THURSDAY, OCTOBER 29, 1903.

VECTORS AND ROTORS.

Vectors and Rotors, with Applications. By O. Henrici, Ph.D., LL.D., F.R.S., and G. C. Turner, B.Sc. Pp. xv + 204. (London: Edward Arnold, n.d.) Price 4*s.* 6*d.*

PROF. HENRICI can always be depended upon to embellish any mathematical subject which he touches, because, with the skill of the analyst, he combines the keen perception of the geometer, which ever seeks to render the results of analysis in some way visible by spatial representation—or, perhaps, to reach the results directly (and often more simply) without any aid from analysis at all. To a mathematician of this kind the subject of vector analysis is peculiarly appropriate. We are therefore indebted to Mr. Turner for putting into systematic form the lectures delivered by Prof. Henrici at the City and Guilds Technical College, and producing a very simple and elementary work the methods and ideas of which should find a very early introduction into our ordinary mathematical teaching.

The system here put forth is non-Hamiltonian. A vector is throughout a mere "carrier." With Hamilton it was this and more; every unit vector, when employed as a factor, said Hamilton, is to be regarded as a quadrantal versor the plane of which is perpendicular to the vector. In the non-Hamiltonian system the vector is not in any way associated with the notion of rotation. Some vectors are, except as regards *direction* and *sense*, absolutely unrestricted in space; others (such as forces acting on a body) are restricted to definite right lines and are called *localised vectors*. For these latter the special name of "rotors" has been invented, and Prof. Henrici must excuse an adherent of the Hamiltonian system for saying that this name seems to be wholly unjustified in a system which refuses to associate the notion of a rotational operation with any vector. Assuming that a "rotor" means, perchance, a "rotator," how comes it that such a name is applied to a mere "carrier"? There is another term also adopted by Prof. Henrici the justification of which is at least difficult, viz. the term "ort." A vector of unit length is called an "ort," which is explained to be "short for orientation," and "orientation" makes a dangerous suggestion of rotation. The "ort" is, of course, Hamilton's *unit vector*. The "rotor" and the "ort" should be regarded by anti-Hamiltonians as the trail of the serpent.[1]

The contrast between the two systems is well illustrated by the discussion of the product, $\alpha\beta$, of two vectors, α and β, which forms the subject of chapter iii. of Prof. Henrici's book. With Hamilton the nature of the expression follows simply and naturally; $\alpha\beta$ means α/β^{-1}, an operation implying rotation—the conversion of the vector β^{-1} into the vector α. It can therefore be taken as either a combined tensor and versor operation, or a combined scalar and vector operation. This at once gives us the complete specification of the vector of $\alpha\beta$, and also that of the scalar of $\alpha\beta$, making the latter equal to $-ab\cos\theta$, where a and b are the tensors of α and β, and θ the angle between them.

Prof. Henrici, by a very simple and consistent rule, specifies the vector part and makes it identical with Hamilton's specification, but he makes the scalar $+ab\cos\theta$, by what, after all, amounts to a perfectly arbitrary and dogmatic definition (p. 95), its systematic connection with the mode of defining $V\alpha\beta$ being somewhat strained and unconvincing.

This, however, is a matter of no consequence, since he is quite at liberty to lay down his own definitions, inasmuch as he is not hampered by the Hamiltonian notion of rotation as associated with a vector.

As regards notation in this part of the subject, it may be pointed out that Prof. Henrici uses $[\alpha\beta]$ for the Hamiltonian $V\alpha\beta$, and (α,β) instead of $S\alpha\beta$, which certainly does not seem to be an improvement, especially when we have to write down a long vector or scalar equation—such, for example, as (iii.), p. 199. Again, the notation $[\alpha|\beta+\gamma]$, instead of $V\alpha(\beta+\gamma)$, is scarcely pleasing to the eye, even if it is not calculated to lead to slips in working.

The only indication that Prof. Henrici gives of his view of the quaternion system is found in p. 104, where he dispenses with the operation of division by vectors. "This operation is complicated and will not be considered at all. It leads to the much more complicated Theory of Quaternions." It is, however, quite open to a Hamiltonian to say nothing about division of vectors; he can treat his vectors as mere "carriers," and claim all the results of a non-Hamiltonian theory as his own; for a non-Hamiltonian is not necessarily an anti-Hamiltonian theory. It remains, of course, quite true that with Hamilton division is the primary notion, and multiplication the secondary.

The subjects selected by Prof. Henrici for vector treatment are geometrical and statical. Almost all the prominent results of elementary geometry are shortly and neatly obtained, and among the illustrations of this subject are the Peaucellier and Hart mechanisms for the description of a right line. There is a very full discussion of centres of mass, and a planimetric method of finding the centre of mass of any area, which method is not so well known as it ought to be. The determination of the centre of parallel forces by the use of link (or funicular) polygons is fully explained, while—to the great advantage of the student—Prof. Henrici is very lavish of his figures.

So very few elegances escape the watchful eye of Prof. Henrici that one feels a pleasure in pointing out something that he might have included in his discussion of force systems. The centre of a parallel system of forces is known to everyone, but the *astatic centre* of a system of coplanar forces has received little attention. Yet it is a striking entity, and one which is closely allied to the other centre. Its definition is fairly well known; perhaps the best specification of it treats it as the point of intersection of the line of no moment with the line of no virial.

The portion of the book dealing with statics treats largely of the stresses in frameworks, shearing forces, bending moments, &c., the treatment being, of course,

[1] Prof. A. Lodge suggests the term "locor" for rotor.

all vectorial, that is, geometrical, and marked by great clearness of exposition. Such a treatment of statics forms a most needful corrective of the methods of a purely "analytical statics," which has a strong tendency to keep the subject aloof from reality, and to obscure its physical nature. "One does not find figures in this book," boasted Lagrange in his "Mécanique Analytique," but the absence of geometrical methods and conceptions is not to the advantage of the subject.

In the penultimate chapter Prof. Henrici gives a short, very useful, and well explained account of the reciprocal figures of graphic statics, and the last chapter is a very short one on the deduction of the elementary trigonometrical formulæ from vector methods. With all deference to the author, however, it is to be feared that pupils will not, within time at the earth's disposal, be so much accustomed to think in vectors as to deduce their notions of a sine and a cosine otherwise than by the old method.

Next to the systematic teaching of the solution of all kinds of equations by graphic constructions, the wider employment of geometrical methods in dynamics is our greatest desideratum, and for this reason we have to thank Prof. Henrici for this elegant little treatise.

GEORGE M. MINCHIN.

THREE PROTOZOAN ARTICLES.

A Treatise on Zoology. Edited by E. Ray Lankester, LL.D., F.R.S., &c. Part i. Introduction and Protozoa. Second Fascicle. Pp. vi+451. (London: A. and C. Black, 1903.) Price 15*s.* net.

THE erratic order in which the various volumes of Prof. Lankester's treatise are appearing is, from the nature of their subject, a matter of very little consequence, and we are glad to welcome now this instalment of the protozoan chapter. It is the second fascicle of part i., of which the first fascicle, containing the introduction and the groups not here included, has still to appear. The inconvenience of the intended arrangement of parts is clearly demonstrated, and it is very fortunate that it has not resulted in the detention at the press of the valuable essays which make up this volume. A large part of the editor's difficulties have resulted, it is clear, from his adherence to the plan of producing bound volumes of nearly uniform size—in following, that is to say, the mode of publication of the recent "Cambridge Natural History" and of other similar works of collaboration. We believe it would prove to be in the interest of authors and readers alike if no attempt were made by the editors of series of this kind to produce periodically completed volumes, and if the separate articles were issued uniformly, but unbound, in the style of German monographs. The total expense to the purchaser of the whole series could remain the same by an obvious arrangement, while the gain to many specialists would be immense. We have a case in point in the present volume. Prof. Minchin's valuable monograph on the Sporozoa occupies about one-half of the whole volume, and might, we gather, have been already for some time in our hands if it had appeared separately in paper covers. Its subject is precisely one in which publication might well have been both early and individual in the interests of the medical profession, for which it has, perhaps, its chief importance at the present time. The deliberate manufacture of volumes, as such, while we can see nothing at all to recommend it, is exposed at the same time to the serious objection of stimulating over-production. The publication of a complete "Cambridge Natural History," and now of what is virtually an Oxford treatise, suggests inevitably that among the whole body of English zoologists a good deal of research has been recently sacrificed to text-book writing, of which a large part, however conscientious, has been redundant.

We can say this now with the greater assurance, because it cannot be taken as applying to the excellent articles on the Foraminifera, the Sporozoa, the Ciliata, and the Acinetaria in the present volume. The section dealing with the Sporozoa, by Prof. Minchin, takes its place as an admirable systematic account of the group, prefaced by a general sketch of their characters and of the typical life-history. The recent developments of our knowledge of sporozoan parasites in connection with malarial disease give a special importance, as we have said, to this monograph. Prof. Minchin provides in his description of the Hæmosporidia exactly what is now becoming essential knowledge for the student of disease, and it is highly desirable, we think, that medical men should approach the study of this group from a more general point of view than that permitted in the restricted accounts of the malaria parasite written specially for their use. In the interests of further developments of curative and preventive treatment in new directions, it is of the first importance that the morphology and life-cycles of the members of this group should be completely determined, although, as the author claims, "the life-cycle of the malarial parasite is now thoroughly known in all its features." The recent work of Schaudinn, who has explained the occurrence of relapse in malaria without fresh infection as due to a kind of parthenogenetic reproduction by resistant and long-lived macrogametocytes, is an example of the value in these inquiries of a zoological outlook, and it is to be remembered that the "black spores" of Ross have not yet been assigned with certainty to their place in a life-cycle. With regard to the voluminously alleged connection between the Sporozoa and cancer, Prof. Minchin is content to express the hostility of most zoologists, but he gives all the necessary material for following the discussion elsewhere. In summing up the affinities of the whole group he decides against the theory of Euglenoid ancestry which Bütschli advanced, and argues in favour of a descent from the Rhizopoda, quoting the interesting example of parasitism which Schewiakoff has found in simple amœboid forms. He concludes his article with a valuable compilation of sporozoan hosts, including Labbé's list with modern additions, and an abundant bibliography is appended, brought up to the beginning of the present year. It would be difficult to suggest any improvement in the author's selection of illustrations or in their execution.

Prof. Hickson, who has undertaken the Infusoria, does not include the Flagellata, but deals only with the Ciliata and Acinetaria, grouped as the Corticata Heterokaryota. Here again we can have nothing but praise for his admirably illustrated account of these

classes, and can only regret that it has been necessarily rather compressed. The limits of space have forced the author to deal briefly with the physiological inquiries for which the Ciliata have provided such a wonderfully fertile field. The work of Verworn and others upon the nuclear functions by means of "protozoan vivisection," and the studies of Miss Greenwood in intracellular digestion, are very shortly dealt with, while the classical accounts by Maupas of the processes of reproduction among the Ciliata deserve more expansive treatment than they receive in Prof. Hickson's excellent summary. Enough is given, however, of these biological studies to illustrate the author's discussion of the significance of the heterokaryote body, the individuality of the Infusoria after conjugation, and the incidence of somatic death among them, with which he prefaces his descriptive classification of the whole group.

