THURSDAY, JUNE 28, 1900.

CHRISTMAS ISLAND.

A Monograph of Christmas Island (Indian Ocean); Physical Features and Geology. By C. W. Andrews, with descriptions of the Fauna and Flora by numerous contributors. Pp. xv + 237. (London: Published by order of the Trustees of the British Museum, 1900.)

TILL 1887 Christmas Island, which is situated in the Indian Ocean nearly a degree to the south-south-west of Batavia, was scarcely known, even by name, to the average Englishman, and only the low-lying shore had been visited by explorers; the steep cliffs, together with the forest with which the island is clothed, forming a barrier which had hitherto prevented access to the central plateau. In that year the Commander of H.M.S. *Egeria*, with the assistance of a landing party, succeeded in cutting his way into the interior; and two years later the island was leased by the British Government to a trading company. Since it contains an area of about forty-three square miles, and appears never to have been inhabited by aboriginal tribes, it presented a most favourable opportunity for studying the fauna and flora of an oceanic island of considerable size situated at no very great distance from a considerable land-mass—the Sunda Archipelago. Down to the time mentioned, it appears, indeed, to have been the largest uninhabited tropical island extant; and as the discovery of valuable deposits of phosphates in the interior indicated that its pristine conditions would soon be rudely disturbed, it was evident that if a biological survey was to be undertaken at all, there was no time to be lost. Fortunately, Sir John Murray interested himself strongly in the matter, and it was eventually arranged that Mr. C. W. Andrews, of the British Museum, who is both a geologist and a zoologist, should undertake the work. He accordingly spent ten months on the island during the years 1897-98; and the present volume, in which he has had the assistance of a number of specialists, is the result of his labours.

As is evident by their permitting a member of their staff to undertake the task, the Trustees of the British Museum gave their support to the exploration; and it is a matter for congratulation that they have seen fit to publish the results in the same form as the Museum "Catalogues." A wise liberality has been exercised in the matter of illustration, the plates (some coloured) being numerous, while a considerable number of reproductions from photographs are given in the text. These latter have, however, received but scant justice at the hands of the printer; and it is, indeed, with some surprise that we notice the volume bears the name of a local firm of printers.

Situated at a distance of over 190 miles from the nearest land, with the intervening ocean attaining a depth of more than three miles, Christmas Island appears to have derived its limited fauna from the Sunda Archipelago, of which indeed it probably once formed a part. The length of its isolation is, however, indicated by the circumstance that four out of its five indigenous mammals are peculiar species, the fifth—a Shrew—being a local variety of an Assam and Tenasserim form. The majority of the few land birds are likewise distinct, the most striking being a Goshawk (*Astur natalis*), an Owl (*Ninox natalis*), and a White-eye (*Zosterops natalis*), specimens of all of which were first collected by Mr. J. J. Lister during a flying visit to the island in 1890. As regards the fauna generally, it exhibits no greater evidence of affinity with that of the Mentawei chain of islands, running parallel with Sumatra and Java, than with that of the two islands last named. And the hypothesis that Christmas Island formed the termination of a "Mentawei Peninsula" must accordingly be given up.

One of the main objects of the exploration of the island was to ascertain whether its geological structure would throw any further light on the vexed question of the origin of atolls. As the result of his observations, Mr. Andrews is led to believe that, from the absence of a sufficient thickness of reef-limestone, Christmas Island, although originally an atoll, could not have been formed in the manner required by the Darwinian theory, as the amount of subsidence which has taken place would have been quite insufficient. That a certain amount of subsidence may have occurred in the early history of the island, Mr. Andrews considers to be quite possible.

"It may, of course, be objected," he writes, "that Christmas Island was never a typical atoll, and to this objection no answer is possible; but since it can be shown that at one time it must have consisted of reefs and islands approximating very nearly to those seen in atolls which are regarded as typical, the determination of the nature of the foundations upon which these reefs and islands rested is at least a step in the right direction. . . . In this case the basis of the island is almost certainly a volcanic peak, the foot of which is now some 2400 fathoms below the level of the sea, and that on its summits and flanks great accumulations of Tertiary limestones have been deposited, and in some cases are interstratified with the products of the eruptions, probably for the most part submarine, which took place from time to time. The oldest of the volcanic rocks are trachytic, the newer basaltic. The last of the eruptions was accompanied by the formation of thick beds of volcanic ash, and it is upon these that the great mass of the Miocene (Orbitoidal) limestones rests."

The occurrence of such a thickness of Tertiary deposits (ranging from the Eocene or Oligocene upwards) is unknown in any other oceanic island. It is important to notice that these rocks, allowing for a difference in the proximity of land at the time of their deposition, are very similar to those of South Java; but the author considers that there are difficulties in believing that the two series of sediments were deposited in a continuous area, as this would involve great local dislocations. Accordingly the volcanic peak theory is adopted in preference to such a view.

In speaking of elevation and depression, the author is careful to guard himself by stating that such terms are merely used in relation to the sea-level; and it would appear, from reading between the lines, that he is rather in favour of an actual alteration of the sea-level in these districts. It may further be inferred that he does not intend his conclusions as to the mode of origin of Christmas Island to affect the case of other atolls, his idea apparently being that all atolls are not of precisely similar origin.

The rocks which have brought Christmas Island into the most prominent notice are the thick beds of nearly pure lime phosphate capping several of the higher hills. It is inferred that this deposit has been formed by the action of beds of guano on limestone forming the summits of the low islets presumed to have existed previous to the first elevation of the present island. Another phosphatic bed is considered to have been produced by guano acting on volcanic ash. It is for the purpose of working these phosphates that the island has been leased by a commercial company.

Although the greater part of the volume is of a highly technical nature, it must not be inferred that this is the case with the whole of its contents. As an example of its lighter side, the excellent account of the habits of the Frigate-bird may be cited. These birds, which form the main support of the present colony of the island, are of an inquiring and fearless disposition.

"The usual way of obtaining them is," writes the author, "for a man to climb into the topmost branches of a high tree near the coast, armed with a pole eight or ten feet long and a red handkerchief. The latter he waves about, at the same time yelling as loudly as possible. The birds, attracted by the noise and the red colour, swoop round in large numbers, when they are knocked down with the long pole. In this way sufficient birds to supply the small colony with food can usually be obtained in an hour or two; occasionally, however, in unfavourable states of the wind, they are difficult to procure."

From first to last, the exploring, the collecting, and the descriptive and literary portions of the book have been thoroughly well carried out. And, despite the fact that no far-reaching or epoch-making discoveries in either zoology, geology, or distribution have been made, all concerned in the production of the volume before us (save the printer) are to be heartily congratulated on the manner in which they have executed their respective tasks. R. L.

A NEW WORK ON SILVER.

Metallurgy of Lead and Silver. Part ii. Silver. By Henry F. Collins. Pp. 352.' (London: Griffin and Co., Ltd., 1900.)

WE recently had occasion to notice the first volume of the present work, and to speak favourably of its merits. We are pleased to find the second portion equally good. It has been a source of great regret that the distinguished master of metallurgy, the late Dr. Percy, did not live to complete his projected work on Silver, instead of leaving what has been termed a splendid fragment: and as no book claiming to give a full account of the metallurgy of the subject has been published since, we cordially welcome the advent of a further contribution. It is perhaps unnecessary to point out how closely interwoven is the metallurgy of lead with that of silver, or to state that a full treatise on silver cannot be written without considerable reference to lead; and when one author is competent to deal with both branches of the subject, it affords the best means of imparting a sound knowledge of these metals. In the present case we have this additional advantage, that the editor is an authority on all questions relating to the nature and properties of silver, together with that of assaying. The immense importance of silver in the economic relations of the United States is well known, and many attempts have been made to introduce similar relations into this and other countries; hence it may be considered one of the most important metals known to mankind. The present work is not an exhaustive treatise on silver, and is evidently intended chiefly for those who are connected with the extraction of the metal from its ores. Those ancient methods which are fast becoming obsolete have not escaped notice; for, while they may not possess much practical value at the present time, their chemical and educational value is not to be despised. Numerous references to original sources of information are given throughout the volume, and this will enable the reader to obtain fuller information than is given here. The method of procedure in special works, such as that of matte smelting at Sunny Corner (p. 268), is described at some length with clearness and precision. The author has followed the same plan as in his first volume, of economising space by giving details of the practice at different localities in the form of tabular statements. This should prove useful for reference and comparison. The book is divided into four main sections, dealing respectively with silver and its ores, amalgamation, lixiviation, and smelting processes. Of these the chapters relating to lixiviation and blast furnace smelting are the best, as they appear to be the branches with which the author is most familiar. The hyposulphite leaching process is described in a more lucid and methodical manner than we have seen elsewhere, and the advantages and disadvantages of calcium sulphide are admirably compared on p. 197. A chapter is specially devoted to hyposulphite leaching practice, in which is given details of plant, mode of working, advantages and disadvantages of lixiviation, cost, and examples of the Russell process in various localities. Data as to cost and results at mills using the Patera and Russell processes respectively are given in the form of tables on pp. 224 to 227. A serviceable chapter on the refining of lixiviation sulphides concludes the section. The fourth section, dealing with the extraction of silver by smelting processes, contains a considerable amount of information in a condensed form. The table of comparison of various systems of smelting is instructive and helpful. The construction of furnaces is made clear by the aid of figures, drawn to scale. The arguments in favour of the hot blast for smelting mattes are pertinent and convincing. Several well-compiled tables are included in this chapter. Pyritic smelting receives only a brief notice in Chapter xv., as this subject has been partly dealt with in the first volume. The subject of matte smelting in reverberatories for silver-copper ores is next considered, and the characteristics of the method, with the points of difference from blast furnace practice, are pointed out. This kind of information is often of great moment to the practical man, who has to decide on the most economic method to adopt in special cases. The final chapters deal with the treatment of argentiferous mattes, which generally require a preliminary concentration to eliminate some of the lead and iron. In some cases a direct method may be

adopted, and information is here given for that purpose. The Bessemerising of copper mattes is briefly described. Silver-copper smelting and refining is limited in its application to ores comparatively free from sulphur, arsenic, and lead, and therefore but little used. The plant employed is specified and illustrated by diagrams and tables. The book concludes with a short account of the various wet methods used for argentiferous slimes. The author's attempt to cover the ground embraced by such a wide subject within a moderate compass will, with the aid of tables and summaries, prove most valuable both to practical men and to students.

OUR BOOK SHELF.

The History of Language. By Henry Sweet, M.A. Pp. xi + 148. (London: J. M. Dent and Co., 1900.)

THERE are few living scholars who are so well qualified as Dr. Sweet to write a thoroughly comprehensive introduction to the science of language. He is, as is well known, one of the foremost European authorities on phonetics; but at the same time he is a profound and original thinker on those psychological aspects of linguistic science in which few phoneticians take any interest. And while possessing a competent knowledge of Indogermanic comparative philology in its latest developments, he is preserved from the narrowness of view of the mere Indogermanist by having made a practical study of Arabic, Finnish and Chinese. Notwithstanding its small size, this "primer" is a very remarkable book. In completeness of outline, it is superior to any elementary manual of the subject known to us; and it is no mere arid skeleton, but contains a good deal of novel and interesting illustration of the principles expounded. Perhaps it is not quite so easy to master as a "primer" is usually expected to be. Although strictly elementary, in the sense that it assumes no previous philological knowledge on the reader's part, it does undoubtedly demand considerable power of close attention and some training in habits of scientific thought. It will therefore probably be less acceptable to absolute beginners than to those who have already some general knowledge of the subject and desire to render their conceptions of it more systematic and precise. Even by advanced philological scholars it may be studied with interest and profit.

The contents of the book may be said to consist of three portions: an exposition of the general principles affecting the development of language, an outline of the history of the Aryan family of languages, and a statement of the author's views as to the exterior affinities of Aryan and the locality in which it was developed. Perhaps the third part is somewhat out of place in an elementary book, but it is at any rate interesting. Dr. Sweet's hypothesis is that primitive Aryan arose in Scandinavia out of a mixture of the language of Ugrian conquerors with that of the aboriginal population among whom they were absorbed. This is not now such a startling heresy as it would have been a few years ago, though it is not likely at present to find a ready welcome from Indogermanists. The apparent affinities between Aryan and Ugrian certainly seem too striking to be due to mere coincidence, but it is a long step from this admission to the acceptance of the definite theory here propounded. The writers who have hitherto advocated somewhat similar views have always discredited their case by their ignorance of philology and their lack of scientific caution. It is to be hoped that Dr. Sweet will give to the world a full exposition of the grounds on which his conclusions are based. Whether he succeeds in the establishment of his particular thesis or not, he can hardly fail to make a valuable contribution towards the ultimate solution of the question.

Micro-organisms and Fermentation. By Alfred Jörgensen. Pp. xiii + 318. (London: Macmillan and Co., Ltd., 1900.)

THE study of the biology of fermentation has made considerable progress in recent years. The knowledge that has been gained of the nature and mode of action of the living agents in question is mainly due to the efforts of foreign observers. Through the investigations of Pasteur, and most notably of Hansen, the subject became a recognised branch of methodical and practical inquiry. To be in a position to employ the essential and to exclude the deleterious agents in a fermentative process is to substitute scientific for haphazard methods. This, briefly put, is the aim of technical mycology, and the gain to a given industry is considerable, as *e.g.* in brewing and distilling operations. Of the books dealing with micro-organisms and fermentation, Dr. Jörgensen's has long occupied a leading position, and hardly requires an introduction to the specialist. The new edition just issued has been completely revised, and the English translation has been well done by Dr. A. K. Miller and Mr. A. E. Lennholm. Dr. Jörgensen's reputation as a teacher and investigator, as well as his intimate association with Hansen, place this work above the ordinary run of text-books. The first chapters deal with the methods of microscopical and physiological examination of micro-organisms, and the methods for obtaining and utilising pure cultures of the useful races of saccharomyces are described. The examination of water and air is next dealt with—a subject of importance on account of the injurious organisms that may exist in the air and water of a brewery. The chapter on bacteria is somewhat incomplete. The technical mycologist has commenced to study the bacteria more closely, and a fuller account of this branch of the subject will be found in Lafar's book. An interesting account is given of the alcohol-forming bacteria, and of certain symbiotic ferments, *e.g.* Kephir and the ginger-beer plant. The moulds of importance in technical work are fully dealt with.

Of recent work, Buchner's "Zymase" is shortly alluded to; but more mention might have been made of Calmette's investigations at Lille and Sèclin upon the symbiotic action of moulds and yeasts in the alcoholic fermentation. The account of the alcoholic ferments in Chapter v. is naturally the main and distinctive feature of this work, and it will be particularly valuable to the English reader on account of the lucid description it contains of Hansen's investigations upon yeasts. The various species of bottom and top fermentation yeasts of interest to the brewing chemist are fully dealt with. The final chapter is devoted to the application of the results of scientific research in practice. The value of the book is added to by a number of illustrations and a very full bibliography. As an introduction to the morphology and biology of the alcoholic ferments, Dr. Jörgensen's work leaves little to be desired, and constitutes a valuable complement to the text-books which deal mainly with the chemical side of the subject.

A. M.

Photography in Colours. By R. C. Bayley. Pp. 74. (London: Iliffe, Sons and Sturmey, Ltd., 1900.)

THIS little book is practically a reprint of a series of articles by the author which have already appeared in a photographic periodical, but the subsequent revisions and convenience of reference occasioned by their collection under one cover should render them more serviceable. The general principle has been to avoid technicalities and purely executive details, aiming rather to

give a lucid explanation of the principles governing the various processes, which may be understood by readers not necessarily acquainted with photographic manipulation.

The opening chapters introduce the elementary ideas of the nature of colour and the undulatory theory of light. Following these is a chapter on the Lippmann process, this being the only direct process having a purely physical origin.

The fourth chapter deals with the principles of colour vision, showing how the colour curves of red, green and blue sensitiveness are employed in deciding the screens used in the three-colour photographic process; two processes of this type, founded by Ives and Joly respectively, being then fully explained.

The work is brought up to date by descriptions of Wood's diffraction grating process, and later improvements on the Joly process. A chapter is also devoted to three-colour photomechanical processes, and another to the method developed by Sanger Shepherd and others of producing lantern slides in three colours.

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Leçons nouvelles sur les applications géométriques du calcul différentiel. Par W. de Fannenberg, Professeur à la Faculté des Sciences de l'Université de Bordeaux. Pp. 192. (Paris: A. Hermann, 1899.)

THE geometrical applications of the differential calculus, which are usually given in English treatises on the calculus, are mostly confined to plane curves. In these lessons, on the contrary, the author begins by assuming a knowledge of elementary analytical geometry of three dimensions, and proceeds at once to deal with subjects which occur in the latter part of an English text-book on solid geometry, in chapters on the general theory of curves and surfaces.

Thus we have sections on the descriptive properties of tortuous curves and curved surfaces, followed by sections on the metrical properties of tortuous curves, of ruled surfaces, and of surfaces in general.

The author's treatment of his subject is exceedingly clear and elegant, and there is considerable freshness of method. We may notice, in particular, the early employment of the six co-ordinates of a line; the use of the system of moving axes formed by the tangent, the principal normal and the binormal at a point on a curve; the systematic application of Gaussian curvilinear co-ordinates in developing the properties of the several classes of curves that may be traced on a surface.

In fact, a student will find here in small compass a pleasant introduction to some of the most powerful methods of modern analysis as applied to geometry, and if he proceeds afterwards to the "Leçons sur la théorie générale des surfaces," by Darboux, his study of that great classic will have been much facilitated.

Elementary Illustrations of the Differential and Integral Calculus. By Augustus De Morgan. New Edition. Pp. viii+142. (Chicago: The Open Court Publishing Company. London: Kegan Paul and Co., Ltd., 1899.)

IT is nearly seventy years since De Morgan first published this tractate in the Library of Useful Knowledge. It was afterwards bound up with his large treatise on the differential and integral calculus, but the very inferior typography detracts much from the pleasure of perusing it there. In the present issue we have a very attractive reprint. Although there has been in recent years almost a superabundance of elementary treatises on the calculus, some of them not lacking excellent illustrations of the fundamental principles and processes of the subject, it may still be said that De Morgan's effort at popularisation remains the greatest of its kind, and far above all others in the philosophic spirit which animates it.

LETTER TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Surface-Tension Experiment.

IF an unbroken vertical jet of falling water is allowed to impinge normally on a smooth circular disc, whose diameter is rather greater than that of the jet, then a phenomenon, illustrated by the accompanying photographs, is observed. These are one-ninth natural size.

A disc about 7 mm. in diameter was supported on the upper end of a knitting-pin, which was held vertically in a clamp.

A jet of water proceeding from a tube of 6 mm. internal diameter was directed downwards, so as to strike the disc centrally.

If the initial velocity of the jet is high, then an umbrella-shaped sheet is formed, which breaks up into a shower of drops at its margin. On diminishing the rate of outflow, the broken

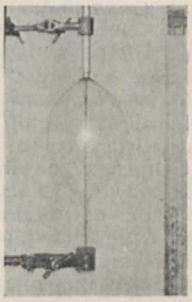


FIG. 1.
4000 c.c. per min.

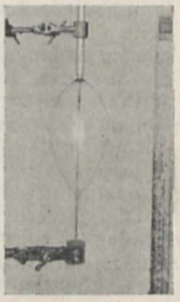


FIG. 2.
3000 c.c. per min.

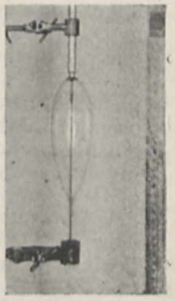


FIG. 3.
2100 c.c. per min.

edge of the sheet gathers itself together and closes inwards until it reaches the upright supporting the disc, thus forming a completely closed pear-shaped surface (Fig. 1). The surface-tension of the falling sheet thus drags in the water radially, for if it were in separate drops these would describe parabolic paths.

