, Unst, Shetlands. There is stated to have been increased auroral activity during the period, the displays during the magnetic storms of February and March being especially beautiful. For some years the auroræ have been tabulated in the report by the days of the solar rotations reckoned from the zero values of Lo according to Carrington's system. The region of maximum activity has been slowly shifting forward in solar longitude. In 1926–27 the numbers of auroræ in the four solar quadrants were 13, 28, 24, 11 respectively : in 1928–29 they were 18, 23, 26, 8. The region of maximum activity has shifted from the second quadrant to the third. This may mean that the solar regions chiefly concerned in these disturbances have a somewhat slower rotation than the value used by Carrington. In each period the sum of the numbers for the two middle quadrants is about double that of the first and fourth.

Research Items.

Religion of the Torres Straits Islanders.—Dr. Haddon's Frazer Lecture for 1929, "The Religion of a Primitive People", delivered in the University of Liverpool, has now appeared in the *Annals of Archæology and Anthropology*. The Islands fall into three groups, in which culture was practically at the same stage, except in so far as affected by the fertility of the soil. For in the eastern islands the soil was rich enough to support the inhabitants on their garden produce, whereas in the other two groups they had to depend upon fishing. The Islanders are all Western Papuans, but belong to different stocks, two being long-headed, while the third has a broad head. When the white man arrived, the Western Islanders practised totemism, but among the Eastern Islanders it had disappeared. They believed in the continuity of life after death. Certain pantomimic ceremonies connected with this belief were said to have come from the island of Daru, off the coast of New Guinea. In the west the great funeral ceremonies were also the occasion for ceremonies connected with dugong hunting, when the spears, etc., were given fresh power. At these ceremonies the spirits of the dead were believed to be present. The ceremonies of Mer consisted of two main elements: (1) the dramatisation of a legend accounting for various matters connected with funeral ceremonies, and (2) the pantomimic representation of persons recently, and remotely, deceased as denizens of the spirit world. Certain men in Mabuiag were said to have friends in the spirit world and to have a gift of spirit divination. At Mawata a turtle ceremony was celebrated when the turtle were breeding. Various ceremonies in which masked dancers took part ensured good fishing and the ripening of wild fruits. Hero-cults invading the islands afforded an inspiring and consolidating influence previously lacking, but their origin is still obscure.

Abnormal Teeth in Mammals.—A weighty paper on abnormal teeth in certain mammals, and particularly in the rabbit, has been published by the veteran zoologist, Prof. W. C. McIntosh, who has just celebrated his ninety-third birthday (*Trans. Roy. Soc. Edinburgh*, vol. 56, 1929, pt. 2, p. 333). The chief contributions on the subject are summarised, and many new examples of abnormality are described and illustrated in 103 text-figures. The conclusion is reached that, amongst rabbits and other mammals as well, there is a close connexion between abnormalities of the teeth and congenital defect or disease. No case of abnormality in the teeth from injury was met with, and when injury was apparent, as in the distal arch of the mandible of a cat, the disrupted teeth were of normal structure.

Physical Basis of Emanation Therapy.—A recent paper by Prof. Stefan Meyer in the *Sitzungsberichte* of the Academy of Sciences of Vienna (vol. 138, p. 557) deals with the history of radium emanation in the body after it has been administered for therapeutic purposes. Whether it is introduced by way of the lungs or stomach, by far the greater proportion reappears in the air exhaled from the former organs. The content of emanation in the breath varies in a simple way with time, rising to a maximum and then falling off after administration in solution, and falling off continually but not exponentially when it has been introduced diluted with air. The two curves showing the amount of emanation in the breath at various times belong to types which are well known in the theory of the growth and decay of radio-active elements, but in this case the 'half-period' corresponds to transfer of emanation from one part of the body to another. The rate of transfer varies both with the individual and with his condition, but approximately ten minutes are required to evacuate half of the emanation in the lungs by way of the mouth, and about half an hour elapses before half of a charge of emanation in the stomach has been absorbed and passed to the lungs. When emanation is absorbed by the blood from the lungs and again returned to them, the corresponding half-period is much the same as when it is passed from the stomach to the lungs. Other investigations are described in the same paper, which should prove to be a valuable contribution to the theory of radium therapy.

Fisheries Industry in Japan.—Among the most important industries of Japan is that of fishing, some figures regarding which were given by Mr. S. Kato in a paper to the World Engineering Conference held in Japan at the beginning of November (see *Engineering*, Nov. 15, p. 652). Japan is said to have an output of more than 2,000,000 tons of aquatic products, all but twice as big as that of Great Britain and Ireland. The fishing industry in Japan employs more than 1,000,000 people and 350,000 boats, as against the 90,000 men and 20,000 boats employed in Great Britain. The output per head and per boat in Japan is therefore comparatively small, but Mr. Kato gave particulars of the steam and motor fishing boats being developed in Japan by which the industry will be made more efficient. These boats are for bonito fishing, seine fishing, and for crab canning. Bonito fishing is carried on from April to September, and the boats for this are of 100 tons, with Diesel engines of 200 horse-power. The twin-screw seine fishing boats are somewhat smaller, but the floating canneries for crab fishing run from 700 to 4000 tons and are steam vessels. A 3000-ton steamer carries 2000 tons of coal, 20,000 cans, and 800 tons of fresh water. In addition to its crew, it has some 450 fishermen and other workmen. Such a parent ship is accompanied by motor junks and motor boats for the actual fishing. The equipment of a large crab cannery includes crushing, pressing, and drying machinery to make fish oil and fish meal from crab-waste.

Fauna of Pitcher Plants.—The general principle of the insect-trap in pitcher plants is well known, and the organisms ordinarily found living in the fluid of the pitchers are of an exceptional character. Since the fluid contains both proteolytic enzymes and bacteria, it would suggest the occurrence in these organisms of antiproteases to safeguard them from the action of the protease—a fact that has been shown to occur by Hepburn and Jones in the case of a fly larva (*Sarcophaga sarraceniæ*). In Part 7 of Vol. 6 of the *Journal of the Malayan Branch of the Royal Asiatic Society*, Mr. Cedric Dover discusses the pitcher-plant fauna of Singapore Island with particular reference to the resistance of mosquito larvæ to the action of the pitcher fluid. His experiments indicate that many of these larvæ living in such situations contain a potential pepsin resistance, which is developed in the presence of pepsin, and he suggests that a biochemist should study the question more fully. If his conclusions are substantiated, they would seem to indicate that environment is a powerful factor in altering the constitution of an organism. It is noteworthy that Culicid larvæ obtained from stagnant water were only able to survive in the pitcher fluid for a few hours, being almost completely dissolved in three or four days. Among the fauna of these plants,

Batrachian larvæ, fly larvæ, Protozoa, and other organisms are dealt with by different authorities in the groups concerned.

Australian Coleoptera of the Family Dryopidæ.—In the *Australian Zoologist*, Vol. 6, 1929, pp. 50-71 (7 plates) Messrs. H. J. Carter and E. H. Zeck contribute an important paper on the Australian representatives of this family of beetles. These insects mostly frequent clear mountain streams ; they are small or minute creatures varying from 1 mm. to 5 mm. in length and very little is known concerning their biology. Although aquatic, they possess no special adaptive organs and are quite unable to swim. They crawl about on the bottom of the water, and the authors record having kept living examples in a vessel of water for five months, without detecting any apparent attempt on the part of the insects to reach the surface. Comparison with the New Zealand fauna reveals the interesting fact that all the Australian species, excepting two, belong to the subfamily Helminæ, which is unknown in New Zealand. The authors list forty-one species, and of these twenty are described as new : two new genera are also diagnosed. The paper is illustrated by exceptionally good figures of these obscure insects, drawn by Mr. E. H. Zeck.

A Revision of the Copepod Genus *Sapphirina*.—Anyone who has had the experience of examining a rich sample of plankton from tropical seas will probably recall his first meeting with a specimen of one of the large species of *Sapphirina* or *Copilia*. These extraordinary copepods may be very large—*S. iris* is 5-7 mm. long—leaf-like creatures so wholly transparent that their presence is perhaps only first realised when puzzling streaks or markings appear above some other object which is being examined. While the beauty of these transparent copepods and the problem of their life-history and probable semi-parasitic relation to *Salpa* make them of unusual general interest, their systematic study is extremely difficult. Lehnhofer (*Wiss. Ergeb. Deutsch. Tiefsee-Exp.*, **22**, Heft 5 ; 1929) has now given a revision of the whole genus *Sapphirina* which raises some points of special importance. He recognises 10 sharply defined species, but the remainder he finds impossible to treat in the same way. Six of them are bracketed in pairs as the extreme forms of unbroken variation-series ; for example, *auronitens-sinuicauda*—while *nigromaculata* Cls. and *scarlata* Giesb. are dealt with as " angenäherten Arten " separable only by small differences in size and doubtfully distinct. Lehnhofer gives in all cases curves of measurements which illustrate clearly the variability of the species. This revision is purely systematic and does not appreciably advance our knowledge of the biology of the genus. Its chief interest lies in the presentation of a good example of the conception of species as groups with extremely wide range of variability, the limits of which are with difficulty definable.