The Foraminifera are dealt with in an article of the highest distinction by Mr. Lister, whose powers of lucid description, together with many original drawings and photographs of first-class merit, allow the reader to follow, perhaps for the first time with ease, the intricacies of skeletal structure and life-history found in this group. A unique value is given to this section by the inclusion within it of Mr. Lister's own researches into the remarkable phenomena of dimorphism in the Foraminifera, which he illustrates by a complete account of the alternation of the microspheric and megalospheric generations in the life-cycle of Polystomella. This dimorphism, with other characters, is followed through the various groups of Foraminifera so far as our present knowledge allows, and the facts are summed in a concluding survey, to which is appended a systematic classification and bibliography. Mr. Lister lays stress on the importance of life-history as evidence in the determination of phylogeny in this group, and this is becoming more and more evident in the case of other groups also of Protozoa. As an example of the questions of fundamental importance which are likely to arise in the further study of these life-histories may be noted the occurrence of the multiform condition especially in the microspheric generation, which Mr. Lister has ingeniously compared with the repetition of ancestral form seen in the sexually produced larva of the Cladoceran Leptodora, but not in its parthenogenetically developed young. This section marks a brilliant advance in description of the Foraminifera, and Mr. Lister is to be heartily congratulated upon it.

The earlier pages of the volume are given to an article by Prof. Farmer on the structure of animal and vegetable cells, of which, short as it is, nearly one-half is devoted to the discussion of reducing divisions and to some other physiological points. The problem of the structure of protoplasm and of the resting nucleus is dealt with, on the whole, perfunctorily, and is nowhere illuminated by reference to the results of Fischer and others in connection with the action of fixatives—results notably confirmed and extended in this country by Hardy—which already promise to remove these questions from the dust of a microscopists' quarrel and place it on the stage of exact physical inquiry.

PRACTICAL PHOTOGRAPHY.

Carbon Photography made Easy. By Thos. Illingworth. Pp. 150. (London: Iliffe and Sons, Ltd., 1903.) Price 1s. net.

Portraiture for Amateurs without a Studio. By Rev. F. C. Lambert, M.A. Part i. (Technical) and Part ii. (Pictorial). Pp. iv+176. (London: Hazell, Watson and Viney, Ltd., 1903.) Price, each part, 1s. net.

The Elementary Chemistry of Photographic Chemicals. By C. Sordes Ellis, F.I.C., F.C.S. Pp. 120. (London: Hazell, Watson and Viney, Ltd., 1903.) Price 1s. net.

Photography by Rule. By J. Sterry. Pp. 124. (London: Iliffe and Sons, Ltd., 1903.) Price 1s. net.

PHOTOGRAPHY as now practised may be regarded from so many points of view, and pursued for so many different purposes, that it is desirable to have treatises on special branches of it, such as those now under notice. A considerable advantage of this method of setting forth the facts and methods of photography is that each section may be dealt with by one who has paid special attention to it, and is able to speak upon it with authority.

Mr. Illingworth, for example, is a man whose business very largely consists in the making of carbon prints. His practical directions are, therefore, beyond criticism, and we put up with, without a murmur, his reference to "chloride, bromide, platinum, or other commoner printing processes" because of the frank and full way in which he describes the process in which he is a specialist. His book would have been better without the chapter devoted to the "Chemistry of the Carbon Process," for here he has gone outside his experience and his knowledge, and what he has set down tends to error and confusion. The discriminating student will discover this for himself, but beginners cannot always separate the wheat from the chaff, and it is for beginners that the book appears to be chiefly intended.

In a volume on the chemistry of photographic chemicals one looks for a special knowledge of the chemicals used in photography, but in the book before us there is not much evidence of this. The author appears to go out of his way to say that a "chemical change theory" of the developable image "is the one generally accepted at the present day." We very much doubt it. But in the matter that deals with the subject as set forth by the title, there are many statements that need modification, if not correction. Silver nitrate is doubtless the most important of all "photographic chemicals," but only little more than a dozen lines are devoted to its consideration. We are told that when prepared by dissolving silver in nitric acid hydrogen is evolved, and that when obtained in the solid form, preferably by fusion, it is not likely to be alkaline. Now fused silver nitrate often is alkaline, and as to the equation showing hydrogen liberated from nitric acid by the metal, the less said the better. We are told that the oxidation of sodium sulphite to sulphate by exposure to the air "is easily detected by the crystals becoming powdery and opaque,"

and that ammonia, when used as a follower to mercuric chloride in intensification, dissolves the silver chloride and forms ammonium dimercurous chloride, while sodium sulphite precipitates the mercury in the metallic form. The word "sensitisers" is applied to substances not usually so called, such as potassium bichromate. We are told that "when toning takes place with gold chloride, chlorine is given off." Of course it is not "given off" as that expression is commonly understood. Many other matters that need correction might be noted. Generally, methods of preparation are given, rather than the properties of the things as the photographer gets them. The latter is what is chiefly wanted, as photographers do not make their own chemicals, nor, indeed, are the instructions herein given generally a sufficient guide to enable them to do so.

Mr. Lambert, in his two small volumes on portraiture, writes from first to last from his own experience, and not only so, but in the greater number of cases demonstrates by examples the effects that he states result from certain procedures. The advantage of colour sensitised plates can be seen at a glance in the representation of the clothes, the hair, and the face or complexion of the sitter by inspecting the comparative examples given. The effects of different lenses, different positions of the camera, different methods of lighting, variations in exposure, different methods of dressing the hair and of posing the model, are all demonstrated. Indeed, it is hardly possible to think of any matter that bears upon the subject that is not dealt with and illustrated. The volumes are very suggestive to anyone interested in portraiture, and will be specially useful to the amateur who has no studio at his disposal.

Mr. Sterry has been a student of photography for a great many years, and has carefully followed, and often contributed to, the progress of the science that has taken place during the last decade or two. He is therefore specially fitted to treat of those methods of photography in which reasonable methods take the place of mere empiricism, and he has set down in a clear manner a summary of recent work so far as it affects the making of negatives and prints on bromide papers, including enlargements.

It seems to be necessary to make every book on photography a kind of manual for the beginner, and we suppose that Mr. Sterry has merely given way to the exigencies of the case when he explains what an "equivalent focus" is, and what is the size of a quarter plate. However, there are not many pages devoted to this sort of thing, and we judge that Mr. Sterry was heartily glad when he had done with them. Whatever beginners ought to do, they will not begin by photographing "by rule," and we doubt whether they can advantageously do so any more than they can well perform a quantitative exercise of any kind before they have got an idea as to how the action goes in a merely qualitative way. We intend it as a compliment to the volume and its author when we say that this book is not likely to appeal to the beginner.

We commend the courage of the author, and thoroughly agree with him when he says that hydroquinone and ferrous oxalate are the "least desirable" developers for general use. He admits, too, that different results may be obtained with the same exposures, by variations in development. Indeed, Mr. Sterry treats the subject in a fair manner, and cannot be accused of belonging to any particular "school." We cannot endorse his statement that the light intensities "between deep shadow and bright sky in an ordinary landscape have been conclusively shown to be less than 1 to 32," and his reference to the proof appears to be in error. The statement that the principal reason why negatives for enlargement should be thinner than for contact printing is the reflection of light from the surface of the paper and back to the paper from the surface of the negative in the latter case, is, we think, founded on a mistaken supposition. The difference appears to be due to the loss of the scattered light when the sensitive surface is not in direct contact with the negative. The author is mistaken in saying that the different methods of intensification give results that are "practically proportional throughout the scale." But remembering that the book is among the very first attempts that have been made systematically to describe the new methods of photography, it must be considered as notably successful, though we wish it had been rather more extended. "Rules" that have puzzled students for years are clearly explained, and effects that appeared to be erratic are shown to be the necessary results of the procedure.

OUR BOOK SHELF.

L'Evolution comparée des Sables. By Jules Girard, Membre de la Société de Géographie. Pp. iv+124. (Paris: Librairie scientifique et littéraire, F. R. de Rudeval, 1903.) Price 5 francs.

It is not clear whether this handsomely printed volume is addressed to the geological student or to the engineer. We presume, indeed, that its production has been a labour of love on the part of its author, who has brought together in a continuous form a number of facts recorded in French, German, and English publications. Here and there an original observation is introduced, like that on the deposit of angular blocks at Vauville (p. 8), which appears to present a problem akin to that of our Permian "breccias" on the coast of Devonshire. The photographs of types of sand-grains on pp. 10–13 have distinct value; in Fig. 8, however, radiolarians, though mentioned, are, to say the least, inconspicuous.

The erosion of the earth's surface by various agents is discussed, as explaining the origin of ordinary sands, and stress is properly laid on the atmospheric currents as agents of transport and accumulation of the fine material produced. Pp. 46–81 are, in fact, occupied by the subject of blown sands and dunes, and the various ways of arresting the invasion of fertile areas. The horse-shoe dunes figured on p. 70 are surely not so localised as the author suggests. They have been well discussed by Sokolów in a work translated into German in 1894, and appear, if we mistake not, in the memorable pages of Sven Hedin's "Across Asia."

The description of the changes undergone by coast lines, especially in historic times, contains many interesting details. We miss, however, a comprehensive summary, such as would be useful to the geographer, showing how geological conditions and movements of the land have affected deposition along

the coasts. In this matter, modern American authors might have been called on. As it is, some such generalisation is promised on p. 112, but the volume ends abruptly nine pages later in the midst of local details of the Netherlands. M. Girard has certainly not allowed his subject to lead him into realms of speculation; on the other hand, his book lacks the system and arrangement which so often make a French work, even when its information is incomplete, seem like a well grouped picture in absolute harmony with its frame.

There are too many misprints in personal names throughout the book, the worst of which is "le baron de Reichtofen" on p. 55. "Scottisch" on p. 53 has also a quaint aspect. G. A. J. C.

Radium and other Radio-active Substances, with a Consideration of Phosphorescent and Fluorescent Substances. The Properties and Applications of Selenium and the Treatment of Disease by the Ultra-violet Light. By William J. Hammer. Pp. viii+72. (London: Sampson Low, Marston and Co., Ltd., 1903.) Price 5*s.* net.

MANY will probably be attracted by the first word of the title of this book, and buy it in the hope of obtaining light and leading on the new discoveries. Such, we fear, are likely to be sadly disappointed. The book is an apparently verbatim report of a lecture delivered at a meeting of the American Electrochemical Society and the Institute of Electrical Engineers. It is difficult to understand why it was reprinted in its present form, for most of the interest seems to have centred in the experiments and exhibits that accompanied the lecture. For example, we read, "Here are a couple of postal cards which I secured in Europe showing the Blue Grotto at Capri. They are printed with phosphorescent paints, and on exposing them to the light you will see that they are very pretty." Reproductions are provided of an elaborate "stage setting" to the lecture, of various tubes with the word radium written beneath, but which, so far as the reader is concerned, might as well have contained sugar, and of some photographs taken with the aid of radium. The latter, although of more general interest, are sometimes misleading. Thus Fig. 7 is a radiograph of glass lenses, and is used to throw doubt on the generally accepted fact that the radium rays cannot be reflected, refracted, or polarised, whereas it is obvious that the photograph is taken with ordinary light, either the phosphorescent light of the radium itself not being eliminated, or else by simple "fogging." With regard to the text, the part dealing with radium consists of the collection of a large number of facts collected together without discrimination or arrangement. Thus two pages are spent on Heydweiller's experiment on the loss of weight of radium, the opinions of various eminent authorities with regard to this experiment are quoted as obtained by the author, and at the end we learn that the observation in question has been admitted by the observer to have been the result of an accident. Snippets of information are provided from most of the important researches which would be quite unintelligible to those not intimately acquainted with the subject and superfluous to those who are.