On further restricting the water supply there is, in general, a tendency for the surface to elongate and at the same time to contract laterally, thus becoming more spindle-shaped (Figs. 2 and 3). In this condition the figure is remarkably steady and well defined.

With a still slower stream of water (Fig. 4), the spindle reaches a certain critical length at which it first begins to

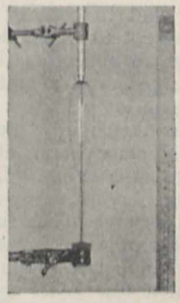


FIG. 4.
1600 c.c. per min.

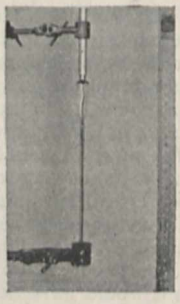


FIG. 5.
1000 c.c. per min.

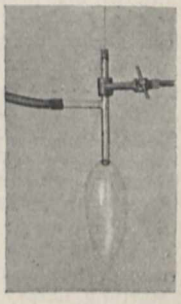


FIG. 6.

oscillate vertically and to pulsate, and then a sudden constriction occurs causing the division of the spindle into two bubbles, one of which rushes down and the other up the vertical support.

The latter bubble persists as a small conical figure immediately beneath the disc (Fig. 5).

Since there is an almost instantaneous transition from Fig. 4 to Fig. 5, it was not found possible to photograph any of the intervening conditions.

The length of the spindle in Fig. 4 (just on the point of undergoing segmentation) is about four times its diameter; a ratio which is considerably greater than in the three preceding figures, and which approaches that known to hold in the case of an unstable liquid cylinder.

The rate of outflow from the tube is in each case stated under the photograph.

The knitting-pin was then replaced by a glass tube, closed at its upper end, but connected below with a manometer, which was put into connection with the interior of the various bubbles by mean of a small hole previously blown in the side of the tube near its upper extremity. The pressure inside the bubbles was always found to be very nearly atmospheric, an excess of about 1 mm. of water being the greatest noted.

Another form of apparatus gave striking results.

A ⊣ tube was supported with the cross piece vertical, and the upper opening was closed with a cork into which a stiff wire was driven, so that it hung centrally, with its other end projecting a little from the lower opening of the tube.

The circular disc was attached to this projecting wire, and was then exactly in the path of the issuing stream of water which was admitted by the side tube.

By properly regulating the velocity of the water a series of surfaces similar to those produced by the former method can be obtained, but the adjustments are not so easily controlled (Fig. 6).

It is curious to note how the water constituting the walls of the bubble reunites into a single stream which falls from its base.

T. J. BAKER.

King Edward's School, Birmingham, May 28.

THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

IN view of the proceedings at the recent third International Conference, of which the Acta are printed on another page, there can be little doubt that the ultimate execution of this important enterprise is now assured. Prior to the meeting, some of us, perhaps, vaguely feared that the foreign delegates would come prepared to suggest all sorts of difficulties, if not to announce the unwillingness of the countries they represented to take any part in the work; but nothing of the kind occurred: all came bent on securing success; not a word was uttered in depreciation of any of the proposals brought under consideration; and all present may be said to have taken an enthusiastic interest in carrying the proceedings to a satisfactory issue. Every one was of opinion that if a fair beginning can once be made, the importance of the work is so great; it will be of such use to scientific workers at large; that it will rapidly grow in favour and soon secure that wide support which is not yet given to it simply because its character and value are but imperfectly understood. Therefore, all were anxious that a beginning should be made.

It has been estimated that if 300 sets or the equivalent are sold, the expenses of publication will be fully met. As the purchase of more than half this number was guaranteed by France, Germany, Italy, Norway, Switzerland and the United Kingdom, the Conference came to the conclusion that the number likely to be taken by other countries would be such that the subscriptions necessary to cover the cost of the catalogue would be obtained.

The resolution arrived at after this opinion had been formed, "That the catalogue include both an author's and a subject index, according to the schemes of the Provisional International Committee," must, in fact, be read as a resolution to establish the catalogue.

Of the countries represented at the various Conferences, excepting Belgium, not one has expressed any unwillingness eventually to cooperate in the work. Unfortunately, neither the United States nor Russia was officially represented on the present occasion. The attempts that have been made to induce the Government in the United States to directly subsidise the catalogue have not been successful: but that the United States will contribute its fair share, both of material and of pecuniary support, cannot be doubted. There as here private or corporate enterprise must undertake much that is done under Government auspices in Europe. As to Russia, the organisation of scientific workers there has been so little developed that it is very difficult to secure their attention, and probably our Russian colleagues are as yet but very imperfectly aware of what is proposed. The importance of Russian scientific work is so great, however, that it stands to reason that it must be fully considered; and it may be supposed that Russia will join when she becomes acquainted with what is proposed and what is required of her.

A Provisional International Committee has been appointed, which will take the steps now necessary to secure the adhesion and cooperation of countries not yet pledged to support the scheme.

Originally, it was proposed to issue a card- as well as a book-catalogue, but on account of the great additional expense this would involve, and as the Americans in particular have not expressed themselves in favour of a card issue, it is resolved to publish the catalogue, for the present, only in the form of annual volumes.

From the outset great stress has been laid on the preparation of subject indexes which go behind the titles of papers and give fairly full information as to the nature of their contents. Both at the first and the second International Conference this view met with the fullest approval. Meanwhile, the action of the German Government has made it necessary to somewhat modify the original plan. In Germany, a regional bureau will be established, supported by a Government subvention, and it is intended that the whole of the German scientific literature shall be catalogued in this office; no assistance will be asked from authors or editors or corporate bodies. In such an office it will for the present be impossible to go behind titles; consequently, only the titles of German papers will be quoted in the catalogue. In the first instance, some other countries may prefer to adopt this course on the ground of economy. But in this country, at least, the attempt will be made to deal fully with the literature, and the cooperation of authors and editors will be specially invited. An author may not always be best able to judge which are the most important points in his paper to be noted in an index, but the experience gained in the Royal Society during several years past has shown that authors furnish most valuable information, and that their suggestions are easily reduced into shape. A full code of instructions for the use of the regional bureaux is now being prepared under the auspices of the Provisional International Committee.

The catalogue is to be published annually in seventeen distinct volumes. The collection of material is to commence from January 1, 1901. As it will be impossible to print and issue so many volumes at once, it is proposed to publish them in sets of four or five at quarterly intervals. During the first year, parts covering shorter periods will be prepared, so as to make the subsequent regular issue possible of volumes in which the literature published during a previous period of twelve months is catalogued. Valuable opportunity will thus be given from the outset of gaining experience both in the preparation and use of the catalogue.

That many difficulties will be encountered in carrying the work out cannot be doubted; but if scientific workers generally will but reflect on the inestimable value of accurate classified subject indexes, they cannot but see that it will be to their great advantage to do all in their power to further the enterprise. If the attempt fail, it will only be because those on whose behalf it is undertaken are blind to their own interests. H. E. A.

NOTES.

THE annual visitation of the Royal Observatory, Greenwich, by the board of visitors, took place on Tuesday last.

A SPECIAL joint meeting of the Royal and Royal Astronomical Societies is being held in the rooms of the Royal Society to-day, to receive preliminary accounts of the observations of the recent eclipse of the sun.

THE Nilson Memorial Lecture will be delivered by Prof. Otto Pettersson, of Stockholm, before the Chemical Society on Thursday next.

THE great kindness and attention shown by the Alcalde and other authorities at Santa Pola to the astronomical party who went there to observe the recent eclipse, and to the captain and officers of H.M.S. *Theseus*, who conveyed the members of the expedition from Gibraltar, occasioned a very pleasing little episode. On leaving Santa Pola a donation of 10*l.* was collected, and left by Captain Tisdall with the Mayor for the benefit of the poor of the town. This gift was highly appreciated by the local authorities, and the amount has been distributed by a local committee. The children in the schools were not forgotten, and each of them received a packet of sweets and a memorial card relating to the eclipse and the visit of the expedition. We are also able to state that the Mayor of Santa Pola has received from the Spanish Government a decoration of the First Order of the Civil Administration. We heartily congratulate him on his new honour, which all who had any relations with him know was well deserved.

AT a public meeting recently held in Belfast, it was decided to renew the invitation to the British Association to visit Belfast in 1902, and a representative deputation was appointed to present the invitation at the forthcoming Bradford meeting of the Association. The last meeting in Belfast took place in 1874, and was under the presidency of Prof. Tyndall.

SIR WILLIAM MACCORMAC is to receive to-day the honorary degrees of M.D. and M.Ch. from the University of Dublin.

THE death is announced of Prof. Boutan, general inspector of public instruction in France. Prof. Boutan was one of the founders of the Société française de Physique, and was also the author, jointly with M. d'Almeida, of a treatise on physics.

THE death is announced of Dr. Karl Lange, professor of pathological anatomy in the University of Copenhagen; also of Dr. Wilhelm Kühne, professor of physiology at Heidelberg.

THE new physical laboratory at Owens College, Manchester, will be opened to-morrow by Lord Rayleigh. The new laboratory will have a larger floor area than that of any other similar institution in the world, with the exception of the Johns Hopkins and the Strasburg laboratories. Great efforts have been made to provide an equipment of the most modern apparatus for use in every branch of physical science, and to maintain conditions which shall ensure their being used to the best advantage. The research laboratories are to be an important feature of the new buildings, and should attract a large number of students. Another feature is the electro-technical wing, which is to constitute a John Hopkinson memorial, and will be formally handed over by the relatives of the late Dr. John Hopkinson, on the occasion of the opening ceremony. It is understood that Dr. C. H. Lees, formerly chief assistant lecturer in the physics department of Owens College, will occupy the post of assistant director of the new laboratories, under Prof. A. Schuster, the director, and that Mr. R. Beattie has been appointed lecturer in electrotechnics.

AT the conversazione to be held at the London Medical Graduates' College and Polyclinic on Wednesday, July 4, Prof. Osler, F.R.S., of Baltimore, will deliver an address on "The Teaching of Practical Medicine," and the museum will be inaugurated.

THE annual general meeting of the Röntgen Society will be held on Thursday, July 5. The Presidential Address will be delivered by Mr. Wilson Noble.

THE second annual meeting of the Astronomical and Astrophysical Society of America is being held in conjunction with the meeting of the American Association at Columbia University. In addition to the papers to be presented, there will be discussions upon the following subjects:—The eclipse of May 28 last; Observations of Eros to be made at the next opposition; Spectroscopic determinations of motion in the line of sight.

AN important meeting of the Committee of the Liverpool School of Tropical Medicine was held on the 19th inst., when it was reported that the Government were co-operating with the School in the matter of the despatch of the Yellow Fever Expedition to America and Brazil, and that a letter had been received from the Marquess of Salisbury asking whether the Committee wished him to communicate with the British representatives in the countries to be visited by the expedition. The offer was gratefully accepted, and a further letter was received from Lord Salisbury saying that he had asked the British Ambassador at Washington and H.B.M. Consul at Para to obtain all possible facilities from the United States and Brazilian authorities respectively on behalf of the expedition. Official invitations for the expedition to visit Washington had been received from the heads of the medical departments of the U.S. army, and to visit Baltimore from the authorities of the Johns Hopkins University. As has already been stated in these columns, the expedition consists of Dr. Durham (Grocers Research Scholar) and Dr. Walter Myers (John Lucas Walker Student), both of Cambridge. The expedition, which started on Tuesday last, goes first to Canada, and then proceeds direct to Washington and Baltimore. After conferring with the bacteriological experts there, the expedition will go to New York, and sail from that port to Para. Subsequent movements will be guided by circumstances.

AT a dinner given last Monday in honour of the Yellow Fever Expedition, Mr. A. L. Jones, chairman of the school, announced his intention of giving 1000*l.* towards the erection of a Tropical Diseases Hospital in Liverpool in connection with the Royal Southern Hospital, to be associated with the name of Miss Mary Kingsley. It was also announced that Mr. Blaize, of Lagos, and Mr. John Holt, of Liverpool, had promised 500*l.* each to the same object. Two other subscriptions of 100*l.* each were announced.

THE Summer School of Medicine, which was to have been held at Cambridge from June 25 to June 30, has, unfortunately, had to be abandoned in consequence of the meagre number of acceptances received. The necessity for the taking of this step is the more to be regretted, as very careful preparations had been made to insure a successful session; demonstrations of the malarial and other blood parasites, and of the most recent work on cancer, had been arranged for, and in addition to these subjects lectures were to have been given by experts in their several lines of work upon various other matters of medical and surgical interest.

THERE are, it is estimated, about 400 lepers in France. They are scattered about in Brittany, in the Pyrenees, on the shores of the Mediterranean, and in Paris, where they number 150. Among the lepers there are missionaries and nurses who have fallen victims to their devoted care of sufferers in other countries, and officials and soldiers who have contracted the disease in the colonies. An anti-leprosy committee has, says the *British Medical Journal*, recently been formed on the

initiative of Dom Santon, a member of the Benedictine Community of Ligugé, who is also a doctor of medicine, for the care of the lepers in France and the prevention of the spread of the disease. Dom Santon has for many years past devoted himself to the study of leprosy, travelling for that purpose in many parts of the world. After conference with the Council of Hygiene he has acquired a property in the Vosges, where he proposes to establish an asylum for lepers to be called the St. Martin Sanatorium. The plans have been approved by the French Government.

THE National Academy of Sciences of the United States has recommended to the trustees of Columbia University that the Barnard medal be given to Prof. Röntgen for his discovery of the X-rays. The medal, of gold, is awarded quinquennially to the person who shall have made such discovery in physical or astronomical science as, in the judgment of the National Academy of Sciences, shall be esteemed most worthy of the honour.

AN entomological expedition is to be sent into Southern Mexico this summer by the University of the State of Missouri. It will be in charge of Prof. J. M. Stedman, head of the Entomological Department, and will have for its object the making of a biological, largely entomological, survey of the region from Vera Cruz on the Gulf, which is in perpetual tropics, to the top of the volcano Popocatepetl, which is far above the perpetual snow line, and down to Acapulco on the Pacific. This will give all the temperature variations from perpetual tropics to perpetual snow, and will allow of the study of life zones under conditions not to be found elsewhere in North America. The collection will become the property of the University, which is to furnish half the expenses, the other half being borne by Prof. Stedman.

AN expedition, consisting of President Jordan and Mr. John O. Snyder, of the Department of Zoology in Stanford University, has sailed for Japan, for the purpose of making a collection of the fishes and insects of that country. Assistance will be given by other graduates of Stanford University at present resident in Japan.

IT is stated in *Science* that Mr. G. B. Gordon has secured the control of the ruins of Copan, and the lands pertaining thereto, for a period of ten years, with the right to make excavations and to remove to Cambridge, Mass., for preservation, a portion of the objects that may be found.

MR. O. A. TITTMANN has been appointed successor to Dr. H. S. Pritchett as superintendent of the United States Coast and Geodetic Survey, Dr. Pritchett having been elected president of the Massachusetts Institute of Technology.

THE American National Geographical Society's prizes for the best essays on Norse discoveries in America have been awarded to Mr. C. B. Dalton, of New York City, and Mr. K. F. Murray, of Norfolk, Va.

Science announces that a donor, who wishes to be anonymous, has presented to the American Museum of Natural History the collection exhibited by Messrs. Tiffany and Co. at the Paris Exposition, consisting of American and foreign cut and uncut precious stones and other objects. The value of the collection is estimated at over 50,000 dollars.

DURING the summer a station will be maintained on Lake Saranac by the New York State Museum, for the study of aquatic insects. The work will be under the direction of Dr. Charles Needham.

THE *Scientific American* states that a new species of petrel has been discovered on the Island of Kauai (Sandwich Islands) by Mr. A. Searle, of the Stanford University. Mr. Searle is also reported to have found on the same island a new species of seagull. He is about to go to Guam for the purpose of exploring that island, and to make a collection of birds and fishes for the Bishop Museum of Honolulu.

EXCELLENT results have been obtained by the French Government from experiments made with wireless telegraphy. The *Engineer* of June 15 says that the demonstrations showed that communication could be maintained, between ship and shore, to a distance of about sixty miles with comparative ease, only the height of the masts of the Government ship *Utile* preventing longer distances being attained. In consequence of these achievements the French Government have decided to equip their Mediterranean Squadron with the necessary apparatus.

WIRELESS telegraphy stations are, by the instructions of the Chief Signal Service Officer of the United States, to be established in the harbour of San Francisco, in Porto Rico and the Philippines.

AMONG the numerous congresses arranged to take place in connection with the Paris Exposition, in addition to those to which attention has already been called in these columns, may be mentioned the following, dealing respectively with :—Automobiles, on July 9; medical electrology and radiology, from July 27 to August 1; medicine, from August 2 to 9; physics, from August 6 to 11, and on the same dates, technical and industrial education; chemistry, from August 6 to 11; hygiene and demography, from August 10 to 17; hypnotism, from August 12 to 15; electricity, from August 18 to 25; prehistoric anthropology and archæology, from August 20 to 25; ethnology, from August 26 to September 1; railroads, from September 15 to 23; acetylene, from September 23 to 28.

IT is satisfactory to find that the present troubles in South Africa have not interfered with Museum progress in the larger towns of Cape Colony. From the *Report* of the Committee of the Albany Museum for 1899, we learn that it was expected the new buildings would be ready for opening about July 1.

A SEVERE thunderstorm occurred in London on the 25th inst., accompanied by heavy rain and hail. The weather had been very unsettled for some days, with gales on our exposed coasts. On the evening of the 24th a storm area lay off the north-west coast of Ireland; this subsequently took a somewhat unusual south-easterly direction. At 8 a.m. on the 25th the centre lay over the Midland Counties, and next morning had traversed the south-eastern part of the English Channel. The rainfall on the 24th and 25th amounted to about an inch in several parts of the United Kingdom. The temperature continues low for the season over the whole country.

TWO specimens of the egg of the Great Auk were sold by auction at Stevens's Rooms last week, and realised 315 and 180 guineas respectively. The more important of the two eggs is an unrecorded one from a French collection, and is described as the finest specimen known of a special type of marking. The price just obtained for it establishes a record, 300 guineas having, until this sale, been the highest amount ever received. About seventy-five eggs of the Great Auk are known to be in existence.

ACCORDING to *Science*, the Millinery Merchants' Protective Association of America has proposed to the various Audubon Societies of the country to cease killing or buying any North American birds, except such as are edible and killed in season, if the societies will undertake not to interfere with the use of these birds or with skins imported from countries not in North America.

THE *Pioneer Mail* (Allahabad) of June 1, 1900, has an interesting article on the recent discoveries in the neighbourhood of the previously identified birthplace of Buddha. Mr. W. Peppé, owner of the Birdpur estate on the Nepal frontier, excavated in January 1898 a reliquary (stūpa) of Buddha, and found relics in a casket inscribed in characters not later than the third, and possibly even of the fourth, century B.C. During last winter Prof. Rhys Davids revisited the spot, and gave to the Royal Asiatic Society at its meeting in April last the result of his own local observations and examination of the relics, which is that they have a very fair title to be considered genuine remains of Buddha. These are stated to have been divided after the cremation into eight portions, and distributed amongst sections of the Śakya clan, which inhabited this region. The relics themselves are fully described and illustrated in the Royal Asiatic Society's *Journal* for July 1898, and further notices on the subject are to be looked for in forthcoming numbers of the same journal, and also (by Dr. Hoey) in the *Journal* of the Asiatic Society of Bengal. It is hoped that the Government of India may support Mr. Peppé in further excavations in this evidently promising locality.