Antarctic Anemones.—Dr. Oscar Carlgren and Dr. T. A. Stephenson describe five new species of Actiniaria from the Australian Antarctic Expedition, 1911–1914 (*Scientific Reports*, vol. 9, Part 2, Series C, Zoology and Botany, April 1929), fourteen species in all being recorded. Embryos were found in the cœlenteric cavity in *Helianthella kerguelensis*, probably having entered the cœlenteron from the brood pouch. In *Bunodactis sulcata*, contrary to Clubb's statement that there are several brood pouches, there was found to be a single brood pouch containing large embryos with much yolk consisting of fat globules. Line drawings in the text illustrate various anatomical features, but there are no figures of the whole animals.

Effect of Genes on Crossing-over.—A detailed analytical study of the influence of particular genes on the crossing-over which takes place in the chromosome to which they belong has been made by Serebrovsky, Ivanova, and Ferry (*Jour. Genetics*, vol. 21, No. 2), using the genes *y* (yellow), a recessive lethal, and a dominant lethal (notch) at the left end of the *X*-chromosome. It is found, in an investigation involving some 60,000 flies, that the introduction of mutations into a chromosome is accompanied by changes in the crossing-over values, especially near the locus of the introduced mutation. The amount of such change is greatest for the notch lethal and least for *y*. This work is a continuation of work which began with the investigation of the effect of the gene ' purple ' on crossing-over. The presence of notch lethal increased the cross-overs between eosin and echinus. Similarly, the recessive lethal increased the crossing-over in loci near it, but with yellow the result was not so clear. The results are explained in terms of the presence-absence hypothesis. It is supposed that the appearance of a recessive gene actually shortens the chromosome, corresponding to a slight deficiency, and leads to asymmetry, reducing the amount of crossing-over. The introduction of genes into the chromosome mate will tend to lessen this asymmetry and so increase the amount of crossing-over.

Studies on *Ranunculus*.—Mixed sexual forms of flowers in *Ranunculus* have been recorded for many years and are now being intensively studied by Messrs. Marsden-Jones and Turrill. In a recent paper (*Jour. Genetics*, vol. 21, No. 2) they record preliminary data regarding crosses between the various sex-forms, but thus far no consistent interpretation of the results appears. Observations are also made on the yellow, lemon, and pale forms of *R. acris* and *R. bulbosus*. These colours are independent of the sex expression, and it is found that plants of all three colours can be heterozygous for colour. In a field in Warwickshire the distribution of the pale flowered individuals indicates that they have spread from a single mutational ancestor. Mr. R. O. Whyte, who is co-operating in a cytological study of the ' intersexes ', has obtained some interesting results. Male, female, and intermediate forms are found to differ in the length of the interval between the critical stages of pollen and embryo sac formation. This is associated with differences in the functional activity of the tapetum, which in turn may be determined by differences in the vascular supply to the different types of flowers. In the form with ' female ' flowers, the reduction divisions in anthers and ovules are coincident, whereas in normal hermaphrodite plants the anther meiosis is much earlier, and the tapetum fully functional. Another interesting fact brought out by these and other studies is that whereas the chromosome number for normal *R. acris* is 14 in England, Sweden, and New York, at Tzarskoe Selo 12 were found. The studies of Sorokin in America indicate instability in other characters associated with gynodimorphism and variations in the chromosome content of the nuclei.

Fossil Vertebrates of North America.—The Carnegie Institution of Washington has produced Volume I of the " Second Bibliography and Catalogue of the Fossil Vertebrata of North America " (*Publication* No. 390), by Dr. O. P. Hay. There are 513 pages of bibliography, and an examination of this section makes the title of the work appear a little misleading, seeing that the entries cover a much wider range than American vertebrates alone. There are, for example, more than seven columns devoted to Huxley's papers, or, to come to modern times, some ten columns to

Abel's works, which again cover a wide field of palæontological investigation. Of this discrepancy between title and contents one can scarcely complain, seeing that the larger the bibliography is the more useful it is likely to prove. The second section consists of 400 pages devoted to a classification of extinct vertebrates from fishes as far as the amphibia, a supplement and index. A full cross reference to authors is given under each species mentioned in the catalogue. Errors in a compilation of this kind must be expected, but these are far outweighed by the obvious value of the work to students, whose time in searching out references will be much saved, and they owe a debt of gratitude to Dr. Hay for this great and laborious work. Its continuation, which is promised, will be welcomed.

Survey by Air Photographs.—The methods of surveying by the use of air photographs was the subject of a recent *Professional Paper* of the Air Survey Committee of the War Office. A continuation and amplification of that paper now appears in "Extensions of the 'Arundel' Method", by Captain M. Hotine (*Professional Paper*, No. 6, 4*s*. net.). The 'Arundel' method was designed for areas in which differences in ground height are less than one-tenth of the flying height. Among other aspects of the problem, this paper deals with the extension of the method of survey to mountainous areas. For this purpose an experimental survey was made of Glen Clova in Forfarshire (Angus), and the result is published on a scale of 1 to 20,000 with a contour interval of 50 feet. It was found necessary to set the time interval of exposure for overlap by observation on the high ground, for the normal overlaps, forward and lateral, are otherwise shortened or excised for considerable elevations. The lighting of steep slopes involves consideration in time of flying, the eastern and western slopes being best photographed in the morning and evening respectively. Valley mists and vertical air currents were minor difficulties and the pilot had difficulty in maintaining a constant height over this type of country. The paper goes on to consider contouring and plotting.

Superconductivity in a Compound.—A fresh case of superconductivity is described by Prof. W. Meissner in a communication from the Physikalisch-Technische Reichsanstalt appearing in the issue of the *Zeitschrift für Physik* for Nov. 9. When copper wire is heated in the vapour of sulphur, it passes into copper sulphide (CuS) without change in geometrical form. The resulting material has a specific resistance of 4×10^{-5} at 0° C., and—taking this value as a convenient unit—a resistance of 0·30 at the temperature of liquid air (86° absolute), and one of 0·02 in boiling hydrogen (20° abs.). At the normal boiling point of helium (4° abs.) the resistance has fallen further, to 0·004, but below this temperature it remains almost constant down to 1·66° absolute, when a sudden drop takes place to an immeasurably small quantity, which then persists for temperatures below about 1·55°. The occurrence of superconductivity in a compound is in itself important, and it is also remarkable that the residual constant resistance found immediately before the superconducting state is attained has the small value which has hitherto always been found to be associated with very pure metals.

Structure of Complex Compounds.—The structures of complex polyacids is now generally explained by a theory due to Miolati and Rosenheim, based on Werner's theory. Whilst this enables a considerable amount of order to be brought into the chemistry of these compounds, it is not always satisfactory and is sometimes rather arbitrary. In the April and October numbers of the *Journal of the American Chemical Society*, L. Pauling has put forward an alternative method which seems to offer possibilities in those cases where the structure may be regarded as formed of anions and cations. The method is somewhat on the lines of that used by W. L. Bragg in elucidating the structure of silicates and depends on the use of crystal data. In considering the tungstosilicate ion, for example, it is pointed out that the crystal radius of the ion W^{+6} is such that six oxygen ions could be grouped about it at corners of an octahedron. Stable complexes can then be formed by arranging WO_6 octahedra in such a way that they share corners with each other. A number of subsidiary principles enter, for which the originals must be consulted.

Optical Activity of Diphenyl Derivatives.—Prof. Kenner's discovery of optical activity among derivatives of diphenic acid has led to the adoption of the interesting suggestion of W. H. Mills that the presence of substituents near to the junction of the two aromatic nuclei produces mechanical interference of free rotation of the nuclei about their common link. This view has been supported by the work of Meisenheimer and, in the November issue of the *Berichte der deutschen chemischen Gesellschaft*, further experimental evidence in support of it is brought forward by F. Pufahl, who describes some hitherto unknown derivatives, which contain substituents in the 5·5′ positions. These resemble the 4·4′ derivatives in being optically inactive and in giving rise to anhydrides. Thus the resolution of derivatives into optical isomerides appears to be confined to such as contain substituents in the 6·0 positions.