The Experiment Station Record. Vol. xiv. Nos. 5–9. (Washington: the United States Department of Agriculture, 1903.)

THE "Experiment Station Record" consists in chief of a series of abstracts of papers dealing with agricultural science all the world over, together with occasional general reviews and summaries. Abstracts are very rarely wholly satisfactory to the scientific worker, but there are few subjects more in need of work of this kind than is agriculture. The recognised organs of agricultural science are numerous enough, but much valuable work escapes their notice and appears in the irregularly issued reports and bulletins of some State or institution or society, or, again, is published in a journal devoted to one of the many pure sciences on which agriculture touches. Hence the value of the "Experiment Station Record"; so thorough is the organisation of the United States Department that very little escapes its net, and the student with an intelligent capacity for reading between the lines will by its help be generally put on the track of anything which concerns him specially. Particularly he will be saved the trouble of looking through the very numerous annual reports and bulletins issued by the separate States in America, for they are fully reported in the "Record," and almost wholly neglected by the German abstractors. We believe our own Board of Agriculture is about to undertake a somewhat similar work for the many scattered publications of county councils and colleges which have been doing agricultural experiments in this country during the last ten years or so. We doubt if the "Experiment Station Record" is as well known as it deserves to be; at any rate, several of our best specialist libraries in London possess it very partially, if at all, useful as it is even to men engaged in pure science. Meantime, it has become indispensable to all workers in agricultural science, and they owe a debt of gratitude to the United States Department of Agriculture both for its publication and for the liberality with which it is distributed. A. D. H.

Jahrbuch der Chemie. Twelfth Year, 1902. Edited by R. Meyer. Pp. xii+544; and General Register to same, i.–x., 1891–1900. (Brunswick: Vieweg und Sohn, 1903.) Price 15*s.* and 11*s.*

MEYER'S "Jahrbuch" is too well known among chemists to require description. It aims at giving a summary or review of the chief chemical contributions of the year. When one considers that in this comparatively short period upwards of 6000 researches (the number is taken from the *Centralblatt*, and does not include patent literature) find their way into print, the process of selection becomes a very arduous one, requiring on the part of the different collaborators—experts in their several provinces—not only much reading, but careful discrimination.

This large mass of material seems on the whole to be well sifted, but the condensed form in which it is presented robs the book of any literary merit, and gives it the indigestible and fragmentary character of a dictionary. English chemical literature scarcely receives full justice, not that the proportion of references is small (out of 160 papers published by the Chemical Society 28 are referred to), but these, it will be generally admitted, do not in all cases represent the most valuable English researches of the year.

The general index for the first decade is published with the "Jahrbuch," and as a book of reference should be useful. J. B. C.

Flowering Plants: their Structure and Habitat. By Charlotte L. Laurie. Pp. x + 157; with illustrations by W. L. Boys-Smith. (London: Allman and Son, Ltd., n.d.) Price 2*s.* 6*d.*

THIS little book is intended for students who have already studied the elementary principles of botanical science. It is divided into three parts, dealing with respectively, the most general conclusions of ecology relating to the habitat of plants, the minute structure of the plant and its adaptations to its habitat, and certain natural orders, regarded more particularly from the point of view of their ecological characteristics. The treatment is simple, though brief, and the illustrations are unusually good.

LETTERS 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.*]

Heating Effect of the Radium Emanation.

IN connection with the discovery of P. Curie and Laborde that radium continuously emits heat at a rapid rate, an interesting question arises as to whether the heat emission is directly connected with the radio-activity of that element or is independent of it.

To settle this point we have performed the following experiments. The heating effect of 30 milligrammes of pure radium bromide was first measured in a differential air calorimeter. The radium bromide was then heated to a sufficient temperature to drive off the emanation, and the latter was condensed by passing through a short glass tube immersed in liquid air, and then the tubes were sealed off. On testing the de-emanated radium, the heating effect diminished rapidly during the first few hours, and fell to a minimum corresponding to about 30 per cent. of the original value and then slowly increased again. On substituting the emanation tube in the calorimeter, the heating effect at first increased for a few hours to a maximum corresponding to about 70 per cent. of the original heat emission of the radium and then slowly decayed with the time.

At any time after removal of the emanation, the sum of the heating effect of the de-emanated radium and of the emanation was found to be the same as that of the original radium. Experiments are still in progress to determine the rate of recovery and loss of heating power of the de-emanated radium and the separated emanation respectively, but so far as the observations have gone, the curves of decay and recovery are the same as those for the corresponding α radiation.

It has been shown (Rutherford and Soddy, *Phil. Mag.*, May) that, if the emanation is removed from radium, the activity of the radium decays in the course of a few hours to about 25 per cent. of its original value. This residual activity consists *entirely* of α rays. The solid radium compound regains its original activity after the lapse of about one month. Immediately after the separation of the emanation the activity (tested in a sealed vessel) rises to about twice its original value, due to the production of excited activity on the walls of the vessel, and then slowly decays with the time, falling to half value in about four days. At any time after removal of the emanation the sum total of the activity of the radium and the emanation has a value equal to that of the original radium.

There is thus an exact parallel between the variation in radiating power (measured by the α rays) and the heating effect. In order to be sure how much of the emanation was removed by heating, control experiments were made on the γ rays from the radium and the separated emanation. This was tested by observing the rate of discharge of an electroscope after the rays had passed through 5 cm. of lead. In some preliminary experiments by one of us last year it was found that the γ rays from radium appeared at the same time as β rays, and were always proportional to them. From these results it was deduced that all but 6 per cent. of the emanation was removed by the heating.

It is thus seen that the heating effect of radium *directly accompanies* the α radiation from it, and is always proportional to it, and that more than two-thirds of the heating effect is not due to the radium at all, but to the radio-active emanation which it produces from itself. This result accounts for the variation of heat emission with age observed by the Curies, an account of which was given by Prof. Dewar at the British Association.

The amount of emanation from 30 milligrammes of radium bromide, when collected in the tube, was sufficient to cause a bright phosphorescence in the tube, but it was too small either to measure or weigh. The amount of heat emitted from the radium emanation is thus enormous compared with the amount of matter involved. It seems probable that the greater part of the heating effect of radium is a direct consequence of the expulsion of α rays. It still remains to be shown in what proportion the radiated energy is distributed between the projected α particles and the systems from which they are expelled.

The results given here are at once explained on the disintegration hypothesis (Rutherford and Soddy, *Phil. Mag.*, May), in which the heat is considered to be derived from the internal energy of the atom. On the view held by some that radium gains its heat from an external source, it would be necessary to suppose that less than a third of the heat is due to the radium itself, and that the other two-thirds are due to the radium emanation which is being continuously produced, and the power of which of absorbing energy from an external source decays with the time.

E. RUTHERFORD.
H. T. BARNES.

McGill University, Montreal, October 16.

Papers and Procedure at the British Association.

AT the recent meeting of the British Association at Southport I heard numerous complaints (repetitions of those I have heard at not a few previous meetings) by the general public, members of the Association, on the too technical character of the papers read before it. These complaints referred to all the sections except, perhaps, those of anthropology, geography, and educational science. One overheard too often to be pleasant such remarks as "I am interested in zoology, but what is the good of coming to listen to such a paper as this? I have no idea what the speaker is talking about"—the paper, in one specific instance, was cytological, and of great value undoubtedly; and, "I have not gained much by becoming a member of the Association; the papers are all over my head." These complaints are being made by well educated men and women interested in science, but not versed in its technicalities.

Believing that this feeling in reference to the subjects brought before the various sections is growing, and is, moreover, not ill-founded, I venture, as a member of twenty years' standing, to direct serious attention through your columns to its existence, and to advocate some change in the character of the papers accepted for reading before the Association, so that the objects for which this great society was founded may be more fully attained as regards the general public of the town visited, on the support of which the Association is so largely dependent.

Purely technical papers which appeal only to the specialist in chemistry, biology, engineering, or physics, are out of place before an audience the majority of whom are not specialists, but who have become members for the occasion in the hope of listening to an understandable exposition of the subject by the men who have contributed to making that section of science. Such purely technical papers should be reserved for the societies which exist for the cultivation of that particular subject. The British Association should either become a purely scientific society or become more what it was established for, an association for the advancement of science among the people, at which the *results* of the investigations of the year are, as it were, summed up and presented to the members, both specialists and those of the general public interested in science, in language which the whole audience can understand. An author, instead of going into the details of the various intricate investigations and experiments he has made—which can often enough be followed fully only by his fellow-workers in that particular section of his subject—should far more than heretofore deal broadly with the results obtained, indicating their value to the particular subject, and their bearing on his own or other departments of knowledge. The general public have really some cause for complaint that their subscription has been obtained from them on a misunderstanding. If the Association is to become more and more a purely scientific society, then the fact should be made more widely known, so that disappointment may not be needlessly caused to those who join it. In that case, moreover, there would be no need of the publicity with which the Association meets at the various towns it visits. It might quietly assemble at the chosen town in rooms hired or lent for the purpose, and associate itself only with the specialists of the place.

Liverpool, October 20. HENRY O. FORBES.

A Little-known Peculiarity of the Hamadryad Snake.

A STRUCTURAL peculiarity of the "king cobra" which I have recently ascertained while studying the anatomy of the Ophidia seems to me to be so remarkable that it must have been noticed in such comprehensive works as Bronn's "Thierreich" and Dr. Gadow's account of serpents in the "Cambridge Natural History" were it known. I venture, therefore, to give a short account of the matter without professing to have made an exhaustive survey of the literature of the group. The windpipe of this snake opens, as usual, not far from the heart into the lung, which presents no remarkable divergencies from the lungs of other snakes; it is in the same way functional as a lung for the first half, and becomes a mere thin-walled air bag posteriorly. Before opening into the lung, however, the trachea is connected with a long series of approximately equi-sized air sacs in the neck, which follow close upon each other, and entirely occupy the neck down to the region where the heart lies. These sacs are so closely adpressed that the appearance given is that of a series of septa, dividing the space surrounding the windpipe and gullet into metamerically arranged compartments. I thought at first, in fact, that I had been able to observe a segmentation of the cœlom in this region quite analogous to that of an annelid. Each cavity, however, is continuous with the interior of the windpipe by an oval and clearly defined orifice on its lower surface. These apertures are regular and of fairly equal size, and give to the windpipe quite the appearance of a flute. There are a large number of them, thirty to forty. There is no question here of pathological conditions or of accidental cuts. The regularly disposed series of sacs into which they open negatives anything of the kind. They are, I suppose, an extreme modification of what the late Prof. Cope termed the "tracheal lung" in Chersydrus and other snakes. The most obviously comparable structure that I can think of for the moment is the ventral slit in the windpipe of the emu, which similarly opens into a thin-walled sac. This is believed to be connected with the singular "drumming" sound emitted by that bird. Perhaps some of your readers who are acquainted with the Hamadryad can inform me as to a possible "voice," or whether it can produce a varied or especially prolonged hiss. I propose to offer a more detailed account of the structure of the windpipe and other organs of this snake to the Zoological Society as soon as possible.