THE *Scientific American* for June 9 gives the following interesting particulars of a specially built train used on the Baltimore and Ohio Railway in a series of experiments upon the atmospheric resistance to railroad trains. The trial train was made up of six passenger coaches, such as are used on suburban service. They were provided with four-wheeled trucks, 33-inch cast-iron wheels, and $3\frac{3}{4}$-inch journals, and the total weight, exclusive of engine and tender, was 325,500 pounds. In preparation for the test all external obstructions were removed from the train. The roofs of the cars were arched; the windows set out flush with the sides of the cars; and the sheathing was laid lengthwise instead of perpendicularly as in other cars. The sheathing extended to within eight inches of the track and covered the trucks. Suitable openings permitted access to the axle boxes, and a sliding door led into the substructure at opposite sides of the car centre. When the cars were coupled, two diaphragms met and enclosed the space between the cars, from edge to edge of the roof line. The platform doors consisted of roller curtains which dropped to the steps and were flush with the sides. Flexible spring curtains completed the vestibule from the roof to the bottom of the car. When the train was coupled it presented the appearance of one long sinuous and flexible car. The tender was of peculiar construction, and continued the unbroken line from the engine cab to the baggage car, to which it was vestibuled. In its entire construction the train complied with the varied demands of practical operation. While the plans called for partial sheathing of the locomotive, it was decided to make the first tests with remodelled cars only, in order to prove how far the existing system of car construction is responsible for the atmospheric resistance of trains. The sheathed train, consisting of six cars and hauled by an engine weighing 57 tons, made the run of 40 miles from Baltimore to Washington in 37 minutes and 30 seconds. One mile was made in 40 seconds, and two miles in 81 seconds. From Beltville to College, a distance of $4\frac{1}{2}$ miles, the time was 3 minutes and 10 seconds, a sustained speed of 85 miles an hour. By far the most remarkable run, however, was from Annapolis Junction to Trinidad, a distance of 20·1 miles in 15 minutes and 20 seconds, at an average speed of 78·6 miles an hour. The first seven miles of this run was up a grade from 25 to 55 feet to the mile, and it was covered in a fraction over 6 minutes; while the last 5 miles on the down grade from Alexander Junction to Trinidad was covered in 2 minutes and 55 seconds, a speed of 102·8 miles an hour. The locomotive used has cylinders 20 × 24, with four coupled 78-inch drivers. The boiler carried 165 pounds of steam. With ordinary firing the steam never dropped below 160 pounds during the entire run. The best time previously made on the line was a few seconds less than 39 minutes, on which occasion the train consisted of four Pullman cars hauled by the company's fastest and most powerful passenger engine.

THE Report of the Kew Observatory Committee for the year 1899 has been published in the *Proceedings* of the Royal Society in the usual form. From January 1 last the Observatory was incorporated with the National Physical Laboratory, and will no doubt greatly extend its useful work. The Observatory Committee, as hitherto constituted, has ceased to exist, but the work of the Observatory will be carried on by the same staff as heretofore. During the past year the magnetic work is said to have been unusually onerous, as many colonial and foreign institutions have sent their instruments to the Observatory to be verified No very large magnetic disturbances were registered; the mean Westerly Declination was 16° 57′. The electrograph has worked in a satisfactory manner during the year, and, with the sanction of the Meteorological Council, the records for a complete year have been lent to Mr. C. T. R. Wilson, of Cambridge, for investigation. The verification of instruments of all kinds amounted to over 22,000, a falling off of nearly 2400 as compared with the work of the previous year. A seismograph has been in regular operation during the year; a disturbance was particularly noticeable on September 10.

THE dynamical principle of atmospheric circulation is treated by Prof. V. Bjerknes in the *Meteorologische Zeitschrift*, 1900, iii., iv. Starting with the property that the circulation theorems of abstract hydrodynamics (according to which the circulation in any circuit formed by the same particles is constant) only hold good when the pressure is a function of the density alone, Prof. Bjerknes points out that in the atmosphere this condition is not satisfied owing to local differences both in the temperature and in the degree of moisture present in the air. Of these two causes the first seems to be the most important. The conception of "solenoids" is then introduced, a solenoid being an elementary unit tube bounded by pairs of consecutive surfaces of equal volume and equal pressure respectively. The fundamental proposition in connection with circulation asserts that the rate of change of the circulation in any circuit is proportional to the number of solenids enclosed by that circuit. A number of diagrams are given representing the cases of land and sea breezes, trade-winds, local upward currents, hill and valley winds, cyclones and anticyclones. The omission to take account of the extra complications arising from viscosity and terrestrial rotation probably prevents these investigations from being utilised for calculations in connection with weather prediction; and for this reason Prof. Bjerknes' theory must be rather regarded in the same light as other dynamical theories of physical phenomena, in which certain simplifications not occurring in nature are made in order to bring the calculations within the range of mathematical analysis. But it is only by the aid of such simplifications that order can be evolved out of the chaos of statistics furnished by the experimentalist.

AN account of the seismological observatory of Quarto, near Florence, together with the observations of more than 170 earthquakes made during the meteoric year 1899 (November 1, 1898–October 31, 1899), is published by the director, Mr. D. R. Stiattesi, in the first *Bollettino Sismografico* of the observatory. Through the generosity of Count G. Bastogi, of Florence, this must be one of the most completely equipped observatories in Italy. It contains two Vicentini microseismographs (one with a mass of 500 kg. and a length of 9·28 metres), a pair of horizontal pendulums with mechanical registration, and a pair of geodynamic levels, besides a large number of seismoscopes and tromometers, all of Italian design.

IN the June number of the *Zoologist*, Mr. A. H. Meiklejohn raises the question as to the manner in which the cuckoo carries her egg when about to deposit it in the nest of the bird selected to act as foster-mother. It is commonly supposed that the egg is carried in the beak, and in Prof. Newton's edition of "Yarrell" several instances are quoted where observers state they have actually seen the *modus operandi*. Mr. Meiklejohn, who was fortunate enough to observe a cuckoo in the act of depositing its egg in a robin's nest, is, however, of opinion that the throat of the bird serves as the receptacle for the egg. He states that (1) the cuckoo was constantly opening her mouth during a preliminary encounter with the robins; (2) that the egg was certainly not laid in the ordinary way in the nest; (3) that the egg itself was slightly moist and sticky; (4) that the throat of the bird presented a slightly distended appearance, which might well have been due to the presence of the egg. It will be interesting to note what his fellow-ornithologists think of the author's explanation of the mystery.

IN American laboratories it appears that the place of the common frog is largely taken by the furrowed salamander (*Necturus maculatus*), which forms the general subject for anatomical investigation. Mr. W. S. Miller, assistant professor of anatomy in the Wisconsin laboratory, has accordingly undertaken to describe in detail the anatomy of this amphibian, and papers on its lungs, vascular system and brain appear in the latest issue of the *Bulletin* of the University. The author calls attention to the great amount of individual variation which occurs in the vascular system of *Necturus*.

IN a communication to the latest issue of the *Proceedings* of the Philadelphia Academy, Mr. Witmer Stone shows that the various species of eider-duck, as well as the red-breasted merganser, have a "summer moulting plumage" analogous to that assumed by the mallard after the breeding season. As in the last-named species, this plumage lasts only during the time when the birds are unable to fly, owing to the shedding of their flight feathers, and its dull coloration is doubtless for the purpose of rendering them as inconspicuous as possible during this period. The author calls attention to the circumstance that the feathers of this temporary dress, like those of the first plumage of all birds, are very inferior in their structure. The moulting plumage of the king-eider has hitherto been considered as the ordinary dress of immature birds.

IN a paper on mosquitoes, by Mr. W. R. Colledge, which appears in vol. xv. of the *Proceedings* of the Royal Society of Queensland, the author states that he has succeeded in keeping one of these insects alive for three weeks, and that Dr. J. Bancroft has had some in captivity for eighty or ninety days. Probably their ordinary full term of existence is three months. In cases where the application of kerosene is inconvenient, the introduction of a few minnows into the ponds or pools in which they breed will speedily lead to the destruction of the larvæ and pupæ.

THE origin and formation of the Red Sea are discussed in a brief article by M. A. Issel (*Bull. Soc. Belge de Géol.*, tome xiii. April). Following Suess, he considers that the lacustrine conditions of the Arabic depression ("Lacus Arabicus") were probably determined in late Miocene times. He maintains that then, or early in Pliocene times, the Nile, a mightier river than it now is, emptied its waters directly into the great lake, the outlet being an immense waterfall. Even in post-Pliocene times the Nile continued to send a portion of its waters into the Red Sea, although it had meanwhile formed new outlets into the Mediterranean area. Traces of this former fluviatile connection are furnished in the actual faunas of the two seas. The opening of the Straits of Bab-el-Mandeb was caused after a period of volcanic activity, the eruptions being succeeded by subsidence and by erosion of the barrier which separated the Red Sea from the Indian Ocean. It is remarked that the opening of the Suez Canal has sensibly affected the distribution of some forms of life.

IN a paper on the fruiting of the blue flag, or Iris, published in the May number of the *American Naturalist*, Prof. J. G. Needham shows that, in addition to the bees by which they are fertilised, the flowers of this plant are visited by a number of insects of other kinds. The visits of these latter appear for the most part to have been hitherto noticed; and as many of these illicit visitors are of no use for the purpose of fertilisation, the ill-adapted ones are, according to the author, habitually deceived by the flower itself as to its proper entrance. Of the various visitors, two small bees of the genera *Clisodon* and *Osmia* were thoroughly at home in the flower, alighting at the entrance and passing immediately down the narrow passage leading into the nectary, and as quickly emerging and flying off. On the other hand, numerous kinds of Syrphid flies spent a much longer time on the flower, which many of them visited only for pollen. Other visitors were certain small flower-beetles and weevils, which never by any chance succeeded in reaching the nectary.

TWO interesting lectures by Prof. D. T. MacDougal, delivered at the Woods Holl Marine Biological Laboratory, are reprinted from the *Bulletin* of the New York Botanic Garden. In his address on the "Significance of Mycorhizas" a general summary is given of our present knowledge of the occurrence of these organisms, both endotropic and ectotropic. All known species of mycorhizal fungi are stated to belong to the families Oomycetes, Pyrenomycetes, Hymenomycetes, and Gasteromycetes; and it is suggested that their further study and identification may result in a considerable increase in our knowledge of the physiology of vegetable life; and that their culture may not be without importance in the nutrition of a number of perennial flowering plants. The lecture on the "Influence of inversions of temperature, ascending and descending currents of air, upon distribution" is devoted to an explanation of the distribution of the flora in the United States, especially in the region of the great cañons.

APPENDIX III. for 1900 of the *Kew Bulletin of Miscellaneous Information* is entirely occupied with a list of the additions to the Library of the Royal Botanic Gardens, made during the year 1899

THE *West Indian Bulletin*, vol. i. No. 3, published in Barbados, contains the completion of the report on the papers read at the Agricultural Conference held in that island, and of the discussions arising out of them.

THE last two parts which have reached us of Engler's *Botanische Jahrbücher* (vol. xxviii. Hefts 1 and 3) are occupied entirely with the useful description and systematic papers which form so conspicuous a character of the work. Among those relating to flowering plants are the following, or instalments of them:—Compositæ of Ecuador, by Hieronymus; The flora of Central America, by Loesener; Classification of the Calyceraceæ, by Reiche; Revision of the genus *Linnaea*, by Graebner; African Verbenaceæ, Borragineæ, and Labiatæ, by Gürke; *Triplochiton*, a new genus of Malvales from the Cameroons, constituting the type of a new family, Triplochitonaceæ, by Schumann; Report of the botanical results of the Nyassa Lake Expedition, by the Editor. Herr Hennings and Dietel furnish respectively instalments of their papers on the Fungi and on the Uredineæ of Japan.

WE have received a number of papers by different officers of the Observatory of Catania. Most of these we have noticed on their first appearance. Among the others, we may mention a valuable memoir, by Mr. S. Arcidiacono, on the eruptive period of Etna from July 19 to August 5, 1899, in which he points out the approximate coincidence of the great explosion on the former day with the total cessation of the flow of lava in Vesuvius and a strong earthquake in Latium, and also an interesting account of the history of the observatories of Catania and Etna.

THE *Mittheilungen aus dem Roemer-Museum*, Hildesheim (No. 11, April 19), includes a paper, by Mr. A. R. Grote, on the phylogeny of the families of butterflies, with a genealogical tree. It is a continuation and amplification of previous papers on the same subject, published by the author in Germany and America, and is mainly based on neuration. Like many authors, Mr. Grote divides the butterflies into two main superfamilies, Papilionides and Hesperiades; but it will surprise many entomologists to find that all the butterflies except the true Papilionidæ are referred to the Hesperiades.

A NEW journal has been started in Berlin, the first number of which bears the title "Laboratorium et Museum," while in the second number the words "et Clinicum" are added. The journal is to be of an international character, and includes articles and notes in English, French and German. The title of the journal is sufficiently suggestive in itself of the contents, which comprise descriptions of new apparatus and reagents, methods of preparation, notices of new books, obituary notices, and lists of trade catalogues, of which the publishers will send copies on application.

DR. FRANCESCO FOSSATI has published in the *Memorie* del R. Istituto Lombardo a bibliography of the writings of Volta. Several such lis ts have already been published: one in 1813 by Prof. Configliachi, containing the titles of forty-four works; one in 1877 by Prof. Pietro Riccardi, containing sixty titles; while the collection procured by Antinori in 1816 contained sixty-seven writings. The present bibliography is partly the outcome of a suggestion made by Prof. Alessandro Volta, junr., at the Como Electrical Congress last year, and it contains the titles of 231 writings.

IN the current number of the *Berichte* (p. 1569) Baeyer and Villiger describe some of the properties of the new hydride of benzoylsuperoxide, $C_6H_5CO\,O.OH$. The substance is obtained by the action of sodium ethylate upon benzoylsuperoxide,

$$C_6H_5CO.O.O.CO.C_6H_5 + NaOC_2H_5 = C_6H_5CO.O.ONa + C_6H_5CO.OC_2H_5.$$

The sodium salt of the new compound is formed together with ethyl benzoate. The ethyl benzoate is removed with ether, and the hydride of benzylsuperoxide separated by acidifying and extracting with chloroform. On distilling the chloroform, the hydride remains as a colourless crystalline mass, which melts at 41–43°. It is very soluble in the ordinary solvents, with the exception of benzene. The smell is penetrating and pungent, resembling, in the dilute state, hypochlorous acid, but not ozone. In its oxidising action on potassium iodide or aniline, and in its reducing action on permanganate, it stands midway between hydrogen peroxide and Caro's reagent (potassium persulphate dissolved in concentrated sulphuric acid). With benzoyl chloride it forms benzoylsuperoxide; with acetic anhydride, benzoylacetylsuperoxide. The oxidation of benzaldehyde to benzoic acid by exposure to air is shown to be due to he agency of this new compound,

$$C_6H_5COH + O_2 = C_6H_5CO.O.OH$$
$$C_6H_5CO.O.OH + C_6H_5COH = 2C_6H_5.COOH,$$

which is formed as an intermediate product.

THE additions to the Zoological Society's Gardens during the past week include a Smooth-headed Capuchin (*Cebus monachus*) from South-east Brazil, presented by Mr. F. Wallace; an Indian Desert Fox (*Canis leucopus*) from Persia, presented by Captain D. J. Leiper; a Small Hill Mynah (*Gracula religiosa*) from India, presented by Captain R. York Heriz, R.N.; two Yellow-bellied Liothrix (*Liothrix luteus*) from India, presented by Miss Petrocochino; a Cockateel (*Calopsittacus novae hollandiae*) from Australia, presented by Mrs. Harry Blades; four Ring-necked Parrakeets (*Palaeornis torquatus*) from India, presented by Mr. J. M. G. Bate; three Chaplain Crows (*Corvus capellanus*) from Southern Persia, presented by Mr. B. T. Ffinch; two Green Lizards (*Lacerta viridis*), four Viperine Snakes (*Tropidonotus viperinus*), a Smooth Snake (*Coronella austriaca*), two Marbled Newts (*Molge marmorata*), European, presented by the Rev. F. W. Haines; an Ourang-outang (*Simia satyrus*, ♂) from Borneo, five —— Mole Rats (*Spalax* sp. inc.) from East Africa, a Grey Parrot (*Psittacus erithacus*) from West Africa, a Yellow-cheeked Amazon (*Chrysotis autumnalis*) from Honduras, nine Mountain Witch Ground Doves (*Geotrygon cristata*) from Jamaica, a Hocheur Monkey (*Cercopithecus nictitans*) from West Africa, seven Brazilian Tortoises (*Testudo tabulata*) from South America, five American Box Tortoises (*Cistudo carolina*) from North America, deposited; two Peba Armadillos (*Tatusia peba*) from South America; three Spotted Owls (*Athene brama*) from Madras; three White-throated Finches (*Spermophila albogularis*) from Brazil, a Thick-billed Seed Finch (*Oryzoborus crassirostris*) from South America, a White-eared Conure (*Pyrrhura lencotis*) from Brazil, a Logger-head Turtle (*Thalassochelys caretta*) from the Tropical Seas, purchased; two Burrhel Wild Sheep (*Ovis burrhel*), a Thar (*Hemitragus enlaicus*), born in the Gardens; two Pied Mynahs (*Sturnopastor contra*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JULY.

July 3. 8h. 0m. to 9h. 11m. B.A.C. 4006 (mag. 5·7) occulted by the moon.
4. 1h. Mercury at greatest elongation (26° 2′ east).
5. Jupiter in conjunction with β Scorpii.
8. 11h. 24m. to 11h. 54m. δ Scorpii (mag. 2·5) occulted by the moon.
8. 13h. Jupiter 1° 35′ north of the moon.
9. 10h. 50m. to 12h. 2m. 24 Ophiuchi (mag. 5·6) occulted by the moon.
9. Pallas in opposition to the sun.
10. 10h. 18m. to 11h. 10m. 33 Sagittarii (mag. 6·0) occulted by the moon.
10. 12h. 19m. to 13h. 18m. ξ^2 Sagittarii (mag. 3·5) occulted by the moon.
10. 16h. Saturn 0° 48′ south of the moon.
14. 9h. 43m. to 10h. 17m. c^1 Capricorni (mag. 5·2) occulted by the moon.
15. Venus. Illuminated portion of disc, = 0·018. Mars = 0·948.
15. 8h. 29m. to 9h. 21m. κ Aquarii (mag. 5·5) occulted by the moon.
15. 10h. 11m. Minimum of Algol (β Persei).
16. 11h. 3m. 11h. 42m. 16 Piscium (mag. 5·6) occulted by the moon.
21. 13h. 2m. to 13h. 52m. 53 Tauri (mag. 5·5) occulted by the moon.
21. 14h. 53m. to 15h. 12m. D.M. + 20°, 751 (mag. 5·9) occulted by the moon.
25. Giacobini's comet situated close to α Cygni.
28. Epoch of the Aquarid meteoric shower (Radiant 340° − 12°).
31. Ceres in opposition to the sun.

THE NEXT TOTAL ECLIPSE OF THE SUN.—We have recently received *Nautical Almanac Circular* No. 18, issued under the superintendence of Dr. Downing. This pamphlet

contains the local particulars of the next total eclipse of the sun, which takes place on May 17, 1901. From inquiries which have been made, it appears that the positions selected in the eastern portion of the shadow track are those which are most easily accessible. These are all situated in the Malay Archipelago, with the exception of Mauritius. The durations of totality at the various stations recommended are as follow :—

Station.	Long.	Lat.	Duration of Totality.
	° ′	° ′	m. s.
Mauritius	57 33·2 E.	... 20 6 S.	... 3 35
Padang, Sumatra ...	100 20·5	... 0 58	... 6 14
Pontianak, Borneo	109 20	... 0 1	... 5 40
Fort Victoria, Amboyna	128 11	... 3 41	... 4 15
Port Moresby, New Guinea	147 9	... 9 28	... 3 19

The elements on which the computations are based are those published in the *Nautical Almanac* for 1901. A map of the region is included in the circular, by the aid of which other stations than those specified may be selected if desired.