Rates of Saponification of Oils.—Very little work has been done on the rates of saponification of oils and of pure triglycerides by aqueous alkali, and the experiments described by McBain, Humphreys, and Kawakami in the October number of the *Journal of the Chemical Society*, which add considerably to the information on this subject, are therefore of interest. A large number of materials, including commercial oils and fats, were used, and the rates of saponification by soda were measured under strictly comparable conditions. All reagents were kept in large excess except the dilute hydroxide, the rate of disappearance of which was followed by means of the hydrogen electrode and was found to be unimolecular so far as the hydroxyl ion is concerned. A soap was used as a constant emulsifying agent and the liquid was rapidly stirred. Castor oil was most rapidly saponified, and colza oil most slowly. Lard is rather rapidly saponified, but olive oil slowly, this oil being next to colza oil. Two specimens of lard showed rather different rates. The range of time is great, being 200-fold for the extreme cases. This is due, according to the authors, to the different ease and degree of emulsification of the various oils. In saponification, as in other related fields, reactions are supposed to take place at the interface between oil and water and not in either phase, and hence the primary factor is the development of this interface, which is favoured by emulsifying agents and by the degree of readiness of the oil to be emulsified. Free fatty acid in the oil increases the readiness to emulsify. Apart from castor oil, there is a relation between iodine value and rate of saponification, unsaturated oils being slower than saturated. Multiple double bonds in the carbon chain seem to inhibit saponification more than single ones such as oleate radicals. There is no relation between the emulsifying power of a soap and the emulsifiability of the corresponding oil.

Water Power Development in Canada and Malaya.

A NOTABLE step in the development of Canadian water power resources has just been taken in the inauguration by His Excellency the Governor-General of constructional operations for the power house which is to be erected by the Beauharnois Power Corporation just above the shores of Lake St. Louis, near the village of Beauharnois.

The scheme includes a canal for the diversion of the water of the St. Lawrence River for power production and also for navigation purposes. This canal, work on which has been commenced by the formation, simultaneously, of two dykes at Valleyfield, when completed, will have a depth of 30 ft., which will be sufficient to accommodate the largest vessels now navigating the Great Lakes. The power station will utilise the 83 ft. fall in the St. Lawrence River between Lakes St. Francis and St. Louis, which lie just above the city of Montreal. It is claimed that it will ultimately become the largest hydro-electric generating station in the world.

The present programme is to provide a development of 200,000 horse-power by Oct. 1, 1932, but it will be possible to increase this figure, which is the minimum limit, to 350,000 h.p. by the same date, if so required, and a primary objective of 500,000 h.p. has been decided upon by the executive officials of the organisation. The extent of ultimate development will depend on the quantity of water permitted to be diverted from the St. Lawrence. The company has, at present, been conceded the right to divert 40,000 cusec. (cu. ft. per sec.). Across the river on the left bank, the Cedar Rapids installation of the Montreal Light, Heat, and Power Consolidated is generating 200,000 h.p. from a head of only 32 ft. If this water were diverted through the Beauharnois Canal, it is claimed that there would be a threefold economy and that nearly 600,000 h.p. could be developed. It is stated, furthermore, that an ultimate development of two million h.p. would be possible if the whole of the water in the St. Lawrence channels were diverted through the canal.

In the meantime, the project in hand involves the expenditure of 16,000,000 dollars on the canal and a total expenditure estimated at 65,000,000 dollars for the installation of 500,000 h.p. During the next three years the countryside on the south bank of the St. Lawrence from Beauharnois to Valleyfield will be the scene of constructional operations of considerable magnitude among enterprises in the history of Canadian water power development.

In the *Metropolitan Vickers Gazette* for October there is an interesting account of the Perak River hydro-electric scheme which is being erected in the Federated Malay States and will be opened next year. It illustrates some of the difficulties that have to be overcome in setting up one of the latest products of engineering skill in the Far East. The photographs shown of 66-kilovolt overhead wires and substations are very similar to corresponding systems in Europe.

The main supply station is a hydro-electric one situated on the west bank of the Perak River, sixty miles north of Malim Nawar. It is the main supply station but it works in parallel with a steam station. All the outdoor substation structures are flood-lighted at night. Double parabolic reflector type projector lamps are fitted on the top of steel poles fifteen feet high. The only objection to the lighting is the fatal attraction it has for the many insects with which the country abounds. The crowds of flying beetles round these lamps sometimes alarm the superstitious watchmen. The working of the whole system is almost entirely automatic. The Cambridge Instrument Co. has supplied the temperature indicators and alarm equipment for the whole scheme. Thermocouples are provided, the temperature of the cold junction being kept constant by a thermostat. Chinese, Indian, and Malay native workmen were employed. The atmosphere compelled attention to all flesh wounds, but the iodine treatment caused the natives to flinch, although they would cheerfully cauterise a wound with a lighted match.

Conversion Tables for Galactic Co-ordinates.

PROF. PIO EMANUELLI, secretary of the Vatican Observatory, has just published an extensive table for the conversion of Right Ascension and Declination into galactic co-ordinates, which forms an appendix to vol. 14 of the *Publications* of the Observatory.

The author gives a summary of the various positions of the north galactic pole as determined by different authorities, and decided to adopt Newcomb's value (slightly modified), rather than a combination of different values. The adopted position of the pole for the equinox of 1900 is R.A. 191·1°, North Decl. 26·8°. It is within half a degree of Heis's position.

In reducing to galactic co-ordinates, a zero of galactic longitude must be selected. Most authorities up to the present have adopted the intersection of the galactic equator with the equator of 1900. This is open to objection since the equator changes greatly owing to precession, and the equator of 1900 would be very inconvenient in distant epochs in the future. Dr. Innes suggested using the galactic longitude of the solar apex, which is assumed to be R.A. 270°, North Decl. 30°, for the equinox of 1900. This is the value adopted in the tables, although the author points out that the International Astronomical Union decided both in 1925 and in 1928 that the star Alpha Cygni should be taken as the zero of longitude. It has the double advantage of being close to the galactic equator (distance one degree) and of having almost insensible proper motion. Further, it is a definite and brilliant point, whereas the solar apex is invisible, and is uncertain by a few degrees; moreover, it is 22° from the galactic equator. However, the table can easily be adapted to give longitudes from Alpha Cygni; it is only necessary to *subtract* (not *add*, as erroneously stated both on p. xv and p. xix) the quantity 27·9°; another erratum in the tables is that this correction is stated to vary with the epoch; it is constant and independent of precession. The correction to reduce the longitude to the intersection of the galaxy with the equator of 1900 is +23·6°; with the equator of 2050 it is +23·8°.

The tables give l, b, the galactic longitude and latitude, to the nearest tenth of a degree for every ten minutes of time in R.A. and every degree of declination. There is a supplementary table for every minute of R.A. in the neighbourhood of the galactic poles. Attention should be paid to the short list of errata at the end of the tables.

Rev. J. G. Hagen, S.J., the Director of the Observatory, contributes a preface, in which he notes that the tables will be applied to obtain the galactic co-ordinates of the nebulæ observed by him; they will be mapped on an equal-area projection.

Rice Grass and Land Reclamation.

THE economic possibilities of *Spartina Townsendii*, commonly known as rice grass, are described in an illustrated booklet issued by the Ministry of Agriculture (Miscellaneous Publications, No. 66, price 8*d*.). The grass, a tall rhizomous, deep rooting plant, occurs on maritime muds and was first recorded in England on the Southampton salt marshes in 1870. Its spread along the south coast has been very rapid, from fifteen to twenty years being usually sufficient for the conversion of waste land into continuous meadow. Propagation is effected by seed or fragments of runners.

The value of *Spartina* lies in the fact that it is particularly suitable for land reclamation and protection, and at the same time can be used for feeding to stock. The grass, owing to its extensive underground system, has the property of binding the mud in which it grows, and with the help of silting brings about a rise in the level of the land. Valueless mud flats can thus be brought into use, and sea walls or banks protected from erosion by consolidation of the mud in front. As food for stock, *Spartina* offers great possibilities. All farm animals eat it readily, whether cut fresh or as hay, and since it remains on its root throughout the winter, it forms a convenient reserve food.

The composition of *Spartina*, apart from mineral matter, is somewhat similar to good meadow hay, and preliminary feeding trials showed it to be fully digestible to sheep.

Experiments are in progress at the East Anglian Institute of Agriculture to determine the best way of introducing and growing *Spartina*, particularly with the view of feeding it to stock. The question as to whether it can be used most profitably fresh, or as hay or silage, are among other problems under investigation.

Although sufficient time has not yet elapsed for any definite results to have been obtained from the experimental plantings in Essex, the growth appears entirely satisfactory, and there is every prospect of its proving valuable to the farmer. In other countries of temperate climate *Spartina* also grows readily. The natural spread of the plant along the coast of France has been most impressive, and cuttings exported from Poole Harbour for experimental planting on the muds of Holland have rapidly become established. The plant seems likely to prove of inestimable value in the solution of the ever-present problem of land reclamation and protection in the latter country.