FRANK E. BEDDARD.

The New Bishop's Ring.

REGARDING M. Forel's suggestion (see NATURE, p. 396) that persons ascending to considerable altitudes should observe whether the ring around the sun, which was so noticeable a phenomenon after the diffusion of the volcanic dust from the Krakatoa eruption in 1883, is again visible, I beg to say that, before reading his letter in *La Gazette de Lausanne*, I had noted the ring on August 20 from the Montanvert, near Chamonix, at an altitude of 6300 feet. The day was exceptionally clear, and when a peak hid the sun itself, the whitish glare fringed with reddish brown that surrounded it attracted my attention. Being upon the summit of Mont Blanc (15,780 feet) on September 1, in clear weather, I again observed the ring, which, however, was no better defined than lower down on the mountain, notwithstanding the circumstance that the dark blue sky furnished an excellent background. Angular measurements there showed that the radius of the visible outer limit of the reddish ring was between 20° and 25°.

While the phenomenon was not again seen by me last summer in Europe, it has often been observed during the past year here at my observatory, elevated only 640 feet above the sea, and an article in *Science* of January 23 by my assistant, Mr. Clayton, describes the reappearance of this second "Bishop's ring" and the accompanying brilliant sunsets during the early part of last winter. Subsequently, the ring was observed in January and February, and also in May, June, and July, when highly coloured and prolonged afterglows followed the sunsets towards the close of the latter month. During the first part of August the ring was seen on clear days, and during September the vivid yellow colour of the western sky, persisting sometimes more than an hour after sunset, was frequently recorded. To-day (October 14), after a period of rainy weather, the ring is distinct, and measurements made here some time ago gave 26° as the radius of the whitish haze and 5° more for the reddish border, indicating that its visible extension was greater even than on Mont Blanc.

M. Forel states that he has seen a coloured circle surrounding the sun since the first of last August. The fact of it not having attracted notice previously in Europe would seem to show either that the clearer atmosphere of the United States favours its perception, or that the microscopic dust in the upper air, which is supposed to produce the diffraction phenomenon, preponderates above this country. The last hypothesis is supported by the fact that, from the proximity of the West Indian volcanoes, the fine dust ejected by them during the eruptions that year may have drifted northward, before making a circuit of the globe, and a larger quantity may still remain suspended in the rarefied atmosphere above the eastern United States than exists over Europe.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory, Massachusetts, U.S.A., October 14.

The Nervous System of Anodonta cygnea.

THE supra-œsophageal ganglion of Anodonta is usually regarded as representing both the cerebral and pleural ganglia, and is commonly spoken of as the "cerebro-pleural." Prof. Howes mentions in his "Atlas" that Prof. M. Hartog has occasionally observed a ganglionic swelling on one or both of the cerebro-visceral connectives in front of the pericardium, but that he himself has failed to find any such enlargement. In view of the doubt that exists, it seems to be worth recording that yesterday one of my pupils, A. C. Roxburgh, while dissecting an Anodonta in the Charterhouse laboratory, exposed a well-developed ganglion of the usual orange colour, upon the left connective in the exact position mentioned by Prof. Hartog. Microscopical examination removed all doubt as to the nature of the swelling, for numerous ganglion-cells were easily recognised in the teased preparation. It is thus probably more correct to term the anterior ganglion "cerebral" rather than cerebro-pleural. Perhaps some of those who are better equipped for research than is possible or advisable for those engaged in elementary laboratories might find it worth while to examine series of sections of the connective at this region. It is possible that the pleural ganglion may in most cases be represented by but a few ganglion cells the presence of which is not discernible to the unaided eye.

May I, as I am writing about this animal, direct attention to an error that is universal in text-books? The muscles always spoken of as retractors and protractor of the *foot* have not the function that their titles imply. The protrusion of the foot is due to vascular turgescence, and its withdrawal to relief of the turgid condition and contraction of the intrinsic pedal muscle fibres. *The muscles in question move the shell, the foot being the fixed point.* Thus the so-called anterior and posterior retractors of the foot should be styled the *protractors of the shell*, and the protractor of the foot the *retractor of the shell.* I may mention that I have often seen Anodonta go backwards when its deliberate movements have led it into a *cul-de-sac* in the aquarium.

OSWALD H. LATTER.

Charterhouse, Godalming, October 24.

LORD KELVIN AND HIS FIRST TEACHER IN NATURAL PHILOSOPHY.

SOME interesting early recollections were related by Lord Kelvin on October 17, on the occasion of the unveiling of a stained glass window, by Henry Holiday, in the Bute Hall of the University of Glasgow in memory of John Pringle Nichol, LL.D., professor of astronomy, 1836–1859, and his son and daughter, John Nichol, LL.D., professor of English language and literature, 1862–1889, and Mrs. Jack, who was born in 1837, in the University, and died there in 1901. Prof. J. P. Nichol was the author of numerous valuable works, including the famous book on the "Architecture of the Heavens." The account which Lord Kelvin gave of his own young days at

Glasgow College is full of interest, and his testimony to the impulse he received from his early teacher will be an enduring tribute to Nichol's memory.

In the course of his remarks, Lord Kelvin said:—Principal Story, You recall to my mind the happy days of long past years, 1836, when John Pringle Nichol came to be professor of astronomy in the University of Glasgow. From the time he first came among us—I say among us, because I, as a child, was not then a member of the university, but an inhabitant of the university—when Dr. Nichol, as we then called him, came among us, he became a friend of my father, and that friendship lasted to the end of my father's life. I may also claim that I became a student of Dr. Nichol's from the time he first came to Glasgow. Year after year passed, and I still remember his inspiring influence. The work on which I am engaged at this day is work to which I was initiated in the years 1837, 1838, and 1839, when I was a child. The summer of 1840 is for me a memorable summer, a year of brightness in my memory. I had been for one session a student in the natural philosophy class of the university conducted by Dr. Nichol. From beginning to end, with the exception of a few days, when my predecessor, Dr. Meikleham, began the course which he could not continue on account of his health, the class of natural philosophy, in the session 1839–40, was taught by Dr. Nichol. He came on short notice to occupy the post, and he did it in a most admirable manner. I lately had the opportunity allowed me by my friend and colleague, Prof. Jack, to see a manuscript book of John Pringle Nichol's, a book of exercises and preparations for the natural philosophy class. I was greatly struck with it, and much interested to see in black and white the preparations he made for the splendid course of natural philosophy that he put us through during the session 1839–40. In his lectures the creative imagination of the poet impressed youthful minds in a way that no amount of learning, no amount of mathematical skill alone, no amount of knowledge in science, could possibly have produced. For, many years afterwards, one of the most important affairs I have ever had to do with began with what I learned in the natural philosophy class in that session. I remember the enthusiastic and glowing terms in which our professor and teacher spoke of Fourier, the great French creative mathematician who founded the mathematical theory of the conduction of heat. I was perfectly astonished. I remember how my youthful imagination was fired with what I heard from our teacher. I asked him, "Do you think I could read it?" He said, "The mathematics is very difficult." At the end of the session I got hold of the book ("Théorie analytique de la Chaleur") out of the university library, and in the first half of the month of May, 1840, I had, I will not say read through the book, I had turned over all the pages of it. Then we started out from Glasgow for Germany, the joint families of my father, my brothers and sisters, and our friend Dr. Nichol and Mrs. Nichol, and John Nichol and Agnes Jane Nichol. The two families made together a tour in Germany, and during two months or six weeks in Frankfort, Mrs. Nichol and her two children were with my father and his family every day while their father went on tour to the Tyrol. Excuse me for speaking of those old times. I am afraid I have trespassed on your patience. These recollections may be nothing to you, although they are dear to me. They are, indeed, closely connected with the subject of the present meeting.

While we were encamped for a time in Bonn, Dr. Nichol took me and my elder brother on a walking tour in the volcanic region of the Eifel. We had four days of intense enjoyment, and the benefit of what we learned from him, and saw around us, in that interesting region remained with my brother all his life, and remains with me.

I have to thank what I heard in the natural philosophy class for all I did in connection with submarine cables. The knowledge of Fourier was my start in the theory of signalling through submarine cables, which occupied a large part of my after life. The inspiring character of Dr. Nichol's personality and his bright enthusiasm lives still in my mental picture of those old days.

The old astronomical observatory—the Macfarlane Observatory—was situated in the upper part of the old college green, or garden, as we used to call it, behind the college, off the High Street. I do not suppose any person here ever saw the old college green, but you have all read of it in "Rob Roy," and of the duel between Osbaldistone and Rashleigh. I do not remember the details of the duel, but I remember it was appointed to be fought in the upper part (at least I have always assumed, in my mind, it was in the upper part) of the college garden of the University of Glasgow. The garden was in two parts, the lower on the near side of the Molendinar, the upper on the higher ground beyond the stream, which we crossed by a bridge. Has any person here ever seen the Molendinar? There used to be mills on it, I assume, from the name. It is now a drain! Before we left the old college it was covered in. We had still the upper and lower green, but the Molendinar flowed unseen for many years after the university left the old site. I remember in the Macfarlane Observatory beautiful experiments on light shown us in the most delightful way by Dr. Nichol, Grimaldi's fringes by sunlight, and prisms showing us splendid solar spectra, and telescopes, and brilliant colours on a white screen produced by the passage of polarised light through crystals. He gave us firmly the wave theory of light, and introduced us to Fresnel's work. As he appreciated Fourier, so he appreciated Fresnel, two of the greatest geniuses in science, and fired the young imagination with the beautiful discoveries of those men. In that old observatory in the high green, and in the natural philosophy class-room of the old Glasgow college, was given to me the beginning of the fundamental knowledge that I am most thoroughly occupied with to this very day, and I am forcibly obliged to remember where and when my mind was first drawn to that work which is a pleasure to me, and a business to me just now, and will, I hope, be so for as long as I have time to work. You can imagine with how much gratitude I look upon John Pringle Nichol and upon his friendship with my father. His appointment as professor of astronomy conferred benefit, not only upon the University of Glasgow, but also upon the city and upon Edinburgh, and the far wider regions of the world, where his lectures were given and his books read. The benefit we had from coming under his inspiring influence, that creative influence, that creative imagination, that power which makes structures of splendour and beauty out of the material of bare dry knowledge, cannot be overestimated.

FLOW OF STEAM FROM NOZZLES.

IT is well known that when a gas is flowing from a vessel by an orifice, if the outside pressure is less than sp_0, p_0 being the pressure in the vessel where the gas is at rest, the pressure in the throat of the orifice is never less than sp_0 if s is

$$\left(\frac{2}{\gamma+1}\right)^{\frac{\gamma}{\gamma-1}}$$

where γ is the ratio of the specific heats. s is 0·527 for air. It is also known that, with fair accuracy, we

may assume steam which is dry and just saturated to behave as if it were a gas the γ of which is 1·13, and steam with 25 per cent. of moisture as if it were a gas the γ of which is 1·113. It results that the velocity in the throat delivering steam is never greater than the velocity of sound in such steam as exists in the throat, and the pressure in the throat is never less than 58 per cent. of the pressure inside the vessel, however low the pressure of the outside space may be.