ANCIENT RECORDS OF METEOR SHOWERS.—In his report for the year 1899, M. D. Eginitis, director of the Athens Observatory, gives a short account of some ancient records of meteor showers which appear to be suggestively consistent with the constants of several conspicuous showers of present times.

A shower was mentioned by the patriarch Nicéphore as lasting all night, but no exact date is given. From the historical statements given, however, M. Eginitis traces the epoch as the autumn of the year 752. This would suggest it being a shower of Andromedes, and, in fact, counting from the conspicuous falls of Bielids in 1852, 1872 and 1892, the twenty years interval corresponding to three periods of the comet, it is seen that the year 752 would be in such a series. He thus considers this apparition of 752 to have been a Bielid shower of Andromedes.

Seven years previously to this, in 745, the appearance of a great comet was recorded by Théophane and Cédrinos.

It may be, however, that the showers of 1852 and later are not from the same swarm as the shower of 752, but that they are the products of slow but continual disintegration of the comet.

Another passage in Cédrinos describes a shower in 558, also occurring in the autumn. Apparently connected with this is the observation of a comet in 518, the interval being almost six times the periodic time of Biela's comet, so that here there would appear evidence of a second series of showers, connected with Biela's comet by similarity of period, but occurring at different epochs from the first series mentioned. The modern showers of 1798 and 1838 would fall in this second group.

Théophane in 763 and Domno Alberico in 1122 record falls of shooting stars in the month of April, and these would correspond to the present showers of Lyrid meteors.

A shower chronicled in April 1094 by Alberico cannot be at present connected with any known radiant.

A MODERN UNIVERSITY.[1]

II.

THE constitution of the new University of Birmingham is on the simplest and broadest lines, and appears to offer scope or great developments in the future, some of which can hardly be foreseen at the present time.

The movement for the foundation of a university arose out of the Mason Science College, founded by Sir Josiah Mason in 1875, just a quarter of a century ago ; though it was not till five years later that the college was open to receive students. In 1892 an amalgamation was effected with the Queen's College Faculty of Medicine, and in 1897 the whole was incorporated as one body under the Mason University College Act. The Senate consists of twenty-seven members, and there are a large number of lecturers and demonstrators ; but that it should have already developed into a university is a very remarkable fact, and a sign of great enterprise and energy on the part of the community among which the college has done its work ; indeed, it is unlikely that this rapid development could have taken place unless it had been fortunate enough to secure the interest and personal influence of a prominent Minister of the Crown.

[1] Continued from p. 186.

The Faculties of the University already provided for are science, arts, medicine and commerce, but provision is made for the addition of other faculties by Statute later on. Each faculty holds its own meetings, and is presided over by its elected dean.

The assemblage of professors constitutes the "Senate," as usual. The "Council," or acting governing body under the Court, consists of the deans of the faculties, five nominees of the Birmingham City Council, twelve members appointed by the Court of Governors, and lastly of the chief officials of the University, *i.e.* the Chancellor, the Vice-chancellor, the Pro-Vice-Chancellor, the Treasurer, the Principal, and the Vice-Principal. The Court of Governors is a very widely representative body, consisting of all the chief officials in the neighbourhood of Birmingham, the head-masters of the principal schools, ten of the Members of Parliament for the boroughs and counties in the Midland district, a nominee of each of the other English Universities (including the University of Wales), a member from each of the Midland County Councils, five nominees by the Birmingham City Council, certain named life governors and donors of certain sums, all the professors of the University, six persons elected by the Guild of Graduates, three by the Guild of Undergraduates, and eleven members appointed by the voluntary elementary schools of the neighbourhood.

It is hardly possible to imagine a wider basis of representation than the one adopted for the Court of Governors of this University.

Among the executive officers there is to be a Secretary, and also a Registrar appointed by the Council ; the Vice-Principal and one of the deans, *i.e.* the Dean of the Faculty of Medicine, are likewise to be appointed by the Council. There is to be a Principal appointed by the Crown ; there is also to be a Vice-Chancellor elected by the Court of Governors, and there is to be a Chancellor ; the first Chancellor being the Right Hon. Joseph Chamberlain, and the first Vice-Principal Prof. R. S. Heath.

Concerning the objects to which all this machinery will be applied, no doubt a good deal will at the beginning be conducted on lines with which we are more or less familiar, though there appears to be no desire to imitate other universities, but rather a hope that it may be possible to strike out on a new line, and develop a broad system of national education suited to modern times, and to the practical requirements of life in an active city of the British Empire.

To this end a committee of inquiry was formed, and a deputation sent to various colleges and universities, chiefly in the United States and Canada, in order to study what was going on there. This body reported to the management committee connected with the establishment of the University of Birmingham, and their report constitutes an important and informing document. In it they say that :—

"Their object has been the teaching of science in its application to industry, and in the first place to the industries of the city and district, coupled with such technical instruction in handicrafts as will enable the students to complete their course in the university itself."

They classify the industries of the district as follows :—mining, metallurgy, engineering, and chemical trades, and non-metallic trades.

They recommend that there shall be chairs of mining, metallurgy, engineering, and applied chemistry. They further recommend that the students should be put through a very thorough course, consisting largely no doubt of a study of mathematics, physics, pure chemistry, and geology, as taught at present, but finishing with a specifically technical course, making it four years in all. A shorter course would likewise be permissible, but it appears would not lead to a degree.

They say the students should be divided into two classes, viz. :—

(1) "Those taking a four-years' course in mechanical (including electrical), civil or mining engineering, metallurgy or applied chemistry, who would study for a master's degree in their respective subjects. At the conclusion of this course facilities would be offered for further study and research to those who could give the time or should wish to proceed to the doctor's degree."

(2) "Those taking a course of from one to three years in any of the above subjects, with a view to the practical application of the teaching to a particular industry. With such students, less time could be devoted to theory, as attention would have to

be concentrated on methods and results. Their work in these courses would be recognised by class certificates."

In addition to the professor of each technical subject there will be an assistant-professor and several instructors, each competent in a particular branch.

They indicate a block plan for the buildings required, their size and their suggested arrangement. These plans suppose a front of two storeys, containing the lecture rooms, library, museum, &c., and at the back a series of blocks, all on the ground floor, and intended for the various laboratories and workrooms which have been described in the report. These could be built to provide accommodation in the first instance for 200 day students, increasing afterwards to 500.

"The space occupied by these buildings, including the necessary yards and roads, a gymnasium, a director's house, and rooms for a caretaker, is about six acres. In view of the future of the university, a total area of not less than twenty-five acres should be provided."

The committee recommend that this land be taken in the outskirts of the city on a main line of, by preference, both rail and road, and they estimate the complete cost as follows :—

Twenty-five acres of land and buildings ...	80,000*l.*
Machinery, apparatus, and instruments ...	66,000
Fittings, utensils, lighting, and heating ...	5,000
Technical library	1,500
Museum	500
Director's house	2,000
Total ...	155,000*l.*

They estimate the cost of maintenance (including the staff) at 10,450*l.* per annum.

Thus the scheme is a very large one, but it is estimated that the fees from students will ultimately do a good deal towards covering the cost of maintenance.

The committee do not advise night classes, and in this we think they are wise ; they consider that the already existing municipal technical school either does provide or might provide for the need these night classes are intended to meet, and they are sure that the curriculum they propose will absorb all the energies of the teaching staff when employed in the daytime only. They do not clearly indicate the training they propose for mining engineers, but for mechanical, electrical, and civil, they draw up a course the same in the first two years ; in the third year the mechanical and electrical branch off on the one hand, and the civil on the other, while in the fourth year there is more specialisation, but not much distinction drawn even then between mechanical and electrical.

So far, the lines indicated are not very different from what is becoming customary, but they propose to attempt a Faculty of Commerce. Now the establishment of a great commercial school on serious lines is a new experiment, and has not yet been successfully tried anywhere. They propose a capital expenditure of 6000*l.* on class-room accommodation, together with books and apparatus, and an annual expenditure of 2200*l.* on a professor, an assistant professor, an instructor, and some special lecturers. We think that they will find that the addition of certain other chairs will be essential if a commercial faculty is to take its proper position, especially political economy and geography, probably law also. We do not see that any provision has been made for these three subjects. We regard a thorough course in political economy as essential to the well-being of a commercial faculty ; and geography, treated completely, we regard as a much more important subject than the committee at present seem to realise.

The advisory committee enter further into the difficult question of commercial education. They say that modern languages should be learnt when quite young ; which indeed is very true, but it seems to us a counsel of perfection. In practice we feel sure that modern languages would certainly have to form a considerable part of a scheme for commercial education.

Commercial arithmetic, they say, does not go far enough ; and that also is extremely probable ; but a training in elementary mathematics, beyond the immediately practical stage, would be of great advantage to the commercial man in many indirect ways.

As to geography, the committee think that the information is best obtained as wanted from books of reference and consultation with one of the touring agencies ; but in this we entirely differ from them. To make proper use of books of reference some previous knowledge of the subject is necessary ; and the earth, especially the portion accessible to trade, is not so big but that an adequate knowledge concerning its chief features should be acquired and possessed by a competent man of business, without having to refer constantly to others.

The committee, however, go on to recommend that, in addition to these things, instruction shall be provided in business organisation, the theory and principles of trade unions, associations, trusts, combinations and rings ; that instruction shall be given in commercial law, likewise in accountancy, in shipping and railway practice, and in banking and exchange ; and they say very wisely that "such knowledge as the foregoing is what is required in business, and is usually only learnt bit by bit at a heavy cost, so that the man of business has generally reached the limits of his working life before he has completed his commercial education, and owing to the want of a codified system business men continue from generation to generation to renew the mistakes of their predecessors, and to repeat their experiments, and after much tribulation to re-arrive at their methods, their rules and their conclusions."

They further indicate that this commercial education is not to be taken as a substitute for a more general education, but is to be a supplement to it. They say, "Students in the commercial education course should not be allowed to enter at too early an age. Twenty is quite early enough ; and it would be most desirable that they should have taken a degree in Arts before studying for the commercial degree, and certainly the highest commercial degree should only be given to those already in possession of an Arts degree."

They hope (again in this case) that the fees from students may make it largely self-supporting, but we incline to think that they estimate the fees from students too highly. If they fix the fee for each student at 50*l.* a year, we fear that the expense will exclude a considerable number of those who might otherwise derive special benefit from the course proposed.

They realise that this attempt at a thorough commercial education is a new experiment, and one which, if successful, may have most important consequences on the commercial future of the country, and they conclude as follows :—

"There is no instance elsewhere of any course at once so complete and so valuable ; there is not even, so far as your committee know, any university in the United Kingdom where there is a separate Faculty of Commerce, and as there has not yet been any effort to treat the subject with the thoroughness now proposed, so there is no means of estimating the extent to which advantage would be taken of such teaching. Your committee, however, point to the fact that a Faculty of Commerce so organised and based on the actualities of business experience, would at the present moment stand alone, and would therefore attract to the Birmingham University all who feel the need of such an education, and would also to a much greater extent create a new demand."

There is no doubt, however, that the Arts Faculty in general requires strengthening in many ways, the addition of new chairs being one of them ; and unless this is done as soon as opportunity offers, the scientific and technical training proposed will not acquire its proper university status. The training of the students must not be limited to their immediate fancied needs ; neither students nor their parents are the best judges of what is in the long run really desirable. A much broader training must be given in the university of the future than has been given in the university of the past. Depth without breadth has been the feature of some Honours schools ; shallowness with athletics has been the feature of some Pass schools. The university of the future must mend all this, and secure that all its graduates without exception have had a broad training in many subjects—subjects lying in different departments of human knowledge ; so that they may be really educated and not merely informed. As to the depth possible, that will vary with individual powers, and the standard must not be made impossible for the average man ; but to give the average man a training in some highly specialised practical department, and then turn him out on the world as a university graduate, is not what we expect or hope for from the new university. Such students there will be, doubtless, and they may well receive special diplomas each in his own branch, but they should not be graduates.

Some other students there will be, who, in addition to a broad and liberal culture, have the power of going deeply into some one subject, and these should receive degrees with honour ;

but both these classes will be exceptional. For the average man a broad training in many subjects, well taught and under the most favourable conditions, is what is wanted, in order to leave him adaptable and efficient in the subsequent uncertain calls of actual life; and such men should constitute the bulk of the pass graduates, and be the backbone of the new scheme.

Annexed to the report is an account of the visit of the committee's deputation to American and Canadian Universities, and the information thus obtained and summarised is of the greatest interest and importance.

A deputation of the Advisory Committee of the University of Birmingham paid a visit to colleges and universities in the United States and Canada at the end of last year, on the suggestion of Mr. Carnegie, who, it is understood, is willing to provide a good round sum for the establishment of an adequate scientific and technical college on this side of the Atlantic. An appendix to the committee's report contains a statement of the condition of affairs which they found in America.

They find that "almost the whole of the students enter on a full four-year course of instruction with a view to graduation. The student on entrance is required either to pass an examination or to present satisfactory evidence that he is qualified to take up the course on which he enters. The entrance examination is not very different, as a rule, from the matriculation examination of the University of London. It is more advanced in mathematics, but probably easier on the literary side."

The working session ranges between thirty-three and thirty-eight weeks; but outside this there are summer excursion classes, and summer workshop classes usually of about one month.

One remarkable difference they find in the system of lecturing. With us, college lectures form a connected course, almost dispensing with the necessity of a text-book, except for supplementing and extending information. It has often seemed to us that such lectures are perfectly right if the student already partially knows the subject; it then systematises and organises and more firmly impresses his knowledge; but if, as too often happens, a student comes to the lecture-room ignorant of the subject, he cannot derive proper benefit from a course of lectures; he cannot discriminate between the essential and the comparatively unessential; he cannot without practice watch experiments and take notes at the same time; he cannot always keep his attention fixed: we have noticed that students who have recently been to a British secondary school, one of the large public schools or indeed any other, cannot as a rule keep their attention long fixed on anything. There are exceptional students, and there are exceptional schools; but as a rule what they chiefly learn in class work at school is a habit of inattention to what is going on, the average procedure in class being too slow for the quicker boys, too rapid for the slower ones, and too dull for all. This habit of inattention, once firmly acquired, remains with them through the first year and sometimes through the second year of their college life, and they are all the time a perfect curse to any who wish to get on, and who are becoming of an age to realise some of the responsibilities and opportunities of life.

For the college lectures in America it would appear that "a large amount of home preparation and work is required. The student is expected to read up in a text-book the subject matter of the lectures beforehand, the lectures in many cases consisting of exposition and experimental illustration of the text-book. Recitation classes are held in connection with each lecture, in which individual students are questioned on the text-book or lectures, or asked to demonstrate on the blackboard before the rest of the class."

Literary studies are not wholly neglected by the students of science, nor is attention to them confined to the needs of the entrance examination. In addition to the requirements of the entrance examination in languages, grammar, and history, a certain amount of time is given by the science students, especially in the first two years, to what appear to be often called "culture subjects," such as literature, composition and rhetoric, history, political economy, French and German.

But the most important and much-to-be-imitated portion of the system adopted in America, is that whereby the credit given for work does not depend solely on a concluding examination, but is made really to represent the aggregate work of the whole session. There is a Paper examination, and that is quite right, for it is eminently desirable that a student should be able to express what he knows accurately and on demand. Quite half the credit ought to be awarded to this faculty, but not all; the remaining half should be awarded for work in class-room and laboratory.

In the States there are no practical examinations as with us. Proficiency in laboratory work is accredited by assigning marks for attendance and for excellence of laboratory and manual work throughout the session. We believe that this system is very successfully in force at such places as the City Guilds Central Technical College at South Kensington, but we have not yet heard of its much to be desired introduction into universities in this country. There is no doubt that it would have the best effect on both student and demonstrator; and it would have the further advantage that the troublesome practical examinations, especially those in the senior stage, when they become rather farcical, could be dispensed with.

Another desirable innovation is thus expressed:—"The right of dismissal at any stage is maintained and used. Any student who shows that he is unable or unwilling to keep up with the work is excluded by the Faculty from the graduation course. He may be allowed to take on special courses, but usually he is dismissed from the institution. The system has been devised to keep, and succeeds in keeping, the students continuously at work, and the result of the process of exclusion in the earlier stages is that nearly the whole of the final classes are successful in graduating."

One of the most important arrangements in America is the large provision made at some of the institutions for post-graduate work. Only a small proportion of students are able to spare time for it, but it is encouraged by affording every facility for study and research to the post-graduate; and graduates from one institution frequently work as post-graduates at another. This system of interchange between universities, which already obtains largely in Germany, is surely to be desired in this country, especially in post-graduate stages, where specialisation naturally and properly sets in.

Over-specialisation in undergraduate stages is, we believe, to be deprecated. A certain amount of general knowledge, both literary and scientific, is needed, and should be acquired by all.

The committee found that in America the proportion of staff to students is much greater than with us; and they further found—what is a matter of great importance—that the subdivision of subjects is, as in Germany, likewise carried much further; so that, for instance, every important branch of engineering has its own professor, with perhaps an assistant professor, and certainly with instructors; and no attempt is made, as with us, to place the whole of a gigantic scientific subject in its higher stages under the control of one man.

We observe that in the fundamental subjects of chemistry and physics the general laboratory arrangements and the scope of teaching appear to be much the same in America as in this country. The laboratories are, however, as a rule more spacious, the equipment in apparatus is on a larger scale, greater facilities are given for research, and the size of the laboratories allows most of the physical apparatus to be kept in position—different rooms being used for different subjects. In the more important laboratories many rooms are provided for original research, which is carried on by the staff and post-graduate students. At Cornell there is a special laboratory for physical chemistry. At several colleges there is a department of applied chemistry, through which all students pass who are graduating in chemistry. This is excellent, and tends to make the knowledge much more real and practical. Chemicals are made, instead of being merely purchased; "the course is short, and generally consists in the production of pure chemicals from commercial articles on a scale in which many kilogrammes are dealt with. The processes are made to resemble, as far as possible, those of manufacturing practice."

In civil engineering we observe that "the work in surveying is very thorough, and includes field work throughout the year, together with a summer course. There is usually an extensive stock of theodolites, levels, and chains, so that each student in the field has his own instrument. During the two last years particular attention is devoted to bridge construction, the student preparing complete drawings and stress sheets in accordance with the practice of the leading railway companies."

Less hostile feeling to academically bred apprentices would be felt in this country if these practical features could be imitated.

In mining engineering, a summer excursion class is sometimes formed to spend some weeks in a mining district, where facilities are given to inspect the actual processes of mining.

Great importance is assigned to engineering-laboratory work,

and the whole ground of the engineering lectures is provided for in the equipment of the laboratories. The machines are large in number and in capacity, so that every student performs experiments on an adequate scale. The work is chiefly pursued in the third and fourth years, and occupies from four to six hours weekly. In some laboratories there are full-size locomotives mounted, so that running tests can be made, and special courses are arranged for those who wish to take up the mechanical side of railway practice. Facilities are given by the railroad companies for testing under the conditions of actual running.

The shops gave the impression of being thoroughly practical, and on such a scale that the knowledge acquired there by the student would be of use in his subsequent professional life.

The greater size of the Continent is, perhaps, partially responsible for the following paragraph in the committee's report, although really if education were properly appreciated in this country, our island is large enough for us to follow the example. The paragraph we refer to looks very attractive to those whose work in this country lies in colleges cramped in the middle of great cities. It runs as follows:—

"We were very much struck with the amount of ground occupied by the colleges, each building standing in its own grounds, so that it is well lighted on every side. Usually there is a large entrance hall, a fine staircase, and wide corridors leading to class-rooms and laboratories. The floor space in the laboratories is generally very much greater than with us. The apparatus, instead of being huddled away in dark corners, is set out and classified as if for exhibition, while the machinery occupies a space worthy of its importance."

We observe also that every college possesses departmental libraries and reading-rooms available for the students, in addition to the large central library and reading-room.