A feature that must not be overlooked when plans for the introduction of *Spartina* to an estuary are contemplated, is the inevitable reduction in the flow of tidal water when the plant becomes established. In certain circumstances this might adversely affect navigation or land drainage. Apart from this, however, the economic possibilities of *Spartina* appear very promising.

University and Educational Intelligence.

CAMBRIDGE.—C. F. A. Pantin, of Trinity and Christ's Colleges, has been appointed University lecturer in zoology for three years. J. E. E. Craster, of Downing College, has been appointed University lecturer in geography for three years.

Dr. F. P. Bowden has been elected into a fellowship at Gonville and Caius College.

RESEARCH scholarships for the encouragement of work in sanitary science are being offered by the Grocers Company. The scholarships are of the value of £300 a year, plus an allowance for apparatus and other expenses, and are tenable for one year, with possibility of renewal for two or three years. Applications must be received by the Clerk to the Grocers Company, Grocers Hall, E.C.2, before the end of April next.

BIRKBECK College, which has since 1920 enjoyed the status of a school of the University of London, has sent us with its Calendar for 1929–30 the first annual Haldane memorial lecture, delivered last May by Lord Justice Sankey. The governors of the College resolved, on the death of Lord Haldane, who had been its president from 1919, to institute this annual memorial lecture in his honour, and the first of the series is devoted, appropriately, to an estimate of his work as lawyer, statesman, and philosopher, and the meaning, object, and value of the adult education movement which he did so much to foster.

THE annual conference of the Geographical Association will be held on Jan. 2–6 at the London School of Economics, Houghton Street, London, W.C.2, under the presidency of Sir Henry Lyons, who will deliver his address on the first day of the meeting. The programme includes discussions on the physical basis of geography in independent schools, to be opened by Mr. B. B. Dickinson, geography and the training of teachers, to be opened by Mr. T. Herdman, and lectures by Mr. H. E. Raynes on the mortality of Europeans in equatorial Africa, by Colonel H. L. Crosthwait on air survey, by Sir John Russell on agricultural developments in South Africa, and on national parks by Dr. Vaughan Cornish. The week-end will be devoted to an excursion to Norwich. The president-elect of the Association is Mr. B. B. Dickinson. On Jan. 2–4, a publishers' exhibition of books, maps, and geographical appliances will be open for the use of those attending the conference.

UNIVERSITY College, London, announces in its Calendar for the current session numerous post-graduate courses of lectures (open to students of other London colleges under the inter-collegiate scheme) and facilities for research in its faculties of arts, laws, science, medical sciences, and engineering, and in the Bartlett School of Architecture. Among recently developed departments of work in the College is that connected with the Ramsay Laboratory of Chemical Engineering. Here the bulk of the work will be of a research character and directed towards the elucidation of industrial problems. The Calendar contains a list, running to 28 pages, of original papers published during the past year in the various departments, the most prolific of which is the department of physiology and bio-chemistry, which was responsible for fifty-three original papers. Among voluminous appendices appears Sir Gregory Foster's annual report for 1928–29, a year noteworthy in the history alike of the College and the University as that in which statutes giving effect to the new constitution of the University were sealed and the new University Court and Collegiate Council were established, and the Calendar contains, very appropriately, an eloquent tribute to Lord Haldane's services to University education in general and the University of London in particular. "No man of his own or any other generation", said Sir Walter Morley Fletcher in recounting those services in the course of his address to the assembly of the faculties of July 4, "has done more to promote the growth of University education in this country." University College, having enjoyed for twenty-five years the leadership of Sir Gregory Foster, will shortly welcome his successor, Mr. Allen Mawer, who is to take over its administration as Provost on Jan. 1, 1930.

Calendar of Patent Records.

December 14, 1688.—On Dec. 14, 1688, Abraham Thevart was granted a privilege for 30 years by Louis XIV " de faire seul, à l'exclusion de tous autres, de fabriquer où bon leur semblera, des glaces de soixante pouces de haut, sur quarante pouces de large, et de toutes autres hauteurs et largeurs au-dessus, . . . et pour cet effet se servir seulement des machines que ledit Thevart a inventées ", on condition that a description of the process be presented within three months. Thevart set up his factory first in the Faubourg St. Antoine and later at St. Gobain, where large sheets of glass were cast in 1693, the first four pieces being presented to the king. In England the first large glass sheets were manufactured by the Company of British Cast Plate Manufacturers, formed in 1773, in a factory at St. Helens, Lancashire.

December 15, 1883.—It was Gottlieb Daimler who first realised the importance of high piston speeds for the internal combustion engine, and the motor-car industry really dates from his patent, which was applied for in Germany on Dec. 15, 1883. His first engine—a four-stroke engine running on benzene—was built into a bicycle, which was driven for the first time in November 1886 in the streets of Cannstatt.

December 16, 1835.—Henry Booth, one of the chief promoters of the Liverpool and Manchester Railway, and the first secretary of the Company, invented the common screw-coupling for railways. It was adopted by his company and has continued in use to the present day. His patent, dated Dec. 16, 1835, for " an improved method of attaching railway carriages together for the purpose of obtaining steadiness and smoothness of motion ", probably was for this invention, but no specification was enrolled and the patent became void within two months of the grant.

December 20, 1822.—The first 'eversharp' pencil was patented in England by John Isaac Hawkins and Sampson Mordan on Dec. 20, 1822, with the title " Improvements on pencil holders for the purpose of facilitating writing and drawing by rendering the frequent cutting of the points unnecessary." The projection of the lead was governed by screw mechanism within the pencil holder.

December 21, 1612.—The patent granted to Joseph Usher, Warner Rich, and Godfrey Devette, on Dec. 21, 1612, for a new engine for supplying water to cities and towns and private houses, etc., contains a provision that a model of the invention is to be supplied within one month from the date of the grant, and furnishes an early example of the official requirement of a description of the invention as a condition of the grant. Sir Hugh Myddleton's patent for the supply of water to London was granted in the previous May, and this may have been the cause of the insertion of the proviso in the later grant.

December 21, 1736.—Jonathan Hull's patent for his " machine for carrying vessels or ships out of or into any harbour, port, or river, against wind or tide or in a calm ", was granted on Dec. 21, 1736. Hull proposed to use a Newcomen engine to propel a tug-boat, by means of a stern paddle wheel operated through rope gear and pawl and ratchet mechanism. His experiments were presumably not successful, but he published in the following year a book describing the invention, which may have stimulated the later inventors.

December 21, 1802.—" Tatham's Clumps ", which were interlocking bricks for building circular structures such as wells, columns, pipes, etc., were patented by William Tatham and others on Dec. 21, 1802. The bricks were made at the works of Scott and Clarkson, at Hackney.

Societies and Academies.

LONDON.

Royal Society, Dec. 5.—F. A. B. Ward, C. E. Wynn-Williams, and H. M. Cave: The rate of emission of alpha-particles from radium. A new type of electrical counter was used in which the whole of the amplification is produced by triode valves. The amplification was linear, so that the counting of α-rays was undisturbed by the presence of β-rays. About 500 particles per minute could be counted. The rate of emission from radium determined by counting about 10^5 α-particles was $3{\cdot}66 \times 10^{10}$ α-particles per sec. per gm. of radium.—E. J. Williams and F. R. Terroux: Investigation of the passage of fast beta-particles through gases. The primary ionisation for beta-particles of 0·5-0·9 of the velocity of light, determined in the Wilson cloud chamber, appears to approach limits of 22 ions per cm. in oxygen, and 5 ions per cm. in hydrogen. Variation with velocity differs appreciably from that predicted on classical theory. From the frequency of branch-tracks, the magnetic moment of an electron seems considerably less than a Bohr magneton. Momentum appears to be conserved in branch collisions.—R. J. C. Howland: On the stresses in the neighbourhood of a circular hole in a strip under tension. The problem is solved by successive approximation for the case in which the stress-system is symmetrical both about axis of strip and about perpendicular diameter of hole. General formulæ are given expressing each approximation in terms of the preceding. The coefficients of the transformation depend upon transcendental integrals which are estimated numerically and coefficients are then tabulated. When the ratio of diameter of hole to diameter of strip does not exceed 0·5, greatest stress at boundary of hole is nearly $4\frac{1}{3}$ times tension at infinity. On the edge, tension rises from a minimum of less than $\frac{3}{4}$ of applied tension at point nearest to hole, to maxima, not much less than twice applied tension, at about one-third of width of strip on either side of central section. On the axis, disturbance due to hole becomes inappreciable at a distance from centre of hole equal to about $1\frac{1}{2}$ times width of strip.