Mr. Napier's experiments first directed attention to this phenomenon, and Prof. Osborne Reynolds, in 1885 ("Collected Papers," vol. ii. p. 311), gave the explanation.

Students are still too much influenced by their knowledge of flowing water; they cannot help thinking that the flow of a gas is analogous, whereas in all important particulars the flow of a gas is entirely different from the flow of a liquid. After much unbelief among students of this subject, it is now becoming known that when there is a divergent mouthpiece outside the throat, the velocity of a compressible fluid may become very much greater than the velocity of sound; speeds of 3000 or 4000 feet per second seem to be possible at the ends of the divergent orifices used in the Laval turbine. Some years ago I framed a theory of the injector which seemed reasonable, and yet I found it wrong in its application to experimental results. I now know that it was really a good working theory. It seemed to be wrong really because I could not imagine a velocity of steam greater than that found by Napier, the velocity of sound.

I wish to show that the reasoning of Prof. Osborne Reynolds leads to an explanation of what occurs in an expanding mouthpiece. The motion is steady in the vessel until the narrowest part or throat is reached; in the expanding mouthpiece the motion is turbulent, but perhaps I may be allowed to consider the motion as steady throughout, as this will illustrate what occurs well enough, and turbulent motion mathematics is quite beyond my powers.

If W is the weight of gas passing along a stream tube the cross section of which is A, then at a place where the pressure is p we know from the usual reasoning that

$$W = A\sqrt{\frac{2g\gamma}{\gamma-1}\,w_0 p_0\left(a^{2/\gamma}-a\right)} = Awv$$

if w is the weight of unit volume of the gas, being w_0 where p is p_0 and if a stands for p/p_0.

Now let us keep W constant, and we are able to calculate the cross section of the stream at any place where p is known.

I sometimes ask the individuals of a class of students to calculate, each of them, a part of such a table as the following:—

Imagine steam in a vessel at $p_0 = 14400$, or 100 lb. per square inch, to flow towards a throat with an expanding orifice outside; at the following pressures I give the corresponding cross sections A of a stream tube and the velocity there. It will be seen that where the tube is narrowest the pressure is 57·85 lb. per square inch; this is near the narrowest part of the orifice. Beyond this in the expanding part A increases, the pressure falls, and the velocity becomes greater and greater.

I take a stream tube in which the flow is 1 lb. per second, or W = 1. These numbers deserve study. It is evident that to get very high speeds the mouthpiece must be much enlarged from the throat, but as rapid enlargement must lead to greater turbulence, velocities much greater than 3000 feet per second ought hardly to be expected.

If we double all the pressures in the table, the values of A and v there given are right for the case of flow of steam from a vessel where p_0 is 200 lb. per square inch; about two pounds of steam per second now flows along the tube.

An expanding mouthpiece increases the flow of water, and velocities are less where cross sections are greater; but in the case of air or steam, the total quantity flowing is not increased, and velocities are greater where cross sections are greater.

p lb. per sq. in.	A sq. ft.	v ft. per sec.	p lb. per sq. in.	A sq. ft.	v ft. per sec.
100	∞	0	40	0·00524	1963
90	0·00732	658	30	0·00599	2252
80	0·00541	994	20	0·00743	2654
70	0·00489	1245	15	0·00889	2910
60	0·00483	1456	10	0·01170	3220
57·85	0·00481	1512	5	0·01430	3506
55	0·00484	1573	2½	0·03306	4214
50	0·00488	1708			

JOHN PERRY.

PROGRESS OF GEOLOGICAL SURVEY OF THE UNITED KINGDOM.

IT would be impossible to give on one page an epitome of the work done in a year by the Geological Survey, but it may be possible to explain the arrangement of the official summary of progress and to indicate the character and range of the information contained in it.

By far the greater number of persons who consult it want first of all to learn whether anything new has been published about their own district. We find, therefore, that the information is arranged geographically under the heads England and Wales, Scotland and Ireland, and that subordinate to these there is a reference to districts, not well defined physical or political divisions of permanent importance, but divisions arbitrarily chosen for the purpose of easy reference to the areas over which the work of the year has been carried on.

The descriptions are further classified under the names of the geological formations found in each district.

The most important part of the work deals, of course, with the observations made in the field and recorded on the maps and sections, or described in memoirs and explanations, but the palæontological, petrological and chemical work all receive special notice, as do the products of economic value and the excellent museum connected with, and largely brought together by, the Survey.

All who are engaged in geological teaching or research, or the practical application of the science, must watch the results obtained by the Survey, whether they involve, as proved by Mr. Thomas, a correction of the section across the Towy Valley, or throw light on the relation of the Devonian to the Old Red, as may be seen in Mr. Strahan's work, or furnish material for determining the exact "geological equivalents" of the coal-bearing strata in several distinct and isolated areas, as shown by Mr. Kidston, or data for discussing with Mr. Clement Reid the conditions which prevailed when the deposits were laid down in which man's remains first appear.

The practical man, who has always met with so much courtesy and assistance in the Survey Office, whether he seeks how he may find water or in which direction he might hope to pick up again a lost seam of coal or vein of metal, has always turned to the publications of the Survey for the results of the latest and most careful examination of the district in which he is interested.

It is, however, difficult for a man of small leisure to search through the maps, sections, explanations, and memoirs to see whether there is anything which immediately concerns him. In the annual report of progress such men find a short account of what has been done and often a forecast of what line of research it is proposed to follow next—as, for example, in the description of the coal-bearing strata in the basin of the Amman.

It would, however, be a mistake to suppose that the results achieved are of interest to geologists only. From the summary of progress just issued, it may be seen that the work appeals to a much wider public than would at first appear. It contains a record of accurate observations on the relation to one another of the great masses of which the earth's crust is made up—very different from the *a priori* reasoning as to how they ought to behave with which we have so often had to be content. If we turn to the very first page of the introduction, in which the able director of the Survey gives a sketch of what he and his men have done, we read that they have demonstrated that the arrangement of the different kinds of rock proves that there have been movements by which slices of sedimentary and igneous matter, of heavy basic and lighter acidic rock, have been thrust in, so that they now appear in alternating layers over large areas, and further that these earth movements have crushed and kneaded and drawn out the constituents of the rock so that its structure is quite different from that which they have reason to infer it once had from the changes observed as they trace each mass across the country.

The physicist and astronomer will find in the survey publications the results of observations on earth movements recorded by a man like Mr. Harker, who is not only one of the highest authorities in petrography, but also a mathematician of the first order; while geographers will note with interest the inferences which are forced upon clear-headed and experienced observers like Mr. Strahan, who are trained, as few ordinary travellers are, to watch every indication of change of rock structure, and to trace the guiding influence of systems of displacement upon the rivers and other denuding agents which have moulded the surface of the land.

In the Survey memoirs biologists will find treatises, by men like Woodward, Clement Reid, and Lamplugh, dealing with ancient climatal and physical conditions which have varied, as inferred from the flora and fauna as well as from other indications, with the great geologic changes of the earth's crust.

On the staff of the Survey are many men of world-wide reputation who are approaching these large questions from many different points of view, and fully realise what large superstructures may be built up on the facts which they lay down. Carping critics talk of the "uncertainties of geology"; that is because the public is sometimes told what working hypothesis is suggested by evidence which is known to be incomplete. It is not necessary for pioneers to be always repeating the *certainties*, and the Summary of Progress lets the public follow the work as it is going on.

NOTES.

THE council of the Royal Meteorological Society has awarded the Symons gold medal to Prof. Julius Hann, of Vienna, in recognition of the valuable work which he has done in connection with meteorological science. The medal will be presented at the annual meeting of the Society on January 20, 1904.

A BUST of John Dalton, presented to the Manchester Literary and Philosophical Society by Sir Henry E. Roscoe on the occasion of the centenary of the announcement of the atomic theory, was unveiled on October 20. The secretary read the following letter from Sir Henry Roscoe:—"I desire to present to the Literary and Philosophical Society of Manchester a bronze bust of Dr. Dalton, as a memento of the many years of pleasant intercourse which I have in past days spent in converse with its members, and as a recognition of the honour which the Society has done me by electing me as an honorary member, and in bestowing upon me its Dalton Medal. The bust is the work of a distinguished sculptress, Miss Levick, and I believe that all those who have seen it agree with me in esteeming it a powerful and lifelike work of art. It will give me great satisfaction to hear that the Society accept my gift, and that they value the bust as a work of art and as a reminiscence of the donor." The president, in formally unveiling the bust, observed that it was a happy coincidence that this meeting took place on the anniversary of the date when Dalton communicated to the Society his paper on the absorption of gases by water, in which was given the first hint of the atomic theory.

THE zebra stallion Matopo, which has been described and figured by Prof. Cossar Ewart in his book "The Penycuik Experiments," and was the sire of some interesting zebra-horse hybrids, is dead. This zebra was purchased some time ago by Mr. Assheton-Smith, Vaynol Park, Bangor, who was hopeful that he might find it possible to repeat some of Prof. Ewart's experiments, but unfortunately his expectations have not been realised. Whilst retaining the skin, he has presented the skeleton of the zebra to the University College of North Wales, where it will form a handsome addition to the zoological collection. It may also be noted that to this college Prof. W. A. Herdman, F.R.S., of Liverpool, recently made a donation of some fishes from Ceylon and Indo-Malaya which he collected when in the East investigating the pearl fisheries of Ceylon. Prof. D'Arcy Thompson, C.B., Dundee, has also presented a skeleton of the somewhat rare sea otter (Enhydra) from Alaska. By presentation and purchase a valuable zoological collection, which is under the care of Prof. Philip J. White, has gradually been formed at the college.

DR. DAWSON TURNER has been awarded a Keith prize by the Royal Scottish Society of Arts for papers upon improved Röntgen apparatus and other electrical matters.

AT an auction sale of rare, valuable and standard books by Messrs. Hodgson and Co., Chancery Lane, on October 21, a complete set of Curtis's *Botanical Magazine*, from the commencement in 1787 to the present month, realised the sum of 120*l*.

THE opening meeting of the Institution of Electrical Engineers will be held on November 12, when the premiums awarded for papers read or published during the session 1902–1903 will be presented, and the president, Mr. Robert Kaye Gray, will deliver his inaugural address.

MR. MARCONI, in company with Captain H. B. Jackson, has gone to Gibraltar to carry out further experiments for the Admiralty. It is hoped to be able to open communication with Gibraltar before losing touch with Portsmouth.

ACCORDING to the daily papers, the Post Office authorities are about to make experiments with the de Forest system of wireless telegraphy. Dr. Lee de Forest has come over

from America to superintend the experiments; the system, in which an electrolytic conductor is used in place of the ordinary coherer, is in considerable use in America.

A FORTNIGHT ago we were able to record the fact that a speed of 125½ miles an hour had been attained by the Siemens car in the high-speed trials which are being carried on at Berlin. Last Friday this record was beaten, and a speed of 130½ miles an hour attained. It is said that a higher speed than this is not desired. The passing of the car at full speed seems to have created a strong impression on a large crowd of sightseers who witnessed the experiments from Dahlwitz Station.