The social aspect of university life is not forgotten, and the following glorified edition of a student's union is well worthy of imitation:—

"The University of Pennsylvania at Philadelphia possesses in Houston Hall a fine building given to the University by an old graduate, in memory of his son, who was also a graduate. It is a club-house for the students, any student becoming a member for two dollars per annum. In the building are reading, billiard and smoking rooms, a luncheon-room, a gymnasium, a swimming bath, and rooms for college societies. The hall is entirely and very well managed by the students. It is regarded by the staff as having a most excellent influence on student life."

In concluding this part of the general report of their American visit, the committee make a well-deserved comment, which we will presently quote, for nothing more splendid in the direction of educational endowment has been seen in our times than the magnificent sums which wealthy American citizens are willing to place at the disposal of university authorities. They do, indeed, realise, as we do not, or at least have not yet, the immense, the super-eminent, importance of real education and knowledge, to a country and an empire which has to hold its own against ever-increasing competition, and constantly to make its way in fresh uncivilised regions. The following are the concluding general remarks:—

"We desire to express our admiration alike for the high ideal of scientific education, which is the aim in American universities, and for the enthusiasm in all classes which renders it possible to approach so near that ideal. Everywhere we found evidence that the wealthier citizens realise the importance of university education, and encourage the universities by generous gifts; and everywhere, both by teachers and by students, these gifts are being used for higher learning and research."

THIRD INTERNATIONAL CONFERENCE ON A CATALOGUE OF SCIENTIFIC LITERATURE, LONDON, JUNE 1900.

LIST OF DELEGATES APPOINTED TO ATTEND THE CONFERENCE.

Austria.—Prof. E. Weiss (Kaiserliche Akademie der Wissenschaften, Vienna); Prof. Karl Toldt (Universität, Vienna).

France.—Prof. G. Darboux (Membre de l'Institut de France); Dr. J. Deniker (Bibliothécaire du Museum d'Histoire Naturelle, Paris); Prof. H. Poincaré (Membre de l'Institut de France).

Germany.—Prof. Dr. F. Klein (Geheimer Regierungs-Rath, Universität, Göttingen); Prof. Dr. B. Schwalbe (Direktor, Real-Gymnasium, Berlin); Dr. F. Milkau (Oberbibliothekar, Universität, Berlin).

Greece.—Mons. de Metaxas (Chargé d'Affaires for Greece).

Hungary.—Dr. August Heller (Bibliothekar, Ungarische Akademie, Buda-Pesth); Dr. Theodore Duka (Hon. Member of the Hungarian Academy of Sciences).

Italy.—Prof. Giacomo Ciamician (R. Università, Bologna); Prof. Raffaelo Nasini (R. Università, Padua).

Japan.—Prof. Einosuke Yamaguchi (Imperial University of Kioto).

Mexico.—Señor Don Francisco del Paso y Troncoso.

Norway.—Dr. Jörgen Brunchorst (Secretary, Bergenske Museum).

Switzerland.—Dr. Jean Henri Graf (President, Commission de la Bibliothèque Nationale Suisse, Berne); Dr. Jean Bernoulli (Librarian, Bibliothèque Nationale Suisse, Berne).

United Kingdom.—Representing the Government: The Right Hon. Sir John E. Gorst, Q.C., M.P., F.R.S. (Vice-President of the Committee of Council on Education). Representing the Royal Society of London: Sir Michael Foster, K.C.B., Sec.R.S.; Prof. Arthur W. Rücker, Sec.R.S.; Prof. H. E. Armstrong, F.R.S.; Sir J. Norman Lockyer, K.C.B., F.R.S.; Dr. Ludwig Mond, F.R.S.; Dr. T. E. Thorpe, For.Sec.R.S.

Cape Colony.—Sir David Gill, K.C.B., F.R.S.; Roland Trimen, Esq., F.R.S.

India.—Lieut.-General Sir Richard Strachey, G.C.S.I., F.R.S.; Dr. W. T. Blanford, F.R.S.

Natal.—Sir Walter Peace, K.C.M.G. (Agent-General for Natal).

New Zealand.—The Hon. W. P. Reeves (Agent-General for New Zealand).

Queensland.—The Hon. Sir Horace Tozer, K.C.M.G. (Agent-General for Queensland).

ACTA.

Opening Meeting, Tuesday, June 12, *at the rooms of the Society of Antiquaries, at* 10 *o'clock.*

(1) Prof. Darboux moved that Sir John E. Gorst be the President of the Conference. The motion having been carried unanimously—

(2) Sir John Gorst took the chair and welcomed the delegates.

(3) On the motion of Sir M. Foster, seconded by Prof. Darboux, it was resolved that Dr. F. Milkau be the secretary for the German language; that Dr. Jean Bernoulli and Dr. J. Deniker be the secretaries for the French language; that Prof. Giacomo Ciamician be the secretary for the Italian language; that Prof. H. E. Armstrong be the secretary for the English language.

(4) That the secretaries, with the help of shorthand reporters, be responsible for the *procès verbal* of the proceedings of the Conference in their respective languages.

(5) Sir Michael Foster read out the names of delegates appointed to attend the Conference.

(6) On the motion of Sir Michael Foster, it was resolved—(i.) That the meeting adjourn at 1 p.m., and meet again at 2.30 p.m.; (ii.) that on Wednesday, the meeting commence at 11 a.m.

(7) On the motion of Sir Michael Foster, seconded by Prof. Rücker, it was resolved that English, French, German and Italian be the official languages of the Conference, but that it shall be open for any delegate to address the Conference in any other language, provided that he supplies for the *procès verbal* of the Conference, a written translation of his remarks into one or other of the official languages.

(8) Sir Michael Foster presented the Report of the Provisional International Committee, and it was resolved that the report be received.

(9) The following resolutions were then agreed to:—(i.) That the publication of a card catalogue be postponed for the present; (ii.) that the book catalogue be at first issued only in the form of annual volumes.

(10) Sir Michael Foster having moved (iii.) that the catalogue include both an authors' and a subject index, according to the scheme of the Provisional International Committee; Prof. Rücker thereupon explained the financial position, and the delegates of the various countries stated to what extent they were authorised to promise contributions towards the expenses of the catalogue. From these statements it appeared that subscriptions to 163 sets of volumes (or their equivalent) of the

catalogue, to the value of £2,771, would be guaranteed, viz. as follows :—

		£
Germany	45 sets equivalent to	765
United Kingdom	45 ,, ,,	,, 765
France	35 ,, ,,	,, 595
Italy	27 ,, ,,	,, 459
Switzerland	6 ,, ,,	,, 102
Norway	5 ,, ,,	,, 85

Other delegates estimated that the probable contributions from their countries would be :—

		£
Austria	16 sets equivalent to	272
Hungary	4 ,, ,,	,, 68
Japan	5 ,, ,,	,, 85
Mexico	5 ,, ,,	,, 85

It was further estimated that the British Colonies and Dependencies would subscribe for at least 25 sets, equivalent to 425*l*. Taking into account the subscriptions to be expected from the United States, Russia, Holland, Sweden, and a number of other countries, as well as the probability of outside sales, the Conference was of opinion that the necessary subscriptions to cover the cost of 300 sets of the catalogue would be obtained. At the close of the discussion the motion above set forth was unanimously agreed to.

(11) In the course of the discussion, it was stated by delegates from several countries that all the sets subscribed for would be distributed among public institutions, and that they contemplated the private sale of the catalogue in addition.

Second Meeting, Wednesday, June 13.

(12) The following motions, of which notice had been given on the previous day, were considered and adopted :—

(A.) The Conference is of opinion that the financial prospects of the enterprise are sufficiently satisfactory to warrant further steps being taken toward the publication of the catalogue, in view of the fact that the representatives of the various countries have declared that the governments or corporations they represent are willing to subscribe for the number of complete sets of copies at the cost stated in paragraph 10.

La Conférence décide : que le côté financier de l'entreprise est suffisamment élucidé pour justifier les arrangements ultérieurs nécessaires pour la publication du Catalogue, les représentants des différents pays ayant en effet déclaré que les gouvernements ou les corps savants qu'ils représentent sont prêts à souscrire au nombre de séries complètes du Catalogue, et aux prix indiqués dans le § 10.

Angesichts der von den Vertretern der verschiedenen Länder abgegebenen Erklärung, dass die durch sie vertretenen Länder oder Körperschaften entschlossen sind, auf die in § 10 angegebene Zahl vollständiger Exemplare zu dem ebenda festgesetzten Preise zu subskribiren, gibt die Konferenz der Meinung Ausdruck, dass die finanziellen Aussichten des Unternehmens zufriedenstellend genug sind, um weitere Schritte zur Veröffentlichung des Katalogs zu rechtfertigen.

La Conferenza è d'avviso che avendo i rappresentanti dei diversi paesi dichiarato che i governi o i corpi scientifici da loro rappresentati sono pronti a sottoscrivere nella misura indicata al § 10, si può ritenere l'impresa abbastanza soddisfacente dal lato finanziario per autorizzare gli ulteriori passi che sono necessari per la pubblicazione del catalogo.

(B.) That, pending the appointment of the International Council, a Provisional International Committee be appointed which shall be entrusted with the duty of approaching, through the Royal Society, such countries as may be necessary, with the view of obtaining their adhesion to the scheme for the publication of the catalogue, or promises of financial support.

Que jusqu'à la constitution définitive du Conseil International, un comité international provisoire soit nommé. Ce comité sera chargé de se mettre en rapport par l'intermédiaire de la Société Royale, avec les personnes autorisées des différents pays, suivant les nécessités de la situation, afin d'obtenir de ces pays l'adhésion ou l'appui financier à l'œuvre du Catalogue.

Dass bis zur Einsetzung des *International Council* ein *Provisional International Committee* ernannt wird, mit dem Auftrage, sich durch die Vermittelung der Royal Society mit den in Betracht kommenden Ländern in Verbindung zu setzen, um sich ihrer Mitwirkung bei der Veröffentlichung des Katalogs zu versichern oder ihre Zusagen für finanzielle Unterstützung zu erwirken.

Che sia nominato un comitato internazionale provvisorio sinò a che non sarà costituito definitivamente il Consiglio Internazionale. Questo comitato avrà l'incarico di mettersi in comunicazione mediante la Royal Society con i diversi paesi, secondo che sarà necessario, per ottenere la loro adesione al progetto di pubblicazione del catalogo o la promessa del loro appoggio finanz ario.

(C.) The said Provincial Committee is further authorised to make other preparations for the publication of the catalogue, but without incurring financial responsibility.

Inasmuch as it will be necessary for some one corporation to make the necessary contracts and undertake the final financial responsibilities, the Provincial Committee is authorised to include among such preparations, negotiations either with the Royal Society, or with another corporation, or with a government, or with a publisher, but the confirmation of all such preparations, and the carrying out of any final agreement or contract, shall rest with the International Council.

Ce comité sera autorisé en plus à prendre d'autres mesures préliminaires en vue de la publication du Catalogue ; mais il n'aura aucune responsabilité financière.

Comme il sera nécessaire, pour un corps constitué quelconque, de conclure des traités et d'encourir les responsabilités financières définitives, le comité provisoire est autorisé à comprendre parmi les mesures préparatoires de ce genre, les négociations soit avec la Société Royale, soit avec un autre corps constitué, soit avec un gouvernement, soit avec un éditeur. Toutefois la confirmation de toutes ces mesures préparatoires, ainsi que l'arrangement financier définitif ou conclusion d'un traité, doivent incomber au Conseil International.

Das genannte Provisional Committee wird ferner beauftragt, andere Vorbereitungen zur Veröffentlichung des Katalogs zu treffen, ohne jedoch eine finanzielle Verantwortlichkeit einzugehen.

Soweit es notwendig ist, dass eine Korporation die erforderlichen Verträge abschliesst und die endgültige finanzielle Verantwortlichkeit übernimmt, wird das Provisional Committee ermächtigt, derartige Vereinbarungen entweder mit der Royal Society oder mit einer anderen Korporation oder mit einer Regierung oder mit einem Verleger einzuleiten, indem die Bestätigung solcher Verhandlungen wie die Ausführung der endgültigen Vereinbarungen dem International Council vorbehalten bleibt.

Questo comitato sarà inoltre autorizzato a prendere altre misure preliminari per la pubblicazione del catalogo, senza avere tuttavia nessuna responsabilità finanziaria.

E poichè è necessario per un corpo costituito di concludere dei contratti e d'assumere la responsabilità finanziarie definitive, cosi il comitato provvisorio è autorizzato ad includere nei lavori preparatori le trattative o colla Royal Society o con altre corporazioni o con un governo o con un editore : ma la conferma di queste trattative e l'approvazione finale del contratto sarà riservata al Consiglio Internazionale.

(13) The "Scheme for the Publication of an International Catalogue of Scientific Literature" was then considered, and it was resolved—

That Article I. be approved—

Omitting the words in paragraph 5 on page 5, lines 9 and 10, "the limits of the several sciences to be determined hereafter," and also the words, page 5, lines 27–29.

That Article II. be approved—

Omitting the words "the same . . . regulations were" in paragraph 10, page 7 ;

Adding Italian to the three languages mentioned in paragraphs 10 (*a*) and (*b*) ;

Altering the word "delegate" to "contracting body (as hereinafter defined)" in paragraph 10 (*d*) ;

Omitting at the top of p. 8 the words within square brackets ;

Omitting in paragraph 11, p. 8, the words within square brackets : "The . . . Appendix II.," and substituting the following : "Each contracting body shall have one vote in deciding all questions brought before the Council" ;

And inserting in paragraph 13, before the words : "There shall also be . . ." the words : "If the International Council so decide."

That Article III. be approved without change.

That Article IV. be approved, omitting the opening paragraph in square brackets.

That Article V. be approved, inserting the words: "or as soon after that date as the International Council may decide," in paragraph 29, after "January 1, 1901."

That Article VI. be approved, inserting at the beginning of paragraph 32, the words: "Unless the International Council decide otherwise";

Substituting in paragraph 34, p. 14, line 33, "instructed" for "authorised."

That Article VII., excepting paragraph 37, be approved—

Omitting paragraph 35 and the next paragraph in square brackets, and substituting therefor: "any body which establishes a regional bureau shall be termed a contracting body."

Omitting the words "which takes a complete share" in the first line of paragraph 40, and omitting the whole of the second sentence in this paragraph, and omitting the three appendices.

(14) It was further resolved to substitute for paragraph 37, Section VII., page 15, the following:—

"That it will be an instruction to the Provisional Committee to negotiate with the several contracting bodies with reference to the sale in their respective regions of copies other than those subscribed for by the contracting bodies."

Que les instructions soient données au comité provisoire pour négocier avec les différents corps contractants la question de la vente dans leurs pays respectifs des exemplaires souscrits par ces corps.

Aufgabe der Provisional Committee wird es sein, den verschiedenen contrahierenden Körperschaften (contracting bodies) bezüglich des Verkaufs von Exemplaren in ihren Ländern, ganz abgesehen von der gewahrleisteten Anzahl, bestimmt e Festsetzungen vorzuschlagen.

(15) It was resolved that the Provisional Committee contemplated in Resolution 12 (B) be constituted as follows:—Prof. Armstrong, Dr. Brunchorst, Dr. Graf, Dr. Milkau, Prof. Nasini, Prof. Poincaré, Prof. Weiss; power being given to the Royal Society, while retaining only a single vote, to nominate further members, and power being given to the Committee to appoint substitutes if any of those named were unable to serve, and also to co-opt two new members.

(16) On the motion of Sir Michael Foster and Prof. Rücker, it was resolved that the Royal Society be requested to appoint the Secretary to the Provisional Committee, and to meet provisionally such expenses as the Committee may incur.

(17) It was resolved that the *procès verbal* of the Conference be signed by the president and secretaries.

(18) The Royal Society was requested to undertake the editing, publication, and distribution of a verbatim report of the proceedings of the Conference.

(19) On the motion of Prof. Schwalbe, a vote of thanks to Sir John Gorst for presiding over the Conference was passed by acclamation.

(20) On the motion of Sir Michael Foster, the thanks of the Conference were accorded to the Society of Antiquaries for the use of their rooms.

(Signed) JOHN E. GORST.
HENRY E. ARMSTRONG.
Dr. JOH. BERNOULLI.
G. CIAMICIAN.
I. DENIKER.

THE ROYAL SOCIETY CONVERSAZIONE.

THE exhibitions at the conversazione, which took place on the 20th inst., were numerous and interesting. There was a great wealth of photographs, including a large collection illustrating the results obtained during the last total eclipse. Among the other objects exhibited were the following:—

Prof. W. Ramsay, F.R.S., and Dr. M. W. Travers exhibited the inert atmospheric gases; their spectra, and some of the apparatus used in determining their physical properties.

The Meteorological Office exhibited North Atlantic weather charts, winter, 1898-99.

Prof. J. W. Judd, C.B., F.R.S., on behalf of the Coral-Reef Committee of the Royal Society, exhibited specimens from the reefs of Funafuti.

Mr. J. Mackenzie Davidson exhibited a stereoscopic fluoroscope. The stereoscopic fluoroscope is an instrument to enable an observer to see the shadows cast by the Röntgen rays on the fluorescent screen in *stereoscopic relief*.

Prof. W. E. Dalby exhibited a model to illustrate and experiment upon the balancing of four-cylindered engines.

Prof. Silvanus P. Thompson, F.R.S., showed experiments on the aberration called *Coma*. Coma is an aberration due to the several zones of the lens not having equal focal lengths, and hence, when the lens is transmitting an oblique pencil, the unequal refraction of the different parts gives rise to a singular unilateral distortion of the cones of rays traversing the various zones. In these experiments, the effects are analysed by covering the lens with a series of zones alternately opaque and transparent. Some singular effects can also be produced without the zone plate, by inserting in the oblique pencil, after traversing the lens, objects to cast shadows on a screen. In this way a straight wire can be arranged so that the shadow it casts is a totally-detached circle. Some diagrams of coma, and a string model illustrating their origin, were also shown.

Mr. W. Gowland exhibited Japanese books on botany, intended to show the general character of the work of Japanese botanists from 1759 to 1856.

Mr. W. Gowland, for the Silchester Excavation Committee, exhibited remains of a Roman silver refinery found at Silchester.

Mr. S. Evershed exhibited an electric supply meter (a frictionless motor meter).

Prof. H. S. Hele-Shaw, F.R.S., and Mr. A. Hay showed lines of induction in a magnetic field, represented by stream-line flow.

Prof. E. Ray Lankester, F.R.S., exhibited enlarged models of gnats (mosquitoes) and of human blood-corpuscles infected by the malaria-parasite; modelled by Miss Delta Emett. (1) Female *Culex pipiens*, Linn., the common brown gnat or mosquito; enlarged twenty-eight times linear. The insect is shown in the act of alighting. This gnat does not harbour the malaria-parasite. (2) Female *Anopheles maculipennis*, Hoffmansegg, the common spot-winged gnat or mosquito; enlarged twenty-eight times linear. (3) Models of human blood-corpuscles infested with the malaria-parasite (æstivo-autumnal or remittent fever) known as *Haemomenas praecox;* magnified seven thousand five hundred times linear. The blood-corpuscles are transparent, and show the parasites within. The upper row shows the multiplication of the parasite within the corpuscles by fission giving rise to "sporocytes," which creep into other non-infected blood-corpuscles and repeat the process, thus increasing the infection. The lower row shows the formation of a crescent-shaped "gametocyte" within the blood-corpuscle. Instead of breaking up, the parasite enlarges and becomes sausage-shaped. The "gametocytes" thus formed are destined to be swallowed by the gnat Anopheles, when they develop in the gnat's stomach—some into eggs and some into spermatozoa.

The Zoological Society of London showed two living female crowned lemurs (*Lemur coronatus*), each with a young one.

Prof. G. B. Howes, F.R.S., and Mr. H. H. Swinnerton exhibited reconstructional models, built up from microscopic sections, of the developing head skeleton of the New Zealand reptile, *Sphenodon punctatus*.