Geological Society, Nov. 20.—D. Williams: The geology of the country between Nant Peris and Nant Ffrancon (Snowdonia) The general stratigraphical succession is given. The topmost Cambrian beds, the Ffestiniog or *Lingula* Grits, are of shallow-water origin. They are faulted against blue-black slates, probably of Lower Llanvirn age. Upwards, the slates pass into the paler Llandeilo slates with *Glyptograptus teretiusculus*, at the top of which occur the Talgau lavas apparently belonging to the Glyder Fach-Capel Curig volcanic suite. These earliest flows are notably sodic. The Snowdon Volcanic Suite is essentially composed of potash-rhyolites and rhyolite-tuffs, succeeded, near the Devil's Kitchen, by pumice-tuffs and flows of andesitic or basaltic character. The Upper Rhyolitic Series of Snowdon itself is here absent. Two large acid plutonic masses, Moel Perfedd and Bwlch-y-Cywion, are believed to represent the denuded plugs of the vents from which the Lower Rhyolitic Series was extruded. Both the folding and the cleavage, which strike approximately north-east and south-west, are attributed to Caledonian earth-movements, the cleavage following closely upon the folding, but preceding the faulting. 'Cleavage-fans' are conspicuous, two 'synclines' being separated by an 'anticline'. There appears to be no evidence in this area of the post-cleavage thrusting observable on Snowdon.—Beeby Thompson: The Upper Estuarine series of Northamptonshire and

northern Oxfordshire. J. W. Judd, in 1867, gave the name 'Upper Estuarine Series' to a series of variable beds, largely variegated clays containing abundance of vegetable matter of probably freshwater origin, interspersed with brackish-water beds and with distinctly marine beds. The author in 1909 recognised an 'Upper Estuarine Limestone', commonly a water-bearing bed in the midst of the series. This bed divides the series into three parts, on which additional information is given. In northern Oxfordshire, between certain inferior oolite limestones or white sands (the time-equivalents of the Lincolnshire limestone ?), or ferruginous sands (the equivalents of the variable beds of the Northampton sand or even of the ironstone series) below, and the great oolite limestone above, occurs a series of beds which in various parts physically, and in others palæontologically, agree, as does the complete set in sequential position, with the Upper Estuarine Series of Northamptonshire. The Northamptonshire and Oxfordshire sections on this geological horizon are thus more definitely correlated. In Part 2 of the paper it is shown how the extended classification of beds can be used for identifying unconformities due to earth-movements developed at different times.

Linnean Society, Nov. 21.—M. J. Godfery: The pollination of *Cephalanthera*. The three British species can be cross-pollinated by insects, though there are no viscid glands to attach the pollinia. An insect retreating from the flower becomes smeared with the viscid secretion of the stigma, which then picks up the pollinia projecting from the anther.—E. B. Poulton: Recent observations on snake-like caterpillars which throw light on a statement in H. W. Bates's classical paper on mimicry. Bates was probably referring to a Sphingid larva which deceived him by the reduction of the caudal horn to a mere hump in the final stage. The two larvæ, *Leucorhampha triptolemus* Cram. and *L. ornatus* Rothsch., behave exactly as Bates described, and bear their terrifying eye-like marks on the ventral surface.—S. K. Montgomery: Report on the Crustacea Brachyura of the Percy Sladen Trust Expedition to the Abrolhos Islands under the leadership of Prof. W. J. Dakin, D.Sc., F.L.S., in 1913; along with other crabs from Western Australia. Of 57 species and varieties in the collection, there are 8 species and 4 varieties described as new; and a new genus is suggested to contain one of these, along with *Grapsus inornatus* (Hess) and *Brachynotus octodentatus* (Milne-Edwards). The Brachyuran fauna of the Abrolhos Islands is more nearly related to that of the north of Australia than to that of the south and south-west. The Ninety Mile Beach, north of Broome, has divided the Brachyura into a northern and a north-western group. The relative absence of the Oxystomes both from the north-western and the southern groups is noted. The Brachyuran fauna of Australia as a whole, and of the south of Australia in particular, varies considerably from the general homogeneity of the Indo-Pacific.

Physical Society, Nov. 22.—D. P. Dalzell: Heaviside's operational method. The method of treatment incorporates the views of the late T. J. I'A. Bromwich with those of J. R. Carson, and is identical with that advocated by Van der Pol. It involves unrestricted use of complex integration as employed by Bromwich, and thus avoids such uncertainties as arise from the use of operators denoted by incomplete symbols. The theory of integration provides a complete explanation of all the aspects of Heaviside's method of solving differential equations.—E. T. Hanson: The dynamical theory of resonators. The theory of the small resonator with neck communicating with the open air depends upon the assumption that the air within the neck may be treated as an imcompressible fluid. The theory is extended to include generally necks of variable cross section.—E. C. Atkinson: Escapement errors of pendulum clock. Prof. Sampson's theory of maintenance is applied to find equations for the errors of rate caused by changes in intensity and limits of the impulse and in friction of moving parts of the impulse mechanism. For the Cottingham clock, rigidity of the stops limiting the impulse is the most important point in design. The equations are also given for the dead beat escapement and show that working conditions which are good so far as friction is concerned are bad for barometric changes. The method used for computing 'remote' error in these cases must be modified when the inertia of the impulse mechanism is appreciable as in the Shortt clock.

DUBLIN.

Royal Irish Academy, Nov. 11.—J. J. Nolan and J. G. O'Keeffe: The ions produced by discharge at liquid surfaces. Chattock's method is used to determine the mobilities of ions produced in discharges at water and alcohol surfaces. The ions are of the same character as those produced by discharge at metal points or by the ionising radiations. The observation of Tyndall and Phillips, that in air saturated with *n*-butyl and *n*-amyl alcohols the mobility of the positive ion is greater than that of the negative, is confirmed.—Miss A. L. Massy: The Mollusca of the Irish Atlantic Slope. The Mollusca (other than the Cephalopoda, Amphineura, Pteropoda, and Heteropoda and Nudibranchia) taken by the Fisheries Branch of the Department of Agriculture, Dublin, on the west of Ireland since the year 1900: the area covered is between lat. 49° N. and lat. 56° N. Records east of the Fastnet Light, Co. Cork, have been excluded and the western boundary is the 1500 fathom line. Many rare deep-water species have been captured. 313 species are enumerated, and under the fossil distribution will be found many records from Irish and Scandinavian sources not very accessible to students of the group.

PARIS.

Academy of Sciences, Nov. 4.—Eugène Slutzky: The extension of the theory of periodograms to series of dependent quantities.—B. Demtchenko: An inverse problem to the problem of Dirichlet.—Henri Cartan: The zeros of the linear combinations of p given integral functions.—Georges Valiron: Meromorph algebroid functions.—A. Markoff, jun.: Nearly periodic movements.—E. G. Barrillon: Concerning discs rotating in a fluid.—R. de Mallemann: The calculation of the atomic frequencies in solids. The formula of Lindemann rests on the hypothesis that at the melting-point the amplitude of the atomic vibrations should be equal to the mean distance of the atoms. From the author's calculations this is inexact, and the ratio is smaller than unity, 0·06 for aluminium, silver, gold, platinum, copper, iron, nickel, cobalt; 0·08 for the alkaline metals; and 0·04 for liquid mercury. This ratio is practically equal to the product of the coefficient of expansion and the absolute temperature of fusion.—Albert Turpain and Michel Durepaire: The electric charges developed in certain amorphous dielectrics under the action of pressure. This phenomenon is exhibited by ebonite, paraffin, glass, and especially by crêpe rubber. A diagram is given showing the electrical charges produced in rubber as a function of the pressure.—E. Pierret: A new mode of receiving ultra-short [electric] waves, 10 cm.–18 cm. wave-length.—L.