WE regret to see the announcement of the death of Dr. C. T. Hudson, F.R.S., president of the Royal Microscopical Society from 1888 to 1890, and joint author of Hudson and Gosse's "Rotifera." Dr. Hudson was born in 1828, and was fifteenth wrangler in the mathematical tripos of 1852. From 1855 to 1860 he was headmaster of Bristol Grammar School, and from 1861 to 1881 of Manilla Hall, Clifton. He was elected a fellow of the Royal Society in 1889, chiefly on account of his work on Rotifers, concerning which he was the chief authority. The genus Pedalion, discovered and described by him, was a very remarkable and important contribution to animal morphology; Dr. Hudson was also the discoverer of numerous other new genera and species of Rotifera, described in the publications of various scientific societies.

AN announcement is made in a Government resolution on the annual report of the Survey of India for 1901–2 that the necessity for effectively revising and keeping up to date the maps now in existence, as well as of providing fresh ones, has been forced upon the Government of India. "We can only hope," says the *Pioneer Mail*, "that there may be no half measures, and that the reform may be thorough, for assuredly the need is more crying than most can have any idea of."

ACCORDING to the *Westminster Gazette*, Mr. F. du Cane Godman has recently presented to the British Museum (of which he is a trustee) a collection of nearly 30,000 specimens of beetles, following on a previous donation of 50,000. The present collection consists mainly of representatives of the family Elateridæ, or "ship-jacks," the bulk being from Central America. The collection in the Museum is now the finest in the world, and housing space is a problem. Our contemporary makes a curious mistake in referring to the fact that 150,000 *specimens* of beetles are already described, and that the annual addition to the British Museum collection averages 400 *specimens*; in both cases, of course, *species* are meant.

A REUTER telegram from Wellington, dated October 25, states that the Antarctic relief ship *Morning* has left Lyttelton to join the *Terra Nova*, the relief ship for the *Discovery*, at Hobart. In connection with the relief of the Nordenskiöld Antarctic Expedition, the *Times* reports that the Swedish vessel *Frithjof*, the French steamer *Le Français*, and the Argentine gunboat *Uruguay* will meet at Ushnaia on November 1, and will then proceed to Seymour's Island, and from thence to Snowhill, Dr. Nordenskiöld's proposed base.

A CORRESPONDENT, referring to Prof. W. H. Everett's letter on rocket lightning in our last issue, directs attention to a closely similar phenomenon observed in London between 2 and 3 a.m. on the morning of October 16. From the south-eastern horizon of a clear sky, a "wriggling stream" of bluish-white light shot up in a vertical direction and broke off short without spreading. It would be interesting to know if any other observer witnessed this display, and if a thunderstorm occurred that night anywhere to the south-east of London within twenty or thirty miles.

COMMANDER R. E. PEARY has been granted leave of absence in order to make one more attempt to reach the North Pole. In a letter to the Secretary of the U.S. Navy, published in the *National Geographic Magazine* for this month, Mr. Peary outlines the plan he proposes to adopt. He intends to make his winter camp fully one hundred miles north of his previous winter quarters, so that when he is ready to start in spring he will be a hundred miles nearer his goal. The distance from Peary's proposed winter camp near Cape Joseph Henry to the North Pole and back again is less than the average distance of four sledging trips which he has made. Mr. Peary proposes to start in July, 1904, to reach Cape Joseph Henry with his vessel in the fall of that year, and to make his dash for the Pole in 1905. In case he does not reach the proposed winter camp in 1904, he will spend 1905 in reaching it, and attempt to reach the North Pole in 1906.

THE fourteenth International Congress of Americanists will be held at Stuttgart on August 18–23, 1904, under the presidency of Prof. Karl von den Steinen. The congress is concerned with the history, culture, linguistics, and mythology of the various aboriginal races of America, and generally with the archæology and ethnography of the New World. Correspondence referring to anthropology and ethnography should be addressed to Prof. Karl von den Steinen, Berlin-Charlottenburg, Hardenbergstrasse 24, and that referring to archæology, discovery, and Central America to Prof. Eduard Seler, Steglitz bei Berlin, Kaiser Wilhelmstrasse 3. The general secretary is Prof. K. Lampert, Stuttgart, Archivstrasse 3.

THE volume referred to in the foregoing note affords convincing evidence of the interest shown in scientific subjects in New Zealand, and it is not unnatural to find that men of science in that colony are beginning to ask that scientific principles may influence the national system of education. Mr. Hill, in a paper on technical education, read before the Hawke's Bay Institute, rightly maintained that "the study of natural science should be fostered even beyond the public school course, and this can readily be done by the introduction of botany, geology, agricultural chemistry, and other cognate subjects into the advanced or secondary course. The maintenance by the Government of technical schools and schools of science and agriculture would give prestige to such institutions, and these, with the university colleges, should supply all the academic, scientific, and technical training that is wanted for the professions and the pursuit of every specialised form of industrial work."

THE council of the Royal Society will proceed on November 5 to the election of a Joule student for the period 1903–5. The studentship will be awarded for investigations in those branches of physical science more immediately connected with Joule's work. Applications from candidates will be received by the Assistant Secretary, Royal Society, Burlington House, London, W.

THE first number of vol. ix. of the *Bulletin* issued by the Società Sismologica Italiana gives the rules of that Society, a list of its members, and a continuation,

up to the end of 1901, of the well-known earthquake register compiled at the Central Meteorological Office in Rome. The late appearance of this publication arises from the fact that with the Italian records there are incorporated corresponding records which have been collected from seismological stations throughout the world. In this publication we therefore have not only entries relating to disturbances confined to the Italian peninsula, but also of practically all the large earthquakes of the world.

WE have received from the Cambridge Scientific Instrument Company its new catalogue of Duddell oscillographs. These instruments were described in detail in NATURE of December 6, 1900 (vol. lxiii. p. 142). Since that time several improvements have been made in their construction which have the effect of making them more trustworthy instruments, and better able to withstand the somewhat rough usage which they are likely to meet with in engineering work. We note also that a double permanent magnet oscillograph is now on the market; this instrument has two sets of strips, and is thus able to show the waveforms of current and P.D. simultaneously; hitherto the portable instrument has only been made with one set of strips. Amongst the illustrations to the catalogue are a number of excellent reproductions of oscillograph records, which serve to show the variety of purposes for which the instrument is suited. One has only to turn to any of the more recent papers dealing with alternate current working to see how important a part the oscillograph is now playing and is destined to play in the future in this branch of electrical engineering.

WE have also received from the Cambridge Scientific Instrument Company a pamphlet describing Prof. Callendar's apparatus for measuring the mechanical equivalent of heat, which was recently described before the Physical Society, and a second pamphlet relating to the application of electric resistance thermometry to meteorology. This latter paper sets forth some of the cases in which the use of resistance thermometers is peculiarly suitable, as, for example, the measurement of water temperatures or underground temperatures. The method can be used with much advantage for measuring or recording temperatures at some distance from the observatory, and has the additional recommendation that the thermometer itself need not be disturbed or approached when the reading is taken. We pointed out some of the other uses of these thermometers in these columns a few weeks ago.

IN a recent number of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale*, M. Charles Henry has an interesting paper on the luminous efficiency of oil lamps and flames generally. He shows that the efficiency increases with the intensity, at first very rapidly, as the intensity rises from 1 to 2 carcels, and then more slowly, becoming practically constant at 3 carcels. The same has been shown to be true for arc lamps, the law of variation being nearly the same in both cases, only the arc lamp naturally varies over a much wider candle-power range; the efficiency does not become a maximum, in fact, until about 600 carcels. If the efficiencies at their respective maxima are compared, the arc lamp is found to be approximately five times as good as an oil lamp, one carcel-second being obtained for an expenditure of 70 watts in the one case and of 320 in the other; this is allowing for the losses in the boiler, engine and dynamo generating the current, and represents, therefore, the actual superiority of the arc over the oil lamp. If, however, the efficiencies at equal candle-power are compared, the oil lamp is three times as good as an arc—but, of course, an arc of 3 candle-power is never used in practice. The efficiency of the oil lamp may be improved 25 to 40 per cent. by surrounding the lower portion of the flame with a copper ring to prevent loss of heat by convection.

IN the *Field* of October 17, Mr. G. Renshaw announces that he has found in the museum of the Royal College of Surgeons a skull of the extinct South African blaauwbok (*Hippotragus leucophaeus*), which is believed to be the only known specimen in existence.

THE *Proceedings* of the Royal Irish Academy for May contain an important paper by Dr. G. H. Carpenter on the relationships between the classes of Arthropods. The author considers that group to have been derived from a single stock, and since typical insects, crustaceans, and arachnids possess the same number of segments, the ancestral type must likewise have been definite in this respect. Consequently, millepedes and the like must be aberrant types in which the segmentation has been abnormally increased. Probably the ancestral forms were naupliform (*i.e.* larval) crustaceans, and not, as commonly believed, well-developed annelid worms.

THE *Illustrated London News* of last week (October 24) contains a special supplement devoted to the first part of an account, illustrated by reproductions from original photographs, of Major Powell-Cotton's recent hunting expedition in Eastern Equatorial Africa. One of the objects of the expedition was, we believe, to obtain specimens of the okapi, but although the celebrated traveller and big-game hunter has been unsuccessful in this respect, he has succeeded in mapping out an extensive tract of hitherto unexplored country, and has likewise acquired much valuable information with regard to the natives and the fauna. It was during this expedition that the two fine giraffes now mounted in the Natural History Museum were obtained. Special interest attaches to the traveller's discovery of a spot to which elephants resort when about to die, the habit on the part of these animals of having a "dying ground" being paralleled in the case of the South American guanaco. The cave-dwellers of Mount Elgon appear to have made a more favourable impression on Major Powell-Cotton than they did on their discoverer, Sir Harry Johnston. One of the photographs shows a native stalking hartebeests behind an ass on the head of which has been fixed the scalp and horns of one of these antelopes. The conclusion of the account will appear in this week's issue.

AT Rossitten, in eastern Prussia, large numbers of crows and rooks are caught alive in nets every year during the two migration seasons. The director of the station of the German Ornithological Society at Rossitten proposes to try a curious experiment with these birds. Small metal rings bearing a number and date will be attached to one foot of each of them, after which they will be liberated and permitted to proceed upon their own paths of migration. Notices have been sent all over Germany requesting that when any of these birds are shot the foot and the ring attached to it may be returned to the director of the "Vogelwarte" at Rossitten. It is quite possible that some of them may stray even as far as the shores of Great Britain, and if this should happen it is hoped that the director's request may be attended to. An accurate record will be kept at Rossitten of the dates of the liberation of every bird and of the locality whence its foot is returned, and it is expected that some interesting deductions will be made from the information thus obtained.

THE small, but well-ordered, zoological garden at Bâle is well worthy of a visit. It is situated in the new quarter of the city beyond the railway station, and has the advantages of a good soil and a clear stream of water running through it. The new lion-house, which will shortly be ready for occupation, is planned on an extended scale, but will not be quite so large as those of London and Berlin. There will be a set of external cages for the animals on the south side, but the interior of the building on the north side will be appropriated to the exhibition of reptiles. There is a fine herd of the American bison, which has frequently bred in this garden, and very good examples of the elk and reindeer, neither of which seem to do well in England. The special pet of the director, Dr. Hagmann, is a young female orang, which has been living at Bâle in good health for more than three years, and is remarkably tame and intelligent. She obeys orders given in German, but has not yet learned to reply to them in that language.