Sir John Evans, K.C.B., F.R.S., exhibited ancient cameos and gems, and palæolithic implements from Africa.

Prof. Wyndham Dunstan, F.R.S., exhibited the poisonous lotus of Egypt (*Lotus Arabicus*). (*a*) Living plant grown at Kew. (*b*) Dried plants from Nubia. (*c*) Specimens of the new glucoside, *Lotusine*, and its decomposition products.

Mr. Fred Enock exhibited an aquatic walking-stick insect, with eggs (*Ranatra linearis*).

The following demonstrations, with experiments and lantern illustrations, took place:—

Mr. Fred Enock, life-history of the *Cicindela campestris*—the common tiger beetle. This common Coleopteron goes through its metamorphoses in deep vertical burrows made in the sand by the curious larva, which "sits" at the top of the hole, patiently waiting for its prey to come to it, as it does not go in search of it. Three years are passed in its subterranean den, at the lower end of which it remains during the winter months in a semi-torpid state; activity is resumed at the approach of warm weather.

Prof. J. A. Fleming, D.Sc., F.R.S., demonstrations with an apparatus for the production of short electric waves, and the study of electro-optic phenomena. The apparatus exhibited consists of a radiator for the production of a beam of electric radiation, the wave-length being about eight inches. The radiator is contained in a zinc box, which prevents the diffusion of the radiation in all directions. The receiver consists of a metallic filings tube of the Branly type, associated with a relay and electric bell. The receiver is also contained in a zinc

shielding box. The impact of electric waves upon the receiver is indicated by the ringing of the bell. The radiator can be placed at different angular positions. With this apparatus are shown experiments illustrating the opacity of metallic screens, continuous or perforated to electric radiation; the transparency of insulating screens, and the transparency or opacity of various liquids. Water is found to be particularly opaque even in very thin layers. All damp objects are very impervious to this radiation, such as a wet duster, a moist brick, tobacco having more than the legal amount of water added to it, and the human body or hand. The refraction of electric waves is shown by the use of a paraffin wax prism, the concentration by paraffin lenses, and the polarised quality of the rays by their reflection or stoppage by parallel wire gratings. Also the production of secondary oscillations in linear conductors by holding rods of metal or tubes of liquid in the radiation. The wave-length of the radiation is measured by producing interference as a result of splitting the beam into two portions and transmitting the two portions down two zinc tubes, the relative lengths of which can be adjusted.

Prof. A. C. Haddon, F.R.S., cinematograph photographs of native dances in Torres Straits.

THE RE-ORGANISATION OF THE EDUCATION DEPARTMENT.

IN introducing the Secondary Education Bill to the House of Lords on Tuesday last, the Duke of Devonshire made the following remarks on the re-organisation of the Education Department:—

"Your lordships may remember that on the Bill of last year some discussion took place upon the future organisation of the Education Department. I thought at the time, and I am still more strongly of opinion now, that that discussion was somewhat premature. It proceeded on the assumption that the organisation of the new office would continue on the same lines as those which had existed when the educational departments were separate and distinct, and that there would be in the new office two divisions, one of which would carry on the work of the old Education Office in connection with elementary education, and the other of which would carry on the work of the Science and Art Department. . . . We now propose to revert to a dual organisation of the office, but not entirely upon the lines of the late Education and Science and Art Departments. The principal officers of the department which we propose will be a principal permanent secretary, who will supervise generally the whole work of the department. It must be remembered, when special importance is attached to this or that minor subordinate appointment, that it will be the permanent secretary who will be responsible to the President of the Board in the administration of the whole department, and that it is impossible, and would be undesirable if it were possible, that the office should be divided into what I may call water-tight compartments, the head of each of which would be charged with special duties and no other, and that the idea should be entertained that the work of the office should be carried on in several departments, which should have no connection or relation with each other. We propose that under the principal permanent secretary there shall be two principal assistant secretaries, one mainly charged with duties in connection with elementary and the other with secondary education. We propose to abolish the name 'Science and Art Department.' The Science and Art Department will be merged in the secondary education branch of the office. As soon as it may be possible, we propose to transfer the greater part of the staff of the late Science and Art Department from South Kensington to Whitehall, except such part of it as may be necessary to leave at South Kensington for the administration of the museum and the colleges of science and art. In place of the third division that was contemplated, we now propose to give the principal assistant secretary of secondary education two additional assistant secretaries, one of whom will be chiefly charged with the supervision and control of literary instruction, and the other of technological study. This is not the organisation, I admit, to which I partly committed myself last year; but I trust that it may, in substance, meet the views, especially the later views, which have been expressed to me by high educational authorities. With the name we hope to get rid of many of the traditions which were supposed to attach to the old Science and Art Department—traditions which have, I believe, been regarded as opposed to the true interests of education by many of those who have been responsible for the management of the older endowed schools. The original idea of the Science and Art Department was, or at all events was supposed to be, that by means of lectures, classes, and examinations a knowledge of the principles of science and art, which would be valuable to the students themselves and to the nation at large, could be engrafted upon almost any kind of previous elementary or secondary training. It is quite true that this idea has been in recent years very largely modified, but I do not think that it is yet generally known how far the original traditions of the Science and Art Department have been already departed from. We hope and intend that the idea of the future education branch of the office will be to make science and art instruction a part of general education in addition to those classical and literary studies which have hitherto formed its main portion. In the schools and institutions directly assisted by the Board of Education the teaching of science and of art, with the addition, perhaps, of some commercial subjects, will probably remain the principal object. But, on the other hand, in those secondary schools, whether of older or more modern type, which desire to enter into connection with the board, there ought not to be, and there need not be, any interference with the older classical and literary studies so long as there continues to be a demand for them. At the same time, we hope that the scientific resources of the Board will be placed at their disposal if they desire, as many of them do desire, to develop the more modern sides of instruction and education. . . . It may be of interest to the House to know what are the principal appointments which have been made or are proposed to be made in the principal office of the new secondary education branch of the department. Sir George Kekewich, the late secretary of the Board of Education, has become the permanent principal secretary of the new Board, and it is he who will be responsible to the President of the Board and to the Government for the administration of the department as a whole. The principal assistant secretary for secondary education will be Sir William Abney, who has done more than any other man in extending the studies of the schools of science under the Science and Art Department. Under him the assistant secretary to deal with the literary side of instruction will be Mr. Bruce, an assistant commissioner to the Charity Commission under the Endowed Schools Act, who has been chiefly engaged and has obtained much experience in the administration of the Welsh Act. The assistant secretary for technological study has not yet been appointed."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. Sir Michael Foster has been nominated by the Council of the Senate as the representative of the University of Cambridge on the Council of the Jenner Institute of Preventive Medicine.

Mr. A. W. Hill, of King's College, and Mr. L. Lewton-Brain, of St. John's College, have been appointed University Demonstrators in Botany.

Mr. E. E. Walker, Trinity College, has been elected to the Harkness Scholarship in Geology and Palæontology.

Prof. Woodhead announces ten courses of lectures and demonstrations in Pathology and Bacteriology to be held during the ensuing Long Vacation.

Mr. Shelford Bidwell, F.R.S., was on June 19 admitted to the degree of Doctor of Science.

Mr. W. N. Shaw, F.R.S., has been elected a Senior Fellow of Emmanuel College. It is a condition attaching to his tenure that he shall give annually in the University not less than three lectures on the Physics of the Atmosphere or some kindred subject. Mr. C. T. R. Wilson, F.R.S., formerly Clerk Maxwell Student in experimental physics, has been elected to a fellowship at Sidney Sussex College.

The following have been awarded scholarships or exhibitions in Natural Science at the several colleges at the end of the academical year:—

Clare College: Bailey, Cartwright, Cassidy, Hughes.

Pembroke College: Lang, Anderson, Hall.

King's College: Kewley, French, Wilde, Mollison, McIntyre.

Christ's College: Fox, Moore, Wilson, Macnab, Muff, Cumberlidge, Sewell.

Emmanuel College: Nixon, Austin, Sutton, Rothera, Banham.

Sidney Sussex College: Bullough, Colt, Drapes, Fearnsides, Harrison, Humphrey, Robinson, Gough.

THE *Appointments Gazette*, which is the journal of the Cambridge Appointments Association, gives in its last issue (June 1900) much valuable information regarding scientific and other posts open to university graduates. It also contains articles on post graduate work in medicine, by Prof. Allbutt; on training for business, by Mr. G. E. Foster; and on Long Vacation courses in French, by Mr. H. J. Millar. A list of some two hundred graduates seeking appointments in various departments of industry, with their university qualifications, ages, &c., completes the journal. This list might be consulted with advantage by heads of departments and others in search of suitable candidates for vacant appointments. The Association is doing a useful work in bringing together employers and employed in the various walks of life where university training is of importance, and it already possesses a large and influential membership. The Master of Trinity is chairman, Mr. W. N. Shaw, F.R.S., vice-chairman, and Mr. W. A. J. Archbold, secretary.

PROF. OLIVER J. LODGE, F.R.S., has been appointed Principal of the University of Birmingham.

THE following appointments at the University College of North Wales, Bangor, are announced:—Mr. W. W. Firth to be assistant lecturer in Electrical Engineering, and Mr. Alexander Darroch to be assistant lecturer in the Day Training Department. Mr. W. Cadwaladr Davies was appointed the representative of the Council upon the Central Welsh Board, and Mr. H. Bulkeley Price the representative on the Carnarvonshire County Governing Body.

DR. JOHN WILLIAM WHITE, of Philadelphia, has been elected to the John Rhea Barton Chair of Surgery in the University of Pennsylvania; Dr. Frank Morley, of Haverford College, has been appointed professor of mathematics in Johns Hopkins University, vice Prof. Thomas Craig, resigned; Prof. Charles J. Bartlett takes the place of Prof. M. C. White, who for thirty-three years has filled the chair of pathology in the Medical School of Yale University.

THE Report of the Council to the Governors of the City and Guilds of London Institute, dated March 1900, has just been issued, and gives a full account of the work accomplished in connection with the year 1899, and contains verbatim reports of the addresses delivered respectively by Sir Andrew Noble and Sir Douglas Fox at the opening of the session, and at the distribution of certificates and prizes. We notice from the report that during the past twenty years the work of the Examinations Department has developed to an enormous extent: thus in 1888 the number of subjects of examination was 24, the number of centres of examination 89, and the number of candidates 816. In 1899 the number of subjects had increased to 63, the number of centres to 397, and the number of candidates to 14,004; the number of registered classes being 1764, and of students in attendance 34,176. These numbers are exclusive of those who receive instruction in manual training. The total number of students last year in the classes registered by the Institute was 36,155, as compared with 34,990 in the previous year.

THE following gifts and bequests for scientific and educational purposes are noticed in *Science*:—By the will of the late Jonas G. Clark, of Worcester, Mass., who founded Clark University in 1889, the entire estate is left to the University, providing the people of Worcester raise a fund of 500,000 dollars. If the sum of 250,000 dollars is raised, he bequeaths 500,000 dollars. If 500,000 dollars is raised, he bequeaths 1,000,000 dollars and makes the University his residuary legatee. He also leaves 100,000 dollars for the University library and a similar sum for a department of art. Messrs. Samuel Cupples and Robert S. Brookings have each given to Washington University one-half of the total capital stock of the St. Louis Terminal Cupples Station and Property Company, which company owns the so-called "Cupples Station." The annual income from this gift to the University will be from 120,000 to 130,000 dollars per year. The gift is to form a permanent endowment fund, the interest of which is to be expended by the Board of Directors in any way which it sees fit. Dr. D. K. Pearsons has offered 50,000 dollars to Carleton College, Northfield, Minn., on condition that the college authorities raise 100,000 dollars before January 1, 1901. By the will of Henry M. Curry the Western University of Pennsylvania receives 10,000 dollars for scholarships; and the University of Pennsylvania has received 20,000 dollars from Mr. J. D. Lippencott and Mr. J. G. Carruth respectively.

THE second general meeting of the Agricultural Education Committee was held on Friday last at the rooms of the Society of Arts. The report of the executive to the general committee gave a brief account of the constitution and proceedings of the committee from its commencement, and explained that its objects were: (1) to secure systematic and efficient instruction, both theoretical and practical, in agricultural subjects suitable to every class engaged in agriculture; and (2) to diffuse among the agricultural classes a more thorough appreciation of the advantages of instruction bearing directly or indirectly on their industry. The policy of the committee, the report stated, was largely recognised in the new Day School Code; and the block grant, the continuous course of rural instruction, lessons in "common things" given through the standards, and the new subject of household management for girls, were all on the lines of the committee's resolutions. Moreover, the executive believed that it was largely due to the representations of the committee that the new Board of Education, shortly after its formation, issued a circular to managers and teachers of rural elementary schools impressing on them the importance of making education in the village school more consonant with the environment of the scholars than was now usually the case, and especially encouraging the children to gain an intelligent knowledge of the common things which surround them in the country. Other provisions of the new Code were referred to with satisfaction, and the report stated that the committee had not failed to co-operate with the Board of Education in bringing them into effect. With regard to the work which remained to be done, attention should be given to organisation. It would seem that the precedent successfully set some years ago in Scotland of handing over the educational work of the Board of Agriculture to an educational authority, while leaving to the Board the inspection of experimental and research work, might well be followed. If that was not done, and the present division of functions continued, the cause of rural education, especially in its higher branches, would undoubtedly suffer. It was also to be hoped that attention would be given to the training of teachers, and that the new Board would introduce some modifications into the curricula of the training colleges to ensure the qualification of a certain number of trained teachers to give instruction on elementary science and common things required by the Code. A good deal also remained to be done in placing evening continuation work on a satisfactory footing.

SCIENTIFIC SERIALS.

American Journal of Science, June.—A method of studying the diffusion (transpiration) of air through water, and a method of barometry, by C. Barus. The diffusion of air through water is studied by observing the gradual loss of the air contained in a Cartesian diver, and this loss is determined from the change in the temperature coefficient contained in the equation of flotation. The same equation also involves in a simple manner the height of the barometer; and a Cartesian diver apparatus is, therefore, virtually a water barometer which need only be one foot high instead of thirty feet.—Separation and determination of mercury as mercurous oxalate, by C. A. Peters. The author estimates mercurous salts volumetrically by precipitating with ammonium oxalate, and determining the oxalic acid by potassium permanganate, and gravimetrically by direct weighing of the precipitate.—Electrical resistance of thin films deposited by kathode discharge, by A. C. Longden. The thinnest films have a resistance which is very much higher than is warranted by their thinness. The sign of the temperature coefficient of resistance varies with the thickness, and it is therefore possible to obtain resistances by kathode-ray deposition which do not vary with the temperature. Such resistances form valuable high-resistance standards.—New meteorite from Oakley, Logan county, Kansas, by H. L. Preston. This is a siderite of 61 lbs. found in 1895.—Some observations on certain well-marked stages in the evolution of the Testudinate humerus, by G. R. Wieland. The development of the humerus of the turtle presents a special interest on account of its graduated change of habitat from dry deserts to the ocean.—Geothermal gradient in Michigan, by A. C. Lane. The geothermal gradient at Bay City is 1·5 degrees F. per 100

feet. The Upper Peninsula is a region notorious for its much lower gradient. The author discusses the various hypothesis framed to account for the differences in the gradient. Among these are the cooling action of Lake Superior, a survival of the Ice Age coldness, and differences in the conductivity of rocks. The author favours the last hypothesis.—Production of X rays by a battery current, by J. Trowbridge. The installation of a plant of 20,000 storage cells at the Jefferson Physical Laboratory has enabled the author to obtain X-rays of exceptional brilliancy, yielding negatives of great contrast. When the X-ray tube is first connected with the battery terminals no current flows. It is necessary to heat the tube, when it suddenly lights up. A distilled-water resistance of about 4,000,000 ohms is inserted in the circuit.

Annalen der Physik, No. 5.—Change of conductivity of gases by a continuous electric current, by J. Stark. The resistance of a gas conveying an electric current is highest near the electrodes, owing to the accumulation of ions of the same sign in this neighbourhood. It has another maximum near the middle, but rather more towards the side of the anode. The resistance is influenced by the heat developed at the electrodes, by the kathode rays, and by the unequal speed at which the two kinds of ions travel through the gas.—Objective presentation of the properties of polarised light, by N. Umow. A beam of parallel plane-polarised light is allowed to fall on various geometrical bodies whose surfaces have peculiar optical properties, such as a cone covered with fuchsine, a quartz plate, or a Babinet compensator. The reflection or transmission of the light gives rise to striking colour phenomena. Peculiar spiral effects are obtained by sending the beam through an opalescent colophonium emulsion.—Magnetic screening, by H. du Bois and A. P. Wills. In this portion of their work, the authors calculate and verify the effect of a triple screen of iron for galvanometers. The external diameters of the three screens are 2·5, 4·3 and 8·0 cm. respectively, and their thicknesses are 0·27, 0·18 and 0·18 cm. The total theoretical "screening ratio," *i.e.* the ratio by which the disturbing magnetic field is reduced, is 60·2, and the observed ratio is 64·6.—Armoured galvanometers, by H. du Bois and H. Rubens. Describes some galvanometers screened in accordance with the results of the previous paper.—Rotating magnetic flag, by G. Jaumann. A small magnet mounted like a flag on a glass rod as an axis may be given a continuous rotation by immersing it in mercury contained in a glass vessel surrounded by a tight-fitting copper vessel, with a current traversing the body of the mercury and returning through the copper vessel. The work spent in overcoming the resistance of the mercury is derived from the current itself. It appears as a counter E.M.F. until the mercury rotates with the magnet.—Thermal deformation of balances, by T. Middel. Delicate balances show a considerable change of sensitiveness with the temperature. The author shows that this is due to the bending of the beam of the balance, owing to the unequal expansion of the upper and the lower portion, and that is due to the unequal working of the metal, the coefficient of expansion for cast brass being less than that of rolled brass.—The additive character of atomic heats, by S. Meyer. The author shows that in the case of twenty-six oxides an excess of the sum of atomic volumes over the molecular volume is accompanied by an excess of the aggregate atomic heats over the molecular heat, and that a defect of atomic volumes is accompanied by a defect of atomic heats in the same manner. Boron and bismuth sesquioxides are the only exceptions.

Bulletin de l'Académie des Sciences de St. Pétersbourg, vol. viii. No. 1.—Yearly report of the Academy.—A newly-discovered Old Turkish inscription, by Dr. W. Radloff, preliminary report. The inscription was discovered by Madame Elizabeth Clements near Urga, and excellent reproductions of it were made. Dr. Radloff found that it was made in honour of the wise Toyukuk, father-in-law of Bilga-khagan, who was born in 646 of our era.—On the elements of earth-magnetism at Kamenets, Khotin and Odessa, by W. Dubinsky.

Vol. viii. No. 2.—On the rapid motion of the line of the absides in the system of α' Gimini, by A. Byelopolsky.—On the spectroscopic determination of the movements of γ Virginis, by the same.—Aurora borealis observed at Pavlovsk on December 20, 1897, by V. Kuznetsoff, with two photographs.—Hydrobiological researches at the Sebastopol Biological Station, by A. Ostroumoff.

Vol. viii. No. 3.—On the attempts at reproducing cometary phenomena by means of experiments, by Th. Bredikhin (in Russian). The recent results obtained by photography permitted us to obtain most exact reproductions of cometary forms. They stimulated the desire of producing theories of comets, and, as far as the author knows, five different theories were proposed lately; they differ essentially in their fundamental principles. No great comets having appeared lately, the earlier drawings, made by previous astronomers, necessarily must be taken into account. Bredikhin found it necessary, therefore, to systematically discuss the facts which relate to the variety of forms of comets, and the passages from the one form to another. These facts can be ignored by no theory, and the author consequently analyses those criteria which must be applied to each theory of the comets.—On the way of building magnetic observatories, by H. Wild.—Description of a very rare case of *Craniopagus parietalis*, by J. Ziematzky (plate).—On the influence of the terms of third order in the perturbations function of the movement of the earth round its centre of gravity on the formulæ of nutation, by A. Ivanof (in French). The author gives a new formula for reducing the length of the second pendulum for any geocentric latitude.