Jolland: The conductivity of solid salts at high temperatures.—G. Bruhat and R. Legris: The absorption of aqueous solutions of tartaric acid and of alkaline tartrates.—P. Vaillant: The absorption spectrum of cobalt chloride and its variations. Six solutions of cobalt chloride were studied, the first pair in water varying in concentration, the other four at the same concentration but in varying solvents. Analysis of the results showed that the ion Co^{++} acted throughout as the only absorbing agent, its activity varying with the concentration and with that of the other ions in the solution.—R. Gindre: A phenomenon of atmospheric optics.—Jean Thibaud and Jean J. Trillat: The diffraction of the X-rays in various substances, principally in liquids.—A. Grumbach and S. Schlivitch: The rôle of the atmospheric oxygen in photoelectric batteries with coloured liquids.—A. Boutaric and Mlle. M. Dupin: The slow evolution of mixtures of colloidal solutions resembling anaphylactic effects.—M. Bourguel and Mlle. V. Gredy: The selective action of a hydrogen catalyst. A study of the addition of hydrogen to phenyl-acetylene with colloidal palladium as the catalyst. The determination of the velocities of hydrogenation shows that the reaction takes place in two distinct stages, first the production of phenylethylene and then the formation of the saturated hydrocarbon. The reaction velocities of these two stages differ considerably, and if, after the complete conversion into phenylethylene, the reaction velocity for the second stage is reached, the fresh addition of phenylacetylene to the mixture re-establishes the velocity of the first stage.—Albert Portevin and Pierre Chévenard: The influence of the fineness of structure at the time of annealing grey cast irons.—Dumanois and Mondain-Monval: The direct oxidation of hydrocarbons by the air. A closed bomb containing pentane and air under pressure was maintained at various temperatures between 80° C. and 230° C., portions being withdrawn from time to time and tested for carbon dioxide and for aldehydes. It was shown that some degrees below the temperature of spontaneous inflammation, chemical reactions were taking place in the mixture, heat being disengaged and carbon dioxide and aldehydes being formed. Similar results were obtained when the pentane was replaced by other hydrocarbons (hexane, heptane, octane).—G. Dupont and J. Lévy: The auto-oxidation of abietic acid.—Georges Darzens: The condensation of the chloride of dimethylacrylic acid with benzene: dimethylvinylphenyl ketone as a product of the reaction. This reaction does not give the hydrindone which might be expected, the reaction stopping at the first stage, dimethylvinylphenyl ketone, $C_6H_5 . CO . CH = C(CH_3)_2$.—Maurice Nicloux: The micro-estimation of carbon and the estimation of this element in arable soil. A modification of the method described in earlier communications avoiding the use of a microbalance.—C. P. Nicolesco: The discovery of the Cenomanian in the valley of Ganzeville (Seine Inferieure).—Pierre Lesage: Continuation of researches on precocity and its heredity in *Lepidium sativum*.—M. Bridel and J. Rabaté: Variations in the composition of new branches of *Amelanchier vulgaris*. Determinations of the ameliaroside in the fresh branches showed large variations from month to month: no reasons for this variation can be assigned at present.—Et. Föex and Et. Rosella: Contributions to our knowledge of the *Piétin* of wheat.—J. Magrou, Mme. M. Magrou, and P. Reiss: Action at a distance of various factors on the development of the egg of the sea-urchin.—Mlle. Choucroun: The hypothesis of mitogenetic radiation.—A. Blanchetière: The pepsin and trypsin hydrolyses of the gliadin of wheat in their relation with the formation of the diacipiperazines.

BRUSSELS.

Royal Academy of Belgium, April 13.—Th. De Donder: The invariantive theory of the calculus of variations (4).—Oct. Dony: (1) An experimental contribution to the study of heating and of electric furnaces. The author replaces platinum, or refractory alloys such as nichrome, with soft iron of large cross section, up to 5 mm. diameter for cylindrical wires. The currents employed were of the order of 200 amperes, and with suitable heat insulation, temperatures of 1150°-1200° C. could be maintained for long periods. Examples of laboratory applications of these furnaces are given.—(2) The reduction of zinc oxide by gaseous carbon monoxide at atmospheric pressure and at high pressures. The electric furnace described above has been applied to the reduction of zinc oxide in carbon monoxide at 1100°-1300° C.—D. Pompeiu: An integral property of functions of two real variables.—Jean P. Bosquet: Some fundamental formulæ of the invariantive theory of the calculus of variations.—Louis van den Berghe: Observations on the sense of smell and on the mechanism of the olfactory currents in some Teleostians. The detailed study of five species, with ten illustrations, is given. The sense of smell varies greatly in different forms; *Blennius pholis* finds its prey both by sight and by smell, whereas *Cottus bubalis* does not use the sense of smell.—Maury: Report of the geodesic section of the Institut Cartographique Militaire.—Lucien Godeaux: The fundamental curves of birational transformations of space.—André Grosjean: The discovery of a horizon with marine fauna at the Limbourg-Meuse coal mine at Eysden (Belgian Campine).

May 7.—G. Cesàro: The directions of extinction of an ensemble of two parallel crystalline plates, placed, in monochromatic light, between a fixed polariser and a movable analyser. The conditions necessary for the existence of extinction positions. The fictitious spherical triangle from which these relations can de deduced.—Cl. Servais: The geometry of the tetrahedron.—L. Godeaux: Point correspondences between surfaces.—J. Pasteels: Analysis of the physiology of the egg of the pholas (*Barnea candida*).—A. De Waele: The influence of carbon dioxide on the vernal awakening of the snail. There is an optimum temperature (about 18° C.) for ending the snail's winter sleep: for the same temperatures moisture favours the awakening, and moist carbon dioxide has the same effect. Dry carbon dioxide prolongs the hibernation.—F. Dacos: A crucial experiment for the diffusion of electrons.—E. Leloup: The maturation and fecundation of the egg of *Salpa fusiformis*.—M. Cosyns and R. Moens: Note on piezo-electric quartz. Researches on the limits of the accuracy obtainable with a quartz crystal utilised as a frequency standard. The different factors capable of modifying the frequency are studied singly. The method utilised has the advantage of being a zero method, and at present has an accuracy of the order of one in 10,000.—G. van Lerberghe: The characteristic equation of perfect solutions and of regular solutions.

June 1.—Th. De Donder: The invariantive theory of the calculus of variations (5).—Cl. Servais: The geometry of the tetrahedron (2).—Lucien Godeaux: The connected points of cyclic involutions of order three belonging to an algebraic surface.—Marcel Winants: A generalisation of Fredholm's equation.—P. Swings and Fl. Bureau: The integration of the equation of the quasi-Keplerian orbits by the method of successive approximations.—G. van Lerberghe and Mlle. G. Schouls: A characteristic equation for binary gaseous mixtures.

Official Publications Received.

BRITISH.

The Victorian Bush Nursing Association. Report and Statement of Accounts to 30th June 1929. Pp. 244. (Melbourne.)

City of Belfast: New Museum and Art Gallery. Publication 97: Guide to Casts of Greek and Roman Sculpture. By I. A. Richmond. Pp. 28. (Belfast.) 3*d*.

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 30, Part 2, Session 1928–29. Pp. ix-xv + 67-186 + plates 3-13. (Edinburgh.) 7*s*. 6*d*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1245 (E. 31): Fuel Flowmeters designed to measure Mass Flow. By P. S. Kerr, with Appendices by D. Robinson, R. J. Penn and W. C. Cooper. (I.C.E. 660: I.C.E. 676: I.C.E. 693.) Pp. 21+8 plates. (London: H.M. Stationery Office.) 1*s*. net.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-third Session adopted at the Annual Meeting of Governors held on the 15th October 1929. Pp. 73. (Glasgow.)

John Innes Horticultural Institution. Conference on Polyploidy held at the Institution on January 19th, 1929, to commemorate the Centenary of the birth of the Founder, John Innes. Pp. 48. (London.)

Education and the League of Nations: being the Report of the Joint Committee of Enquiry into the Teaching of the Aims and Achievements of the League of Nations. Pp. 28. (London.)

Report of the Second Quarterly Meeting of the Ross Institute Industrial Anti-Malarial Advisory Committee, held in the Council Chamber of the Rubber Growers' Association, 2 Idol Lane, E.C.3, on Monday, October 14th, at 2.30 P.M. Pp. 8. (London: Ross Institute and Hospital for Tropical Diseases.)

Imperial Cancer Research Fund. Twenty-seventh Annual Report, 1928–1929. Pp. 18. (London.)

Quarterly Journal of the Royal Meteorological Society. Vol. 55, No. 232, October. Pp. 323-418. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Department of Scientific and Industrial Research. Building Science Abstracts, compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 10, October. Abstracts Nos. 1983-2216. Pp. v+351-386. (London: H.M. Stationery Office.) 9*d*. net.

Seventeenth Annual Report of the Director of the Solar Physics Observatory. Pp. 4. (Cambridge.)

Livingstone College. Annual Report and Statement of Accounts for the Year 1928–29. Pp. 24. (London: Leyton, E.10.)

Journal of the Indian Institute of Science. Vol. 12A, Part 13: i. Amylase from *Zea mais*, by Vinayak Narayan Patwardhan; ii. Enzymes from the Seeds of *Caesalpinia bondu ella*, by Vinayak Narayan Patwardhan. Pp. 185-192. (Bangalore.) 8 annas.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin 43: The Bionomics of *Fasciola hepatica* in New South Wales and of the Intermediate Host, *Limnea brazieri* (Smith) By I. Clunies Ross and A. C. McKay. Pp. 62. Pamphlet No. 13: The Mechanical Analysis of Soils. By C. S. Piper and H. G. Poole. Pp. 19. (Melbourne: H. J. Green.)