THE geology of the country near Chichester is described in a memoir of the Geological Survey by Mr. Clement Reid, F.R.S., with contributions by Mr. G. W. Lamplugh and Mr. A. J. Jukes-Brown. The memoir, which is accompanied by a colour-printed map (sheet 317), deals with a portion of the South Downs in Sussex, with the picturesque regions of Midhurst, Petworth and Pulborough on the north, and the low-lying fertile tracts of drift gravel and brick-earth on the south. The formations described range from the Wealden to the London Clay, together with Clay-with-flints, certain marine gravels, and other superficial deposits. The price of the memoir is one shilling, and of the map one shilling and sixpence. Both may be obtained from any agent for the sale of Ordnance Survey maps, or through any bookseller from the Ordnance Survey Office, Southampton. For educational purposes this and other memoirs in the same series are invaluable.

THE second part of the general report and statistics for 1902 relating to mines and quarries, edited by Prof. C. Le Neve Foster, F.R.S., and published as a Home Office Blue-book, deals with questions of labour. It gives the facts relating to persons employed and accidents at mines and quarries in the United Kingdom, and to the enforcement of the Mines and Quarries Acts. In 1902, 1061 separate fatal accidents occurred in and about the mines and quarries of the United Kingdom, causing the loss of 1172 lives. Compared with the previous year, there is a decrease of fourteen in the number of fatal accidents and of fifty-seven in the number of lives lost. Three-fourths of the fatal accidents by explosions of fire-damp or coal-dust were due to naked lights, the illegal use of matches, or the illegal opening of a safety-lamp. The worst disaster of the year was the explosion at MacLaren Colliery, Abertysswg, Monmouthshire, where sixteen persons lost their lives and eighteen were injured. In connection with this explosion, Prof. Le Neve Foster remarks, "fortunately the roads were well watered, or otherwise the loss of life would probably have been very much larger"; and in this contention he is supported by Mr. Martin, one of H.M. Inspectors of Mines who reported on the disaster, and concluded his report with the following words:—"This is perhaps the first practical proof of artificial watering limiting the effects of what would otherwise have proved a widespread and much more disastrous affair. It is certainly an object lesson for all colliery managers." Owing to the large number of accidents occurring at quarries from the use of explosives containing nitro-glycerin when in a solid or frozen state, it has been thought desirable to circulate special notices to be posted up on the door of the magazine or store from which the men fetch their explosives. The notice directs that all cartridges made of dynamite, gelignite, blasting gelatin, and other explosives containing nitro-glycerin must always be thawed (in a properly designed warming pan) before use during the months of December, January, February, and March, and also at any other times if the cartridges are not in a soft or pasty condition.

A PECULIAR form of the basidiomycetous fungus *Lentinus lepideus* is described by Mr. W. G. Smith in the *Journal of Botany* (October), in which numerous clavaria-like branches spring from a central club-like portion. Mr. E. G. Baker completes in this number his systematic arrangement of the Indigoferas of tropical Africa.

THE current number (October) of the *Reliquary and Illustrated Archaeologist* contains some notes by Mr. W. R. Prior on an image of the sun found last autumn at Trundholm, in northern Zeeland, and two pictures of the object, one of which is here reproduced on a reduced scale, by permission of the publishers, Messrs. Bemrose and Sons, Ltd. The image is 1 foot 1½ inches broad and 8 inches high, and was found in fragments about six inches under the surface of the ground. It was easily reconstructed by Dr. Sophus Müller, director of the National Museum at Copenhagen, and a full description of the object has appeared in Danish.

Sun Image found at Trundholm, Denmark.

"It has been clearly proved," says Mr. Prior, "an image of the sun being dragged round on a chariot as an object of worship, an idol of the sun-worship dating from about 1000 B.C., and the best of its kind found anywhere, both as regards design and execution. In Egyptian and Oriental mythology, as well as in Grecian, the sun was represented as a round disc, often inlaid with gold. Several pictorial representations of the sun are known from the same period, but none that has any close resemblance to this find. Everything seems to indicate that the find belongs to the older Bronze age, and is of purely Scandinavian origin in its rich ornamental style and artistic workmanship, which appear in northern bronzes of that period."

IN order to obtain flowers out of their natural season, it is possible to retard their growth at an early stage by placing the plants in cold, dry houses, and then to force them later under the influence of heat and moisture, or it is possible to stimulate the young buds into premature development by subjecting them to the effects of ether. M. A. Maumené, a strong advocate of the etherisation system, discusses its scientific and practical aspects in the *Revue scientifique*. He maintains that not only do plants develop more quickly after being etherised, but that development is more regular and complete.

In Japan the custom prevails of burning down yearly, tri-yearly, or at longer intervals the tracts of ground known as "hara," this name being applied to the bare hillsides which have been denuded of trees. One of the first products on these lands is a grass known as "kaya," *Miscanthus sinensis*, and it is with the idea of increasing this crop that the lands are burnt. This fallacy is combated by Mr. O. Shishido in the *Bulletin* of the College of Agriculture, Tokio, where he points out that the *hara*, although favourably situated, are now practically unproductive areas. In the same journal Mr. H. Shirawasa indicates the development of the oil in the camphor-tree which crystallises out into camphor.

A useful little book has been published by the Royal Geographical Society entitled "Hints on Outfit for Travellers in Tropical Countries," by Dr. Charles F. Harford. The hints are of just the practical kind that intending travellers will find serviceable.

A sixth edition of Prof. W. H. Burr's "The Elasticity and Resistance of the Materials of Engineering" has been published by Messrs. John Wiley and Sons, of New York, and Messrs. Chapman and Hall, of London. More than half the book is new, and the advanced matter relating to the general theory of elasticity in amorphous solid bodies, and the theories of torsion and flexure, have been placed at the end of the book as an appendix.

The Bureau of American Ethnology has published a Natick dictionary compiled by the late Dr. James H. Trumbull. In an introduction Dr. Edward E. Hale explains that the dictionary is published as it was left by Dr. Trumbull, whose widow presented the MS. to the American Antiquarian Society. The manuscript was passed to the late Major Powell, who placed it in the hands of Dr. Gatschet, of the ethnologic staff of the Bureau, who has superintended its publication. It is hoped that the book will form the first volume in a series of vocabularies of the native languages.

It has been shown recently that the composition of the surface layers of a solution differs to a slight extent from the composition of the solution as a whole. Experiments made by Miss C. C. Benson with very dilute amyl alcohol, which readily gives rise to a durable foam on shaking, show that this foam is also different in composition from the main solution, the proportion of alcohol being slightly greater in the foam than in the rest of the liquid. The composition of the solutions was determined by surface tension measurements by the drop method.

The problem of turning to practical use the free nitrogen of the atmosphere for the purposes of agriculture and industry is one which has excited attention for many years past. According to a recent communication of Dr. Frank, of Charlottenburg, the fixation of atmospheric nitrogen on a technical scale can be effected through the agency of the carbides of the alkaline earth metals. Barium carbide is especially suitable for the purpose, and by the absorption of atmospheric nitrogen is converted directly into barium cyanide. The reaction with calcium carbide proceeds differently, the product obtained being calcium cyanamide, which, however, by heating with water under high pressure is easily converted into calcium carbonate and ammonia. Experiments have, moreover, shown that the calcium cyanamide can be used directly as a means of supplying nitrogen to the soil.

Although the analogy between asymmetric carbon and nitrogen in regard to optical rotation is assured by the fact that the activity of the nitrogen compounds can be explained by a simple extension of the theory of van 't Hoff and Le Bel, yet previous experiences seem to point to the analogy being very incomplete. The instability and the tendency of the active forms to undergo spontaneous racemisation are conspicuously characteristic of the nitrogen compounds. These properties no doubt depend upon the readiness with which nitrogen passes from the pentavalent into the trivalent form, a transformation which at once destroys the spacial asymmetry. An interesting paper dealing with the subject is published by Dr. Wedekind in the current number of the *Zeitschrift für physikalische Chemie*.

An investigation of the best conditions for the electrolytic refining of copper has recently been carried out by Messrs. F. J. Schwab and I. Baum, an account of which is given in the October number of the *Journal of Physical Chemistry*. The factors which have been taken into consideration are the cost of the power necessary to precipitate a tank of copper with different current densities and at different temperatures, the cost of heating the tank, the deterioration of the electrolyte, the interest charge on the copper in the tank, and the quality of the copper deposited. As the result of a large number of series of experiments, in which the influence of these factors and their correlation were examined, the authors come to the conclusion that in order to operate a plant most economically and to secure the best financial returns, copper should be refined in covered tanks at a temperature of 70° C., with a current density of $3\frac{1}{2}$–$3\frac{3}{4}$ amperes per square decimetre.

The additions to the Zoological Society's Gardens during the past week include two Chestnut-breasted Finches (*Donacola castaneothorax*), a Bicheno's Finch (*Estrelda bichenovii*), fourteen Banded Grass Finches (*Poephila cincta*), eight Gouldian Finches (*Poephila gouldiae*) from Queensland, two Modest Grass Finches (*Amadina modesta*), fourteen Chestnut-eared Finches (*Amadina castanotis*), two Undulated Grass Parrakeets (*Melopsittacus undulatus*), a Peaceful Dove (*Geopelia tranquilla*), a Graceful Ground Dove (*Geopelia cuneata*) from Australia, presented by Mrs. Alfred H. Houlder; an American Bittern (*Botaurus lentiginosus*), captured at sea, presented by Mr. Yeo; two Chameleons (*Chamaeleon vulgaris*) from North Africa, presented by Mr. G. T. Coleman; a Hocheur Monkey (*Cercopithecus nictitans*) from West Africa, a Grey Seal (*Halichoerus grypus*) from the West Coast of Ireland, a Red-fronted Lemur (*Lemur rufifrons*) from Madagascar, an Adelaide Parrakeet (*Platycercus adelaidae*) from Australia, deposited; two Great Kangaroos (*Macropus giganteus*) from Australia, a Banded Cotinga (*Cotinga cincta*) from Brazil, purchased; a Hybrid Waterbuck, between (*Cobus unctuosa* ♂ and *Cobus ellipsiprymnus* ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in November:—

Nov. 3. 3h. 45m. to 7h. 2m. Transit of Jupiter's Sat. III. (Ganymede).
7. 11h. 23m. Minimum of Algol (β Persei).
9. 8h. 43m. to 9h. 28m. Moon occults λ Geminorum (Mag. 3·6).
10. 7h. 26m. to 10h. 44m. Transit of Jupiter's Sat. III. (Ganymede).
,, 8h. 12m. Minimum of Algol (β Persei).
14–16. Epoch of Leonid Meteors (Radiant 150°+22°).
15. 1h. Venus in conjunction with the Moon. Venus 0° 55′ N.
,, Venus. Illuminated portion of disc = 0·429.
16. 6h. 11m. to 9h. 53m. Transit of Jupiter's Sat. IV. (Callisto).
17. 11h. 12m. Transit (ingress) of Jupiter's Sat. III. (Ganymede).
27. 23h. Venus at greatest elongation (46° 44′ W.).
30. 9h. 55m. Minimum of Algol (β Persei).

RECENT SPECTROGRAPHIC OBSERVATIONS OF NOVÆ.—Using the slitless spectrograph recently attached to the Crossley reflector, Prof. Perrine has obtained photographs of the recent spectra of various novæ.