Vol. viii. No. 4.—Ephemerid of the comet of Encke from June 1 to July 31, 1898, by A. Ivanoff.—On the differences of the horizontal intensities of earth magnetism obtained from observations of the unifilar and the bifilar theodolite, by H. Wild.—Positions of 1041 stars of the star-cluster 5 Messier, deduced from photographs, by Madame Shilow. Full list, compiled from careful measurements made on photographic plates.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—"The Crystalline Structure of Metals." Second Paper. By Prof. J. A. Ewing, F.R.S., and Walter Rosenhain, B.A.

The investigations described in this paper deal principally with the phenomena of annealing. The first section of the paper describes experiments made in the hope of observing under the microscope the process of recrystallisation in strained iron. This attempt to watch the process of recrystallisation failed, although the experimental difficulties of keeping a specimen under microscopic observation while it was being heated were successfully overcome. The specimen was electrically heated in a vessel with a thin glass or mica window, and the microscope-objective was kept cool by directing a strong blast of cold air on it and on the surface of the window.

The next section of the paper deals with the changes of crystalline structure which go on in lead and other metals at comparatively low temperatures. The authors' attention was directed to this by noticing that a piece of plumber's sheet lead, when etched with dilute nitric acid, exhibits a strikingly crystalline structure, with large crystals. The character of this appearance led the authors to the view that a slow process of annealing or recrystallisation was at work in such lead at ordinary atmospheric temperatures, and the authors have satisfied themselves that this is the case. The method of investigation consisted in taking a series of micro-photographs, at low magnifications, of certain marked areas in the surface of a specimen, in order to watch the change which went on through lapse of time, or after application of some thermal treatment.

When a piece of cast lead is severely strained by compression, the originally large crystals, after being considerably flattened, are driven into and through one another, so that the etched surface of a strained specimen presents a fine grain, whose crystalline nature only becomes apparent under considerable magnification (80 to 100 diameters). A piece of lead severely strained in this way, and kept for nearly six months in an ordinary room without any special thermal treatment, was found to be undergoing continuous change during that time. A series of photographs of this specimen, taken at intervals during the six months, show that a great number of the small crystals have grown larger at the expense of their neighbours. In similar specimens which have been kept at 200° C., the growth has been much more rapid and more pronounced. The rate of growth is a function of time and temperature, but some specimens show much more rapid changes than others under similar conditions of temperature; in some cases five minutes' exposure to a temperature of 200° C. is sufficient to alter the

crystalline pattern completely. Experiments have also been made at 100° C. and 150° C., leading to the general result that crystalline growth will occur at any temperature from that of an ordinary room, *i.e.* 15° C. or 20° C., up to the melting point of lead, and that in general the higher the temperature the more rapid is the initial rate of change. No numerical data can be given, as the crystals are quite irregular, both in size and shape.

A comparison of micro-photographs of the same specimen at various stages reveals the fact that the growth of an individual crystal occurs, not in uniform layers all round it, but by the formation of arms and branches that invade the neighbouring crystals, the intervening portions sometimes changing at a later stage. This action is analogous to the formation of skeleton crystals in a metal during solidification from the liquid state, the space between the branches filling in as solidification proceeds.

A marked feature observed in several specimens was the large and rapid growth of one or two individual crystals; in several instances such individuals grew until they were some hundreds of times larger than their neighbours. Generally the most aggressive crystals were found near the edges of the specimen. It is noticeable that at times a crystal which has already grown considerably is swallowed up by a more powerful neighbour.

Some light is thrown on the nature of these actions by the fact that this growth only occurs in crystals that have been subjected to severe plastic strain. By casting the metal in a chill mould, specimens of lead can be obtained having a crystalline structure quite as minute as that found in a severely strained specimen, but this structure remains unchanged at temperatures which produce rapid change in a strained specimen.

The investigation of the effects of such comparatively moderate temperatures was extended to other metals, viz. tin, zinc and cadmium. In tin, the various phenomena of crystallisation from the fluid state are strikingly illustrated on a large scale by the thin layer of that metal which constitutes the surface of commercial tin-plate. The effects of rapid and slow solidification in producing small or large crystals respectively are well marked, and an examination of the etched surface of tin-plate under the microscope reveals beautiful geometrical markings or pits, whose oriented facets produce the well-known selective effect of oblique illumination. The study of the crystalline structure affords an explanation of the nature and method of production of patterns in "moirée métallique," a process which has long been in use for the decoration of articles manufactured of tin-plate.

The final section of the paper deals with an hypothesis, which is advanced as an attempt to explain the mechanism of the growth of crystals in apparently solid metal.[1] According to this hypothesis, the metallic impurities which are present in a metal play an important part in the action. When a metal solidifies from the fluid state, the metallic impurities ultimately crystallise as a film of eutectic alloy in the inter-crystalline junctions; when fairly large quantities of such eutectics are present, the microscope reveals their presence as an inter-crystalline cement, such as that formed by "pearlite" in slowly cooled mild steel; very minute quantities of eutectic, however, will be invisible and yet capable of forming a thin film of fusible cement. The authors conceive that the changes of crystalline structure which go on while the piece is in the solid state are accomplished by the agency of eutectic films between the crystals, in dissolving metal from the surfaces of some crystals and depositing it on others. When a metal is severely strained, these films of eutectic will be also strained and in many places broken, thus allowing the actual crystals to come into contact with one another. The difference in the rate of etching of adjacent crystals and the phenomena of the electrolytic transfer, in an acid solution, of lead from one crystal to another in the same mass of metal, support the supposition that there is a difference of electric potential between the crystal faces which are brought into contact by severe strain. If it be assumed that a film of eutectic alloy when fluid, or even when in the pasty condition that precedes fusion, can act as an electrolyte, we may regard any two crystals thus in contact, with a film of eutectic interposed in places, as a very low resistance circuit, and the growth of the positive crystal at the expense of the negative would result. Moreover, such growth would be more rapid at higher temperatures, and its rate at a given temperature would vary in different specimens according to the nature and quantity of the impurities present. That an alloy can act as an electrolyte has not been established experimentally, but the assumption is supported by the close general analogy between alloys and salt solutions. This analogy extends to the very question of the growth of crystals, as Joly has shown that when crystals of a salt are immersed in their mother-liquor, growth of one at the expense of others will take place.

It should be added that solution of one crystal into the intervening film of eutectic, along with deposit on the neighbouring crystal from the eutectic, may occur as a consequence of differences of orientation, producing differences of "solution pressure" apart from actual electrolysis, but the fact that growth has not been observed to occur except in strained crystals favours the view that the action is electrolytic.

Some further results which have been deduced from the above hypothesis have been verified by experiment. It follows from the hypothesis that an inter-crystalline boundary containing no eutectic would be an impassible barrier to crystalline growth, but if the eutectic could in any way be supplied, growth across the boundary might take place. In an absolutely pure specimen of lead, there would be no eutectic at the inter-crystalline junctions, but as extremely minute traces of impurity would suffice to set up the action, it is almost hopeless to verify the hypothesis in this way. Some experiments on the cold welding of lead have, however, borne out these conclusions. Two clean, freshly-scraped lead surfaces will unite under great pressure in the cold state, and if a piece so welded be annealed, the crystalline growth due to the annealing, with very rare exceptions, never crosses the inter-crystalline boundary formed by the welding surface. To test whether the presence of some eutectic would allow growth to take place, small quantities of a more fusible metal were scattered over the freshly-scraped surfaces of lead before squeezing them together. Then, after a cold weld had been made by pressure, on annealing by exposure to 200° C. it was found that crystal growths frequently crossed the line of the weld, as the above theory led one to expect. This experiment has been repeated many times with the uniform result that whenever a small quantity of eutectic, or of an impurity capable of forming a eutectic with the lead, was scattered over the clean surfaces before welding, a distinct growth of crystals across the boundary took place as a result of annealing. On the other hand, a large number of welds were made without introducing any impurity, and with very rare exceptions they showed no growth across the boundary, even after the annealing process was continued for some weeks. In rare exceptions a minute amount of growth across the boundary was observed, but these may fairly be accounted for by the almost unavoidable presence of traces of impurity. The result as a whole goes far to confirm this solution theory of crystalline growth in annealing.

June 14.—"Static Diffusion of Gases and Liquids in Relation to the Assimilation of Carbon, and Translocation in Plants." By Horace T. Brown, F.R.S., LL.D., and F. Escombe, B.Sc., F.L.S.

This paper is intended to be the first of a series descriptive of the work carried out by the authors in the Jodrell laboratory on the fixation of carbon by green plants, and deals mainly with the purely physical processes by which atmospheric carbon dioxide gains access to the active centres of assimilation.

The new evidence which F. F. Blackman brought forward in 1895 in favour of the gaseous exchanges of leaves taking place exclusively through the stomatic openings, presents at first sight certain difficulties of a physical nature, which have led to an examination of the whole question of the free diffusion of carbon dioxide at very low tension, and under a set of conditions very different from those under which the previous determinations of the coefficient of diffusion of carbon dioxide and air have been made by Loschmidt and others, where the gases were initially of equal tension, and the ratios of mixture departed widely from those of ordinary atmospheric air. The inquiry has led to the discovery of some new facts connected with the static diffusion of gases and liquids, which are of considerable interest, not only from the physical point of view, but from the explanations they suggest of certain natural processes which are primarily dependent on diffusivity.

The method employed in the first instance for the determination of the diffusivity of atmospheric carbon dioxide was one of *static diffusion* down a column of air of a definite length towards an absorptive surface at the bottom of the column When a static condition has been established, there is a steady flux of the carbon dioxide down the air column

[1] It is proper to say that this hypothesis is due to Mr. Rosenhain.—J. A. E.

which may be quantitatively investigated by the same simple mathematical treatment as the "flow" of heat in a bar when the permanent state has been reached, or the "flow" of electricity between any two regions of a conductor maintained at a constant difference of potential.

By a long series of experiments of this nature it was found that the diffusivity constant, k, for very dilute CO_2 does not materially depart from the value assigned to it by Loschmidt and others, when experimenting with much higher ratios of mixture, and that the difference is certainly not of sufficient magnitude to be taken into serious account in the study of the natural processes of gaseous exchange in the assimilating organs of plants.

In the static diffusion of a gas, vapour, or solute, as the case may be, the amount of substance diffusing in a given time, all other conditions being the same, is directly proportional to the sectional area of the column. It is found, however, that if the flow is partially obstructed by interposing at any point in the line of flow a thin septum pierced with a circular aperture, the rate of flow across unit area of the aperture is greater than it would be across an equal area of the unobstructed cross-section of the column at this point. If the margin around the aperture has a width of at least three or four times its diameter, the rate of flow is now found to be directly proportional to the *linear dimensions* of the aperture and not to its area, so that the velocity of flow through unit area varies inversely as the diameter.

A large number of experiments on the diffusion of carbon dioxide, water-vapour and sodium chloride in solution are given in support of this proposition. All these show that the rate of diffusion across such a septum, all other conditions being the same, is directly proportional to the diameter of the aperture, and not, as might have been expected, to its area.

Exactly the same result is obtained when small circular discs of an absorbent, such as a solution of caustic alkali, are surrounded by a wide rim and exposed to *perfectly still* air, the amount of carbon dioxide absorbed under these conditions being proportional to the *diameters* of the discs.

If, however, there are any sensible air currents the absorption becomes proportional to the areas.

These two sets of phenomena may be explained as follows:—

In the case of the absorbing disc in perfectly still air, the convergent streams of carbon dioxide creep through the air towards the absorbing disc, establishing a steady gradient af density, and this creep will be a flux perpendicular to the lines of equal density, which form curved surfaces or "shells" surrounding the disc and terminating in the rim. The state of things is exactly analogous to the electric field in the neighbourhood of a conductor of the same shape and dimensions as the absorbent disc.[1] In the case of the gas, the curves or "shells" of equal density are the analogues of the similarly curved surfaces of equipotential above the electrified disc, whilst the converging lines of creep or flux of the gas are the analogues of the lines or tubes of force which bend round into the disc as they approach it.

If we consider two such absorbent discs of different diameters, the curved surfaces in each system corresponding to a given density will be found at actual distances from the discs which are in the same proportion to each other as are the diameters of the discs. In other words, the gradient of density on which the rate of flow depends will be proportional to the diameters of the discs, which is exactly what is found experimentally.

This case of an absorbent disc is the exact converse of one which has been theoretically investigated by Stefan, viz. the conditions of evaporation of a liquid from a circular surface. He found that the lines of flux of the vapour proceeding from the surface of the liquid must be hyperbolas, whilst the curved surfaces of equal pressure of the vapour must form an orthogonal system of ellipsoids, having their foci, like the hyperbolas, in the bounding edges of the disc. This was a purely mathematical deduction which has never been verified experimentally, but it will be seen that the exactly converse phenomena of diffusion are in complete agreement with it.

In the other case of a diffusive flow through a circular aperture in a diaphragm, the lines of flow, which are *convergent* as they approach the aperture, bend round their foci situated in the edges of the disc and form a *divergent* system on the other side. If the chamber into which they pass is a perfectly absorbent one, and is sufficiently large, there will be formed on the inner side of the diaphragm a system of density shells similar to those outside, but with the gradient of density centrifugally instead of centripetally arranged. This system of shells is termed negative, and is as effective as the outer positive system in regulating the flow according to the "diameter law," so that this law will still hold good even if the outer air currents are sufficient to sweep away the external positive shells altogether.

All the known facts of diffusion through circular apertures in a diaphragm are in complete accord with the above explanation, which is fully elaborated in the original paper.

By diffusing colouring matter through apertures in a septum, under such conditions as to prevent convection currents, the "density shells" have been rendered visible, and it has been shown that their ellipsoidal form is exactly that which is demanded by the above hypothesis. Moreover, this method gives an experimental demonstration of the more rapid projection of the diffusing particles from the edges of the aperture than from a point nearer its centre, a fact completely in harmony with the deduction of Stefan regarding the evaporation of liquids under analogous conditions.

The various cases which present themselves in practice with regard to the rate of diffusion through single apertures in a diaphragm are then discussed from the above point of view, and simple formulæ for the determination of this rate for single and double systems of density shells are established: (1) for cases where the thickness of the diaphragm is negligible, and (2) for other cases where the apertures become more or less tubular. In a subsequent section of the paper it is shown how closely the observed facts conform to these deductions, and that in static diffusion through apertures in a septum we have a new and accurate method for the determination of the diffusivity constants of atmospheric CO_2, of the vapours of liquids, and of substances in a state of solution.

Since the velocity of the diffusive flow through unit area of an aperture in a diaphragm varies inversely with the diameter, it might reasonably be expected that a diaphragm could be so perforated with a series of very small holes arranged at suitable distances from each other, as to exercise little or no sensible obstruction when it was interposed in a line of diffusive flow, although the aggregate area of the small holes might represent only a small fraction of the total area of the septum. Multiperforate diaphragms of this kind were found to possess all the remarkable properties which had been anticipated.

The material used for the septa was very thin celluloid, which was perforated at regular intervals with holes of about 0·38 mm. in diameter. Details of a number of experiments with such diaphragms are given, in which it is shown that they may be so arranged as to produce but little obstructive influence on the diffusive flow of a gas when the total area of the apertures amounts only to about 10 per cent. of the area of the septum, and that nearly 40 per cent. of the full diffusive flow may be maintained when the number of the apertures is so far reduced as to represent an area of only 1·25 per cent. of the full area of the septum.

The explanation is to be found in the local intensification of the gradient of density in the immediate neighbourhood of the diaphragm, and which does not extend to the column away from the apertures. This disturbance of gradient is brought about by the rapid convergence of the lines of flux, and their divergence on the other side, with the consequent formation of a system of "density shells" over each aperture. A system of perforations of this kind may be compared with a system of conductors electrified to a common potential, the density of the diffusing substance above the apertures corresponding to electric potential, and the non-absorbing portions of the diaphragm to a surface formed by lines of electric force. Just as the electric capacity of a plate is not much reduced by cutting most of it away, so also is it possible to block out a large portion of the cross-section of the diffusing column without materially altering the general static conditions on which the flow depends.

The importance of these results in relation to diffusion through porous septa is next considered, diffusion through a thin porous septum being only an extreme case of free diffusion through a multiperforate diaphragm, whose apertures are so far reduced in size as to materially interfere with the mass movement of the diffusing substance.

A section of the paper is devoted to the application of these new observations to the processes of gaseous and liquid diffu-

[1] The authors are indebted to Dr. Larmor for this suggestion of the electrostatic analogy.

sion in living plants, and it is pointed out that the structure of a typical herbaceous leaf illustrates in a striking manner all the physical properties of a multiperforate septum. Regarded from this point of view it is shown that the stomatic openings and their adjuncts constitute even a more perfect piece of mechanism than is required for the supply of carbon dioxide for the physiological needs of the plant, and instead of expressing surprise at the comparatively large amount of the gas which an assimilating leaf can take in from the air, we must in future rather wonder that the intake is not greater than it actually is.

From data afforded by actual measurements of the various parts of the stomatal apparatus of the sunflower it is shown that an extremely small difference of tension of the carbon dioxide within the leaf, as compared with that in the outer air, will produce a gradient sufficient to account for the observed intake during the most active assimilation.

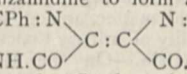
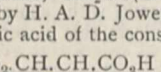
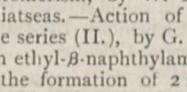
It is also shown that the large amounts of water-vapour which pass out of the leaf by transpiration are well within the limits of diffusion, and that it is unnecessary to assume anything like mass movement in the outcoming vapour.

The translocation of solid material from cell to cell in the living plant is next considered, especially with reference to this transference being, at any rate in part, brought about by means of the minute openings in the cell-walls through which the connecting threads of protoplasm pass. Notwithstanding the very small relative sectional area of these perforations they probably exercise an important function in cell-to-cell diffusion, in virtue of their properties as multiperforate septa.

There are two appendices to the paper, one in which a full description is given of a series of experiments on the absorption of carbon dioxide by solutions of caustic alkali from air in movement; the second being devoted to a detailed description of the methods used for accurately determining the carbon dioxide absorbed.