Report of the 7th Congress of the Far Eastern Association of Tropical Medicine, British India, December 5th, 10th, 24th, 1927. Pp. iii+193. (Kasauli: Central Research Institute.)

The Journal, Hyderabad Geological Survey. Vol. 1, Part 1: i. The Annual Report for 1337 F. of the Geological Survey Department, H.E.H. the Nizam's Government, with Maps and Sections; ii. A History of the Golconda Diamond Mines, compiled from all available Sources with Maps and Appendices, together with a Reprint from the Transactions of the Royal Society of a Paper read in 1677 by the Rt. Hon. the Earl Marshall of England. Pp. v+62. (Lingsuggur: Hyderabad Geological Survey.) 2.8 rupees.

The Ninety-sixth Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 6, Part 3. Pp. xxxi-xl+187-312+14. (Camborne.) 5*s*.

FOREIGN.

Department of the Interior: U.S. Geological Survey. Professional Paper 154-A: Moraines and Shore Lines of the Lake Superior Region. By Frank Leverett. Pp. iv+72+8 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research, Vol. 3, No. 3, September. R.P. No. 99: Thermoelectric Temperature Scales, by William F. Roeser; R.P. No. 100: Light Fastness of Lithographic Ink Pigments, by William D. Appel and Robert F. Reed; R.P. No. 101: Effect of Oxidizing Conditions on Accelerated Electrolytic Corrosion Tests, by Henry S. Rawdon and W. A. Tucker; R.P. No. 102: Representation of Aberration Diffraction Effects by means of Rotating Sectors, by A. H. Bennett; R.P. No. 103: Hot Aqueous Solutions for the Quenching of Steels, by H. J. French and T. E. Hamill; R.P. No. 104: Preparation of Experimental Saggar Bodies according to Fundamental Properties, by R. A. Heindl and L. E. Mong; R.P. No. 105: A Suppressed-Zero Electrodynamic Voltmeter, by F. K. Harris; R.P. No. 106: Two Isomeric Crystalline Compounds of *d*-mannose with Calcium Chloride, by J. K. Dale; R.P. No. 107: A Study of Purified Wood Fibres as a Paper-making Material, by Royal H. Rasch. Pp. 343-506. (Washington, D.C.: Government Printing Office.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Report on the Fisheries of Egypt for the Year 1927. By El Miralai Ahmed Fouad Bey. Translated from the Arabic by Selim Eff. Khoury. Pp. vii+83. (Cairo: Government Publications Office.) 5 P.T.

Bulletin of the American Museum of Natural History. Vol. 58, Art. 11: A Collection of Brachyuran Crustacea from the Bay of Panama and the Fresh Waters of the Canal Zone. By Lee Boone. Pp. 561-583. (New York City.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 22: Secondary Education. By Carl A. Jessen. Pp. 19. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of Agriculture. Technical Bulletin No. 137: The Pandora Moth, a Periodic Pest of Western Pine Forests. By J. E. Patterson. Pp. 20. 5 cents. Technical Bulletin No. 138: Studies on the Fall Army Worm in the Gulf Coast District of Texas. By R. A. Vickery. Pp. 64. 10 cents. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 207: The Angular Intensity Distribution of Continuous X-ray Spectrum. By Y. Sugiura. Pp. 251-290. 65 sen. Nos. 208-213, 208: Über die Alkalicellulose und deren Bedeutung auf die Herstellung der Kunstseide, von Gen-itsu Kita und Ichirō Sakurada; 209: On the Development of Experimental Methods in Photo-Elasticity, by Ziro Tuzi; 210: Photo-Elastic Study of Stress-Distributions in the Side-Framing of Steel Car, by Ziro Tuzi; 211: Mechanical Properties of Snow-Layer, by Masao Kuroda; 212: A New Design of Cathode-Ray Oscillograph and its Applications to Piezo-Electric Measurements, by Shumpei Watanabe; 213: Study on Impact Test by Means of Piezo-Electricity and Cathode-Ray Oscillograph, by Shumpei Watanabe. Pp. 112+14 plates. 2.20 yen. (Tōkyō: Iwanami Shoten.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 65: Formeln zur genäherten Störungsrechnung in Bahnelementen. Von Bengt Strömgren. Angewandt auf die Planeten 633 Zelima, 956 (1921 IW), 979 Ilsewa, 1035 Amata und 1049 (1925 RB), von O. Möller Nielsen und E. Laursen. Pp. 26. (København.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votocek et J. Heyrovský. Année 1, No. 11, Novembre. Pp. 571-626. (Prague: Regia Societas Scientiarum Bohemica.)

University of Illinois Engineering Experiment Station. Bulletin No. 196: An Investigation of the Friability of Different Coals. By Cloyde M. Smith. Pp. 50. 30 cents. Bulletin No. 197: A Study of Fatigue Cracks in Car Axles. Part 2: A Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in co-öperation with the Utilities Research Commission. By Prof. Herbert F. Moore, Stuart W. Lyon and Norville J. Alleman. Pp. 30. 20 cents. (Urbana, Ill.)

CATALOGUES.

South Africa: Books, Prints, Paintings and Manuscripts. (Catalogue 520.) Pp. 32. (London: Francis Edwards, Ltd.)

Respiration Apparatus designed by Dr. E. Simonson. Pp. 8. (Berlin-Friedenau: Askania-Werke A.G.)

Catalogue of First and Early Editions, mainly of 19th and 20th Century Authors. (No. 337.) Pp. 134. (Cambridge: W. Heffer and Sons, Ltd.)

Christmas Catalogue: a Selection of Books suitable for Presentation. Pp. 16. (London: Francis Edwards, Ltd.)

First Editions of English Literature: the Nineteenth Century to the Present Day. (Catalogue No. 522.) Pp. 56. (London: Francis Edwards, Ltd.)

Zeiss Field Glasses. (T. 380£.) Pp. 54. (London: Carl Zeiss (London), Ltd.)

Diary of Societies.

FRIDAY, DECEMBER 13.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—Prof. E. S. Salmon, F. R. Petherbridge, M. H. Moore, and others: Discussion on Apple Scab, its Incidence and Control.

BIOCHEMICAL SOCIETY (at St. Bartholomew's Hospital), at 3 P.M.—H. E. Archer and G. A. Harrison: The Effect of Reaction on the Heat Test for Bence-Jones' Proteinuria.—W. H. Hurtley: Notes on the Determination of Iodine in Blood, etc.—K. V. Thimann: The Precipitation of the Basic Amino-acids of Proteins by Phosphotungstic Acid.—M. J. Rowlands and B. Wilkinson: Vitamin Content of Grass Seeds in Relationship to Manures.—A. G. Norman: The Biological Decomposition of Plant Materials.—D. R. P. Murray and C. G. King: The Stereochemical Specificity of Esterases.—H. Chick and M. H. Roscoe: Stability to Heat of Vitamin B_2 (Anti-dermatitis, Anti-pellagra).—F. K. Herbert and M. C. Bourne: The Non-Glucose Reducing Substances of Blood, with Special Reference to Glutathione.—B. W. Town: Isolation of Isoleucine from Gliadin.—H. G. Reeves and E. T. Renborn: Some Properties of Dihydroxyacetone.—J. M. Gulland and R. A. Peters: Observations on the Reducing Substances in Avian Blood.—G. Graham: The Presence of Homogentisic Acid in the Blood of Patients with Alkaptonuria.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—W. Grose: A Form of Coupling for Geared Diesel Engines for Land and Marine Purposes.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A. N. Brown: Observations of (Ch. 678) U Persei, 1924–29.—E. A. Kreiken: The Distribution of the Double Stars along the Giant Series.—J. G. Hagen: On the Significance of Baxendell's Nebulosity.—H. G. Tomkins: Three Features of the Lunar Crust, from Photographs taken at Dedham.—Dr. H. Spencer Jones and J. W. Jackson: Stellar Parallaxes Determined Photographically at the Cape Observatory (2nd list).—W. S. Franks: Visual Observations of Dark Nebulæ.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Clinical Meeting, at Royal London Ophthalmic Hospital), at 5.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—J. H. Awbery and Dr. Ezer Griffiths: Apparatus for Determining the Specific Heat of a Material in Powder Form.—Dr. W. E. Deming: On the Determination of the Parameters in an Empirical Formula.—N. S. Alexander: The *J*-Phenomenon in X-Rays.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—Capt. B. H. Peter: The Trend of Development in Railway Signalling.

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

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. G. F. Charnock: Bearings for Power Shafting.

TEXTILE INSTITUTE (London Section) (at Chemical Society), at 6.45.—A. E. Woodhead: Commercial Application of the New Esterified Cotton Fibres.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—W. Hargreaves: Safety Valves.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. Stern: Fastness to Light.—C. D. O. Winslade: Some Aspects of Colour Testing.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—N. R. Davis and C. R. Burch: Electric Furnaces for Steel Melting.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Newcastle-upon-Tyne), at 7.15.—E. Wilson and others: Is Sea Experience essential in order to become a Good Marine Engineer?

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at St. Thomas' Café, Swansea), at 7.30.—E. A. Tyler: Further Notes on Pure Chemicals.

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Ernest W. Moir, Bart.: Some Engineering Difficulties and how they were overcome (Presidential Address).

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—E. J. Spurr: The Dyeing and Finishing of Hosiery Fabrics.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. F. C. Lea: Physical Testing.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND, at 8.—Dr. L. H. Lampitt: The Chemist and Commerce (S. M. Gluckstein Memorial Lecture).

EUGENICS SOCIETY (at Linnean Society), at 8.—Prof. S. J. Holmes: General Morbidity.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Miss D. A. E. Garrod: Cave Excavation in the Near East.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (jointly with Manchester Literary and Philosophical Society: Chemical Section) (at Manchester).—C. Hollins: Patent Law in Relation to the Dyestuffs Industry.

SATURDAY, DECEMBER 14.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—Papers open for further discussion: —Burnt Outcrops of the High Main Coal at Newcastle-on-Tyne, R. G. Carruthers; The Distribution and Sequence of the Non-Marine Lamellibranchs in the Coal-Measures of Northumberland and Durham, Dr. W. Hopkins.—To be discussed:—Report of an Investigation of the Underground Conveying and Loading of Coal by Mechanical Means.

BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at Royal Anthropological Institute), at 3.30.—Dr. A. F. Shand: The Trust of Love.—Dr. Kardos: Phenomenal Thing-moments.

PHYSIOLOGICAL SOCIETY (at St. Thomas's Hospital Medical School), at 4.—L. E. Bayliss and A. R. Fee: The Secretion of Urine from Innervated and Denervated Kidneys Perfused with the Heart-Lung Preparation.—J. C. Eccles and Sir C. S. Sherrington: An Improved Bearing for the Torsion Myograph.—Sybil Cooper and J. C. Eccles: The Mechanical Response in the Isometric Twitch.—A. St. G. Huggett: Respiratory Reflexes in the Fœtus.—W. A. Osborne: Intravenous Administration of Oxygen.—L. B. Winter: Lactose Excretion in the Puerperium and the Isolation of Sugars from Urine and Blood.—E. N. Chamberlain: The Effect of Endocrine Extracts on the Cholesterol Content of the Suprarenals.—Prof. R. J. S. McDowall: The Effect of Carbon Dioxide on Certain Reflex Activities.—Prof. J. Mellanby: The Isolation of Prothrombase from Mammalian Blood.—G. F. Marrian and Dr. A. S. Parkes: The Relative Amounts of Œstrin Required to Produce the Different Phenomena of Œstrus.—M. Hill and Dr. A. S. Parkes: Sensitisation of the Pregnant Uterus to the Action of Oxytocin by the Preliminary Injection of Œstrin.—*Demonstrations*:—Prof. H. E. Roaf: Is the So-called Secondary Excitation of the Retina due to Stimulation of the Rods?—E. M. Landis and T. Lewis: A Case of Raynaud's Disease Treated by Cervical Sympathectomy.

MONDAY, DECEMBER 16.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Section—Informal Meeting) (at Loughborough College), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London), at 7.—C. G. E. Dahl: Calculating Machines.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—Dr. H. Norinder: Surges and Over-Voltage Phenomena on Transmission Lines due to Lightning and Switching Disturbances.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—M. H. Baillie-Scott and others: Debate on Are Building Bye-laws destructive of Rural Beauty?

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—M. A. Spender: Further Work on the Great Barrier Reefs.

ROYAL SOCIETY OF MEDICINE, at 8.30.—Reception: Commander L. C. Bernacchi: Southern Polar Exploration.

TUESDAY, DECEMBER 17.

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

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section—Manchester and District Branch) (at Milton Hall, Manchester), at 7.—F. G. Rathbone: Economy in Steam Plants.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—H. D. Babcock: A Photographic Study of the Solar Spectrum in the Wave-length Region 10,000 to 11,000 A.U.—Projection of Films: Dr. W. H. Wright: The Rotation of Jupiter.—H. Rosenberger: (*a*) Living Cells of Human and Animal Tissue, etc.; (*b*) Colloids and their Behaviour.—Dr. W. Clark: A Further Demonstration of the Kodacolor Process.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—Mr. Clark: Modern Aero-engines.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry—Leeds Area Section) (at Medical School, Leeds), at 7.15.—Prof. M. J. Stewart and others: Discussion on Asbestosis and Silicosis.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—J. Wallace: The Super Sports Motor Cycle.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. Small: The Properties of an Air-Steam Mixture as a Working Substance.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (Annual General Meeting) (at National Institute of Industrial Psychology), at 7.30; (General Meeting), at 8.—Miss I. Lorrain-Smith, Miss Katherine Pollock, Dr. H. M. Vernon, Major W. S. Tucker, and Dr. M. Culpin: Symposium on Noise.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—L. H. Evans: The Stress-strain Diagram.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—J. P. Mills: A Tour in the Chittagong Hill Tracts.

WEDNESDAY, DECEMBER 18.

SOCIETY OF GLASS TECHNOLOGY (at Science Museum, South Kensington), at 2.—J. B. Murgatroyd: The Choice of Annealing Schedule for Commercial Glassware.—L. H. Milligen: The Strength of Glass containing Cracks.—Dr. J. T. Littleton and Dr. F. W. Preston: A Theory of the Strength of Thermally Toughened Glass.

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark and I. D. Margary: Floral Isophenes and Isakairs.—Sir Gilbert Walker: On the Mechanism of Tornadoes.—E. W. Bliss: A Study of Rainfall in the West Indies.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. F. Walker: The Geology of the Shiant Isles.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—A. A. Hughes: Early Bell Founding.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 6.15.—Mr. Massé: Carols (Lecture).

LIVERPOOL ENGINEERING SOCIETY (at 24 Dale Street, Liverpool), at 6.30.—Capt. R. S. Capon: Aircraft Performance.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Queen's Hotel, Birmingham), at 7.30.—N. Bland: Front Wheel Drive.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—J. F. Colquhoun: Public Street Lighting, etc.

FOLK-LORE SOCIETY (at University College), at 8.—H. W. Howes: Some Functional Aspects of European Folklore.

ROYAL MICROSCOPICAL SOCIETY, at 8.—W. Wall: A Trifoliate Pedicellaria in *Echinus miliaris*.—F. V. Welch: A Microscope Lamp.—J. E. Barnard: Note on Dark Ground Illumination.

THURSDAY, DECEMBER 19.

LINNEAN SOCIETY OF LONDON, at 5.

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

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by Means of Thermal Storage.—T. G. N. Haldane: The Heat Pump—An Economical Method of Producing Low-Grade Heat from Electricity.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group—Informal Meeting), at 7.—L. Eveleigh: The Zöechrome Process of Natural Colour Kinematography.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at Municipal College, Portsmouth), at 7.30.—G. Shearing and Capt. J. W. S. Dorling: Naval Wireless Telegraphy Communications.

CHEMICAL SOCIETY, at 8.—Prof. A. Smithells, H. Whitaker, and Miss T. Holmes: The Influence of Hydrogen and of Water Vapour on the Ignition of Carbon Monoxide.—F. H. Burstall and Dr. S. Sugden: The Parachor and Chemical Constitution. Part XIV. Tellurium Compounds.—K. A. N. Rao: Studies in 'Strainless' Rings. Part II. The Effect of Transdecalin on the Carbon Tetrahedral Angle.—J. N. Ashley and C. R. Harington: Synthesis of 1-2-thiol-histidine.—Prof. F. L. Pyman: 2-Thiol-4(5)-β-aminoethyl Glyoxaline (2-thiolhistamine).

INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Manchester).—Papers on Reclaimed Rubber.

FRIDAY, DECEMBER 20.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—Determination and Isolation of the Picture.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. Challis: Line Signalling on the Southern Railway.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. E. Cammaerts: Italian and Flemish Art: A Contrast.

PUBLIC LECTURES.

SATURDAY, DECEMBER 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Witchcraft.

MONDAY, DECEMBER 16.

UNIVERSITY OF LEEDS, at 5.15.—J. Gray: Ciliary Movement.

TUESDAY, DECEMBER 17.

CARDIFF TECHNICAL COLLEGE, at 7.30.—W. S. Vernon: X-Rays.

WEDNESDAY, DECEMBER 18.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. E. L. Collis: Industry in Relation to Personal and Public Health.