Physical Society, June 22.—Mr. T. H. Blakesley, Vice-President, in the chair.—A paper, entitled "Notes on Gas Thermometry," by Dr. P. Chappuis, was read by Dr. Harker. The author having been led to recognise that hydrogen could not be used as a thermometric substance at high temperatures, on account of its action on the walls of the glass reservoirs, has had recourse to a constant volume nitrogen thermometer with an initial pressure slightly under 800 mm. The value of the coefficient of expansion of nitrogen at constant volume is variable, diminishing up to 80° C. and then increasing slightly. In fact, nitrogen at 100° C. behaves like hydrogen at the ordinary temperatures, its compressibility being less than that required by Boyle's law. A table of corrections was therefore prepared. The readings of the constant volume nitrogen thermometer are too low, but the corrections are small, amounting to about 0·04° C. at the temperature of boiling sulphur. The mean result of the author's experiments for the boiling point of sulphur is 445°·2 under a pressure of 760 mm. Callendar and Griffiths' results obtained with a constant pressure air thermometer is 444°·53. The difference is attributed to the joint action of several causes:—(1) The corrections for a constant pressure thermometer are about double those of a constant volume instrument. This correction applied to Callendar and Griffiths' result would raise it about 0·1°. (2) Callendar and Griffiths have used a value for the gas constant which is larger than that obtained by more recent experiments. Adopting the latter value, the boiling point would be raised to 445°. (3) The divergence may be due to the expansion of the reservoir. The most accurate way of determining this is by the interference method of Fizeau. This method is used with small pieces of the material, and the author has employed it to determine the coefficient of expansion between 0° and 100°. Extrapolation to 450° might cause errors The linear expansion has recently been determined by Bedford between 0° and 840° by a comparator method. The homogeneity of porcelain is doubtful, especially when glazed, and the great differences occurring between the expansions obtained from the above methods is attributed to the change in form of the tube in Bedford's experiments, brought about by unequal thickness and want of homogeneity and consequent unequal expansion. The author therefore adheres to his value of the boiling point obtained from the expansion by the Fizeau method, whilst recognising the uncertainty attaching to the application of the coefficient of expansion of the reservoir over an interval four times as great as that over which it was determined.—A paper on a comparison of impure platinum thermometers, by Mr. H. M. Tory, was read by Prof. Callendar. The object of this paper is to investigate the probable order of accuracy attainable in the determination of high temperatures by the use of ordinary commercial specimens of platinum wire. Five wires were compared, from 400° to 1000° C. The fundamental coefficients of the wires varied within 40 per cent. of the maximum value, but the temperatures observed by them when calculated on the platinum scale by means of the ordinary simple formula, did not differ by more than 9° at 1000° C. Each wire was directly compared with a pure standard wire, the two being wound side by side in the same tube. Curves have been drawn with the platinum temperatures of the standard wire as abscissæ, and the differences between the temperatures indicated by the two wires compared as ordinates. These curves are all straight lines, within the limits of observation, and hence the determination of two constants is sufficient to enable us to compare an impure platinum thermometer with the standard, and therefore with the scale of the gas thermometer. The two constants can at once be obtained from observations at the boiling point of sulphur and the freezing point of silver, and thus a practical thermometric scale can be established, which between 0° and 1000° never differs by more than two or three degrees from the gas scale.—Prof. Callendar said he was unable to agree with the correction to his observations suggested by M. P. Chappuis. He considered that the uncertainty in the coefficient of expansion of the gas was due to uncertain changes in the volume of the bulb, and to uncertainty in the coefficient of expansion of mercury. The fundamental coefficient of mercury was ·00018153 according to Regnault, ·00018216 according to the later reduction of Broch, and ·00018256 according to experiments by Chappuis with a hard glass bulb. It made a difference of no less than 4 per cent. in the fundamental coefficient of expansion of the glass, according as the original results of Regnault, or the value found by Chappuis, assuming the linear expansion of the glass, were adopted. The importance of the changes in the volume of the bulb had been fully pointed out, and a method of taking approximate account of these changes had been explained in the paper on the boiling point of sulphur in 1890. Unfortunately the glass employed was rather soft, and the changes of volume which occurred were too great to permit of the most accurate determination of the coefficient. The boiling point, when corrected for the smaller expansion of the bulb, came out lower than 444·53°. With regard to porcelain, Prof. Callendar did not consider it a good material, on account of the glaze. He did not think that the average coefficient of a tube or bulb over a large range of temperature could be inferred from a small and possibly asymmetric specimen. The results might be less inconsistent in the case of homogeneous and well-annealed metallic bulbs. The correction for the expansion of the bulb was, he believed, given by the expression $dt = (C + b\theta)t(t - 100)$. He did not agree with M. P. Chappuis that the correction was independent of c, although the value of b was certainly most important at high temperatures. He also wished to take exception to the method adopted by Chappuis of calculating the correction of the nitrogen thermometer. According to Joule and Thomson, the correction should be greater; according to other authorities, it might be less. He hoped to discuss this in a further communication to the Society. Mr. Glazebrook said that, although he placed confidence in Chappuis' formula for a definite piece of porcelain between certain temperatures, he thought further and careful work was necessary before fixing on a formula for ordinary use. Prof. Carhart said he would like to see a comparison made between the results of experiments with gas thermometers and those with platinum and platinum-rhodium couples. Mr. Rose-Innes expressed his interest in the behaviour of nitrogen about 100° C., as mentioned in M. P. Chappuis' paper. Dr. Lehfeldt said the peculiarities of the nitrogen scale between 70° and 80° might be explained by the reversal of the properties of nitrogen between 0° and 100°.—A paper on the law of Cailletet and Mathias and the critical density was read by Prof. S. Young. The law of Cailletet and Mathias is very nearly, though in most cases not absolutely, true. It appears to be only strictly true when the ratio of the actual to the theoretical density at the critical point has the normal value 3·77. The curvature of the "diameter" is generally smaller the nearer this ratio approaches its normal value. The curvature is in nearly every case in opposite directions, according as this ratio is greater or less than 3·77. The curvature is generally so slight that the critical density may be calculated from the mean densities of liquid and saturated vapour at

temperatures from about the boiling point to within a few degrees of the critical point with an error generally not exceeding 1 per cent. If, however, the critical density is calculated from the mean densities at low temperatures, the error may be considerable; in the case of normal decane it is between 5 and 6 per cent. The law does not, as a rule, hold good at all for substances the molecules of which differ in complexity in the gaseous and liquid states. Mr. Rose-Innes said that in his paper the author had used the generalisations of Van der Waals, although the author himself had shown that they were not strictly true. Prof. Young said that the generalisations held in some cases, although they did not in others. In all cases they were approximately true, and it was therefore advisable to use them, and study the results as far as possible.—The Society then adjourned until next October.

Chemical Society, June 7.—Prof. Thorpe, President, in the chair.—The following papers were read.—Condensation of ethyl acetylenedicarboxylate with bases and β-ketonic esters, by S. Ruhemann and H. E. Stapleton. Ethyl acetylenedicarboxylate reacts with benzamidine to form a substance of the probable constitution,  , which the authors term glyoxaline red.—Condensation of phenols with ethyl phenylpropiolate, by S. Ruhemann and F. Beddow. Sodium phenoxide reacts with ethyl phenylpropiolate, yielding a substance of the constitution $C_6H_5.C(OC_6H_5):CH.CO_2Et$; this ester is easily hydrolysed, and the acid readily loses carbon dioxide, giving phenoxystyrene, $CH_2:C(OC_6H_5).C_6H_5$.—The constitution of pilocarpine, by H. A. D. Jowett. Isopilocarpine yields on oxidation a lactonic acid of the constitution  ; the alkaloid also contains the groups :NH and $:NCH_3$.—The nitrogen chlorides derivable from metachloroacetanilide and their transformations, by F. D. Chattaway, K. J. P. Orton and W. H. Hurtley.—The persulphuric acids, by T. M. Lowry and J. H. West. A quantitative study of the equilibrium established between sulphuric acid, hydrogen peroxide and "persulphuric acid" on mixing the former two substances, affords evidence indicating the existence of the acids $H_2O_2.4SO_3$ and $H_2O_2,2SO_3$ in a mixture of sulphuric acid and hydrogen peroxide.—On diphenyl- and dialphyl ethylenediamines, their nitro-derivates, nitrates and mercurichlorides, by W. S. Mills.—Derivatives of cyanocamphor and homocamphoric acid, by A. Lapworth. The halogen derivatives of cyanocamphor are reduced to cyanocamphor and homocamphoramic acid, $C_8H_{14}(CO_2H).CH_2.CONH_2$, by strong aqueous alkalis. α-Bromo-homocamphoric acid, $C_8H_{14}(CO_2H).CHBr.CO_2H$, made by heating homocamphoric dichloride with bromine, can be converted into homocamphoric acid, $C_8H_{14}<^{CH.CO_2H}_{CO.O}$.—The ultra-violet absorption spectra of some closed chain carbon compounds. II. Dimethylpyrazine, hexamethylene and tetrahydrobenzene, by W. N. Hartley and J. J. Dobbie.—A study of the absorption spectra of *o*-oxycarbanil and its alkyl derivatives in relation to tautomerism, by W. N. Hartley, J. J. Dobbie and P. G. Paliatseas.—Action of formaldehyde on amines of the naphthalene series (II.), by G. T. Morgan. The action of formaldehyde on ethyl-β-naphthylamine in cold acetic acid solution results in the formation of 2:2-diethyldiamino-1:1-dinaphthylmethane.—The bromination of benzeneazophenol (II.), by J. T. Hewitt and W. G. Aston.—Condensation of ethyl crotonate with ethyl oxalate, by A. Lapworth. Ethyl γ-oxalocrotonate, $CO_2Et.CO.CH_2.CH:CH.CO_2Et$, is formed by the action of sodium ethoxide on a mixture of ethyl crotonate and ethyl oxalate; it is converted into α-pyrone-α'-carboxylic acid,  , by hydrochloric acid.—Researches in silicon compounds. VI. On silicodiphenyldiimide and silicotriphenylguanidine, by J. E. Reynolds. On heating silicophenylamide, $Si(NHC_6H_5)_4$, the diimide, $Si(NC_6H_5)_2$, and silicotriphenylguanidine, $Si(NC_6H_5)(NHC_6H_5)_2$, are obtained.—Note on Bach's hydrogen tetroxide, by H. E. Armstrong.

Linnean Society, June 7.—Prof. Sydney H. Vines, F.R.S., President, in the chair.—Mr. R. Morton Middleton exhibited a letter, dated "London, 13 June 1788," in the handwriting of Sir J. E. Smith, addressed to Charles Louis L'Héritier, at Paris, in which he mentioned a visit to Oxford with Sir Joseph Banks and J. Dryander for the purpose of looking over the plants and drawings of Sibthorp, who was then lecturing there; and added some critical remarks on several species of *Sida* which L'Héritier had sent him for determination. Mr. Middleton also exhibited an engraved portrait of Sir J. E. Smith from the *Gentleman's Magazine*, 1828, which, with the letter, he presented to the Society.—Mr. F. Enock, with the aid of the lantern, exhibited several photomicrographs and photographs of living insects, and gave an illustrated account of the life-history and metamorphoses of a dragonfly (*Æschna cyanea*).—Mr. E. S. Goodrich read a paper, entitled "Notes on *Syllis vivipara*, Krohn." This worm, which he found in a tank at the Naples Laboratory, appeared to be identical with that described by Krohn in 1869 (*Arch. f. Naturg.* xxxv. p. 197), and in general form resembled Claparède's *Syllis Armandi* (probably *S. prolifera*, Krohn). The peculiar point of interest was its method of reproduction, the embryos growing within the body-cavity of the parent to an advanced stage (when they resemble the adult except in their smaller size and fewer segments), and escaping by the breaking off of the posterior portion of the parent's body.—Dr. Otto Stapf read a paper on the two Melastomaceous genera *Dicellandra*, Hook. f., and *Phaeoneuron*, Gilg. He showed that the differences between them are not in the heterandry and homœandry respectively, as was supposed, but in much more important characters which concern all those parts which affect the formation of the fruits and seeds. The diagnoses of the two genera must therefore be revised, with the result that *Phaeoneuron* and *Dicellandra* change their character as monotypic genera.—A paper was read by Miss A. L. Embleton giving a full account of the anatomy and histology of *Echiurus unicinctus*, received from Prof. K. Mitsukuri, of Tokyo.

CAMBRIDGE.

Philosophical Society, May 7.—Prof. Clifford Allbutt, F.R.S., in the chair.—Exhibition of anomalous bones from predynastic Egyptian skeletons, by Prof. Macalister, F.R.S.—Ammocoetes a Cephalaspid, by Dr. Gaskell, F.R.S. The paper contained evidence that Ammocoetes was the living representative of the ancient Cephalaspids.—Note on some abnormalities of the limbs and tail of Dipnoan fishes, by H. H. Brindley. *Lepidosiren* and *Protopterus* sometimes exhibit partial bifidity of the limbs and tail. This condition of the limbs of *Protopterus* has received some speculative attention, and it has also been suggested that a branched limb of *Lepidosiren* might have a respiratory function. Boulenger and Howes have since shown that *Protopterus* may regenerate its limb in a branched condition, and sections of branched limbs of *Lepidosiren* show histological features clearly suggesting a reproduced condition. Budgett and Kerr have noticed a considerable tendency to injury and reproduction of limbs and tail in both these fishes—and there can be no doubt that the reproduction is often bifid. A parallel is therefore afforded with the bifidity sometimes seen in lizards' tails, which in all cases examined are reproduced structures. In some of the latter there is evidence that the extra tail is a new growth arising from an injured place, and in others that the new growth is bifid from its commencement. In the cases of *Lepidosiren* examined the latter condition alone seems to hold.—On the standardisation of anti-venomous serum, by W. Myers. It was shown that Calmette's method was based on views which were no longer tenable; and, further, that a special mixture of snake venoms is required. A more accurate measure of the antitoxin was to test its neutralising power, using ten times the minimal lethal dose of unheated Cobra poison, and mice of 15 grams weight as test animals. With this method it was possible to estimate the serum to within 15 per cent.

Royal Meteorological Society, June 20.—Dr. C. Theodore Williams, President, in the chair.—Mr. W. Marriott read a paper on rainfall in the west and east of England in relation to altitude above sea-level. This was a discussion of the mean monthly and annual rainfall for the ten years 1881-90 at 309 stations which the author had grouped according to the altitude of the stations above sea-level. The western stations were considered to be those which drained to the west, and the eastern stations those which drained to the east of the country. The diagrams exhibited showed that there is a general increase in the annual amount of rain as the altitude increases, and

that the rainfall is considerably greater in the west than in the east. The monthly diagrams brought out prominently some interesting features, among which were (1) that the monthly rainfall in the west is subject to a much greater range than in the east; (2) that in the west the maximum at all altitudes occurs in November, but in the east it is generally in October; (3) that in the west the spring months, April, May and June, are very dry; and (4) that both in the west and east there is a very great increase in the rainfall from June to July.—A paper by Mr. J. Baxendell was also read, giving a description of a new self-recording rain-gauge designed by Mr. F. L. Halliwell, of the Fernley Observatory, Southport. This rain-gauge, which the author believes approaches very closely to an ideal standard, has also the merit of being constructed at a moderate price.

PARIS.

Academy of Sciences, June 18.—M. Maurice Lévy in the chair.—On the monument erected to Lavoisier, by M. Berthelot. The monument is now finished, and will be unveiled on July 27.—The problem of the cooling of the earth's crust treated from Fourier's point of view, but by a much simpler method of integration, by M. J. Boussinesq.—Actinometric observations during the eclipse of May 28, by M. J. Violle. A diagram of the results obtained is given which closely approximates to the theoretical curve, the divergence being mainly due to the lag of the instrument, but also apparently in part owing to an absorption of heat by the solar atmosphere. The minimum ratio deducted from the observations was 0·12, distinctly less than the ratio of the radiant surfaces 0·14. Two sets of observations were carried out, one on the Pic du Midi, at a height of 2860 metres, and the other from a balloon, at a height of about 10,000 metres.—On the formation of nitric acid in the combustion of hydrogen, by M. Berthelot. Hydrogen was burnt from a jet in oxygen containing varying amounts of nitrogen, and also in the calorimetric bomb at pressures of from one to twenty atmospheres, and the amounts of nitric acid formed determined. The proportion of nitric acid formed was greatest in the bomb, and increased with the initial pressure of the gases.—The combustible gases of the atmosphere: the air of towns, by M. Armand Gautier. Air is drawn, after careful purification from dust, moisture and carbon dioxide, over red-hot copper oxide, and the amounts of water and carbonic acid determined. The mean results for twenty-two days was 1·96 mgr of hydrogen and 6·8 mgr. of carbon per 100 litres of air; but these quantities become 3·96 mgr. and 12·45 mgr. respectively when a correction is applied for the incomplete combustion effected by the particular length of copper oxide used.—The last eclipse of the sun and the zodiacal light, by M. Perrotin.—The occultation of Saturn by the moon of June 13 last, by M. Perrotin.—On the formation of beds of stipite, brown coal and lignite, by M. Grand'Eury. In the formation of brown coals marsh plants were the chief factor, trees only occurring rarely.—M. Dwelshauvers-Dery was elected a Correspondent for the Section of Mechanics, and M. D. P. Œhlert a Correspondent for the Section of Mineralogy.—Observations of the total eclipse of the sun of May 28 last, made at Argamasilla, in Spain, by M. H. Deslandres. The work undertaken included the measurement of the velocity of rotation of the corona, and the examination of its ultra-violet spectrum; the study of the ultra-violet spectrum of the reversing layer; the calorific spectrum and the direct photography of the corona.—The partial eclipse of the sun of May 28, at the Observatory of Toulouse, by MM. Montingerand, Rossard and Besson. The results obtained were confined to direct observation of contacts, measurement of the common chord, photographic observations and the knowledge of meteorological phenomena.—The total eclipse of May 28 studied at Elche, by M. J. C. Sola. Photographs of the spectra of the chromosphere and corona were taken.—Observations of the shadow fringes made during the total eclipse of the sun of May 28, by M. Moye.—On the uniform integrals of the problem of n bodies, by M. Paul Painlevé.—On the general theory of rectilinear congruences, by M. A. Demoulin.—On the expansion of fused silica, by M. H. Le Chatelier. The mean coefficient of expansion of fused silica for a temperature range of 0° to 1000° is 0·000,0007, the smallest coefficient known for any common substance.—Action of oxidising agents upon alkaline iodides, by M. E. Péchard. A study of the interaction of alkaline iodides with potassium permanganate, sodium periodate, potassium manganate, ozone and hydrogen peroxide.—Study of the viscosity of sulphur at temperatures above the temperature of maximum viscosity, by M. C. Malus.—On the selenides of iron, by M. Fonzes-Diacon. Several selenides of iron can be prepared of the composition indicated by the formulæ $FeSe_2$, Fe_2Se_3, Fe_3Se_4, Fe_7Se_8, and FeSe. They are attacked by hydrochloric acid with difficulty, $FeSe_2$ being unaffected by this reagent.—The true atomic weight of boron, by M. G. Hinrichs. From two analyses of boron carbide made by M. H. Gautier, the author concludes that the true atomic weight of boron is exactly 11.—Action of sulphur dioxide and hydrogen sulphide upon pyridine, by M. G. André. Sulphur dioxide gives a crystalline compound with pyridine, $C_5H_5N.SO_2$, and the action of suphuretted hydrogen upon this gives pyridine trithionate and tetrathionate.—On the αβ-dimethylglutolactonic acids, by M. E. E. Blaise.—On the reserve carbohydrates in the seed of *Trifolium repens*, by M. H. Hérissey. A mannogalactane was isolated from the seeds of *Trifolium repens*, resembling in its properties the carbohydrates obtained from lucerne and fenugreek.—Presence of iodine in the blood, by MM. E. Gley and P. Bourcet. Iodine was found to be present in the blood of dogs in amounts varying from ·013 mgr. to ·06 mgr. per litre of blood. The iodine is in the liquid portion of the blood existing combined with proteid matter, analogous to the iodine in the thyroid gland.—Reality of urinary toxicity and of autointoxication, by M. A Charrin.—On the anticoagulating power of serum in the pathological state, by MM. Ch. Achard and A. Clerc. Human blood serum, when present in sufficient quantity, prevents the coagulation of milk by rennet, the quantity of rennet solution required to produce coagulation measuring the activity of the serum. The anticoagulating power of the serum is unaffected by many diseases, but in others, such as pneumonia, septicemia with acute nephritis, uterine cancer, and advanced tuberculosis, this power is reduced to one-half or even less.

CAPE TOWN.

South African Philosophical Society, May 2.—L. Péringuey, President, in the chair.—Mr. Sclater exhibited a portion of a bone found at a considerable depth below the surface in Grave Street, and presented to the Museum by Col. Feilden. The bone was obviously the upper portion of the radius and ulna of a large ungulate animal; it appeared to be too large for an ox, and Mr. Sclater suggested that it might perhaps be that of a hippopotamus.—The Rev. Dr. F. C. Kolbe read his paper, entitled "Ultimate analysis of our concept of matter." The lecturer first briefly stated the four prevailing views on the subject—the mechanical, the dynamic, the vortical, and the scholastic or Aristotelian. The first two theories being for various reasons rejected, the lecturer stated that the purpose of this paper was to reconcile the third and fourth.

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