A spectrogram of Nova Aurigæ, taken with a total exposure of 5 hours on August 29 and 30, shows that important changes have taken place in the spectrum of this star since 1901, when the spectrum was photographed by Mr. Stebbins. At that time the chief nebular line at λ 501 was equal in intensity to the lines at λ 462, λ 434, and Hδ, but in the recent photographs it is entirely absent; the other lines are relatively the same, but all appear to have decreased in intensity with regard to the continuous spectrum. This Nova is now of the fourteenth magnitude.

In the case of Nova Persei, a spectrum obtained on July 30, with an exposure of 2 hours 3 minutes, shows that striking changes have taken place since March, 1902. Hβ has decreased greatly in brightness during the interval, and the condensation at λ 434 has also become less marked, whilst Hδ has only suffered the normal diminution in brightness. The lines at λ 339 and λ 346 show the greatest changes, the former having entirely disappeared, whilst the latter is barely distinguishable on the latest spectrogram; the chief nebular line does not appear to have changed relatively to the general spectrum. On July 30 the magnitude of Nova Persei was about 11·5 or 12.

Even in the more recent Nova Geminorum important changes are already noticeable; photographs were secured on August 28, 31, and September 2, and when compared with the observations of May 11 it was seen that during the interval of 3½ months the whole spectrum had become much weaker; the chief nebular line had become much stronger, whilst Hβ had greatly decreased in relative intensity. The line at λ 434 is by far the strongest in the whole spectrum, and that at λ 463 is much broadened and probably composite; there are also indications of the higher hydrogen lines on the background of continuous spectrum. On a number of spectrograms obtained between April 2 and 8 a condensation at λ 350 was a remarkable feature, on April 18 no indications of this condensation were present, whilst on April 26 there was a strong condensation at λ 346, but nothing at all at λ 350; later observations confirm this interesting phenomenon.

Visual observations of the spectrum of Nova Geminorum, made by Mr. H. D. Curtis on August 17 and 18 with spectrograph No. 1 attached to the 36-inch refractor, showed the three chief nebular lines well developed, Hβ faint, the line at λ 4959 rather stronger, and the line at λ 5007, into which the greater part of the Nova's light seemed to be concentrated, very much more intense, whilst D and Hα were not visible. The change of this star into one of the nebular type is apparently now complete (Lick Observatory *Bulletin*, No. 48).

OCCULTATION OF A STAR BY JUPITER.—A communication to the Kiel Centralstelle, published in No. 3903 of the *Astronomische Nachrichten*, announced that Mr. T. Banachiewicz, of the Warsaw University, had observed an occultation of the star B.D.−6°.6191 (mag.=6·5) by Jupiter at about 7h. 10m. (Berlin M.T.) on September 19.

Several observers recorded their observations of this phenomenon in No. 3906 of the *Nachrichten*, amongst others Herr Kostinsky, of the Pulkowa Observatory, who gave the times of immersion and emergence as 20h. 10m. 21s. ±1s. and 21h. 52m. 4s ±1s. (Pulkowa S.T.) respectively.

In a letter to the October number of the *Observatory*, Mr. Denning gives the details of his observations of the phenomenon about half an hour after the probable reappearance of the star, when it was situated at about 10″ from the S.S.E. limb of the planet. He states that the same star will be about 20′ south of Jupiter on December 29 at approximately 10h. G.M.T.

ROTATIONAL VELOCITY OF VENUS.—*Bulletin* No. 3 of the Lowell Observatory contains a description, by Mr. V. M. Slipher, of some experiments made at that observatory in order to determine, by the Deslandres spectrographic method, whether Venus has a short rotational period or not.

The instrument used was the new Lowell spectrograph, made by Brashear, which gives an angular dispersion of 46″·5 for one tenth-metre when set for the minimum deviation of λ 4270. The spectrograph is so attached to the adapter that it may be rotated about the optical axis in order to obtain spectrograms with the slit in various relative positions; the plates used were fine-grain Seed's "23" brand, and were exposed for about 8 minutes during the hour immediately succeeding sunset, whilst the air currents were most quiescent. For purposes of measurement an iron spectrum was photographed on the same plate, and twelve of the finest iron lines were used as fiducial lines. The results obtained show very small probable errors, and indicate that Venus does not possess a short period of rotation. A period of twenty-four hours would cause an inclination of the lines amounting to one-third of a degree, and similar experiments performed on the planet Mars, and published in *Bulletin* No. 4, show that a longer period than this would be clearly indicated by the apparatus and method used.

THE STANDARDISATION OF ELECTRICAL PRESSURES AND FREQUENCIES.

WE have received a copy of the resolutions of the Engineering Standards Committee with reference to standard pressures for direct current and standard frequencies. In view of the importance of the subject to the electrical industry at large, the document is reprinted below in full.

Standard Direct Current Pressures and Standard Frequencies.

The standardisation of electrical pressures and frequencies was the first portion of the important work entrusted to the subcommittee on generators, motors and transformers by the electrical plant committee. The subcommittee consists of the following gentlemen:—

Colonel R. E. Crompton, C.B., chairman.
Colonel H. C. Holden, R.A., Captain A. H. Dumaresq, R.E., representing the War Office.
Commander G. L. Sclater, R.N., Mr. L. J. Steele, representing the Admiralty.
Mr. Llewellyn Preece, representing the Crown Agents for the Colonies.
Dr. R. T. Glazebrook, representing the National Physical Laboratory.
Mr. B. H. Antill, Mr. W. B. Esson, nominated by the Electrical Engineers' Plant Manufacturers' Association.
Mr. A. C. Eborall.
Mr. S. Z. de Ferranti.
Mr. Robert Hammond.
Captain H. R. Sankey.
Mr. C. H. Wordingham.
Mr. Leslie S. Robertson, secretary.
Mr. C. le Maistre, electrical assistant secretary.

At an early stage in their deliberations, the subcommittee decided that the most advantageous method of approaching this problem, beset as it is with so many difficulties, would be from the point of view of those most affected, namely the users of lamps and of motors for power purposes. It was therefore agreed that the standard pressures to be suggested should be measured at the consumers' terminals as settled by Act of 1899.

At the present time there exist many different pressures declared by the various lighting and power authorities. In view of the great desirability of obviating this unsatisfactory state of affairs it was deemed advisable to suggest the minimum number of standard pressures which would best meet present commercial requirements and, at the same time, utilise to the fullest extent the consumers' existing appliances.

After careful consideration, it became evident to the subcommittee that the direct current pressures of 110, 220, 440, and 500 volts would best meet the requirements, because carcases built for these standard pressures could be utilised for pressures 10 per cent. above or below the suggested standards, without any alteration whatever in the castings or mechanical components, by merely altering the windings and excitation.

It is to be hoped that now these direct current pressures have been fixed as standards by the committee, they will in future be universally adopted by the engineers advising

corporations and others distributing electrical energy. In course of time the benefits to the electrical industry at large, which will certainly follow the adoption of these standard pressures, must become more and more apparent.

A circular was drafted embodying the suggestions of the subcommittee, and this was submitted, first to the manufacturers for their consideration, and secondly to the leading consulting engineers and users of motors.

The information so courteously placed at the disposal of the subcommittee by the consulting engineers and manufacturers was most carefully weighed and considered by the subcommittee, and certain definite conclusions were arrived at, the circular being sent, in the first instance, to the manufacturers, as they were the people most directly interested. Replies were received from all the leading firms, who expressed themselves unanimously in favour of the recommendations of the subcommittee. The consulting engineers similarly gave their adherence to the proposals of the subcommittee.

Before coming to their final decision the subcommittee on generators, motors and transformers conferred with the subcommittee on electrical tramways, of which Mr. A. P. Trotter is chairman, and a joint meeting took place, with the result that the pressure of 500 volts, which most concerned the latter subcommittee, was agreed to, and in addition to the pressures already agreed to 600 volts was decided upon as the standard pressure for electrical railways.

The question of the adoption of standard frequencies, although of equal importance with that of standard pressures, was not surrounded with the same difficulties. It was, however, deemed advisable to fix upon the standard frequencies at the earliest possible stage of the work, as no progress could be made in the standardisation of prime movers for driving alternate current machinery until such time as the frequencies had been settled upon. On this question there appeared to be a great preponderance in favour of frequencies of 25 and 50. The only point upon which any serious difference of opinion appeared to exist was the advisability of the adoption of a third frequency of 40 or 42, to enable rotary converters to be used to the fullest advantage. All the arguments in favour of this third frequency were fully discussed, but after carefully weighing the *pros* and *cons* the subcommittee decided not to recommend the adoption of more than two frequencies, namely, 25 and 50.

The recommendations of the subcommittee were then submitted to the electrical plant committee, the publication committee, the main committee, and the Board of Trade for their approval.

This having been obtained, it was deemed advisable, in the interests of the electrical industry of the country, that the findings on the questions of direct current pressures and frequencies should be published at an early date, without waiting for the completion of the entire report to be issued at a later date.

The following are the resolutions on standard direct current pressures and standard frequencies :—

(1) That the standard direct current pressures, measured at the consumers' terminals, be :—

110, 220, 440, 500 volts.

(2) That the standard direct current pressures, measured at the terminals of the motors, be :—

For tramways 500 volts.
For railways 600 volts.

(3) That 25 periods per second be the standard frequency for :—

(*a*) Systems involving conversion to direct current by means of rotary converters.
(*b*) Large power schemes over long distances.
(*c*) Three phase railway work, where motor gearing and the inductive drop on the track rail have to be considered.

(4) That 50 periods per second be the standard frequency for :—

(*a*) Mixed power and lighting on town supply mains.
(*b*) Ordinary factory power plant.
(*c*) All medium size power plant where rotary converters are not employed.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THE present transitional phase of geographical thought and activity was faithfully mirrored in the proceedings of Section E. The majority of the papers revealed the wide range of geographical interests rather than any great advance in geographical coordination. In this they are typical; for while there are many workers at geographical problems, few, if any, would put forth the claim of being complete geographers. There are indications of many geographical specialisms being recognised. Their exponents are, however, at one disadvantage when compared with other specialists. An organic chemist usually has had a thorough training in chemistry before he specialises in organic chemistry. Few geographical specialists have had any training as geographers. Each makes his own contribution, but it is often an isolated one, and does not fit into a general plan of the subject. The unity of geography and the relation of its parts are very gradually being elucidated. The want of this coordination is strongly felt by most geographical workers. At the conclusion of the Southport meeting one wished for a summary coordinating the communications discussed. Perhaps this is felt, though to a less extent, in other sections, and it would be useful if the presidential duties were made to conclude by the giving of a brief review of the work done at the section.

The address of the genial president, Captain Creak, was the only one which surveyed the whole world. It was on terrestrial magnetism, and has already been printed. Dr. Vaughan Cornish's researches, summarised in the report of the committee on terrestrial surface waves, are on world-wide phenomena, which he illustrated on this occasion mainly by beautiful views of the wave forms of Niagara, from which he has recently returned, and by pictures of wave forms in snow and on quarry roads caused by heavy sledge traffic.

The section was also privileged to hear an address from Prof. Pettersson, of Stockholm, who spoke for an hour in excellent English, on the effect of ice melting on oceanic circulation. Prof. Pettersson has long insisted that the thermodynamic cycle of latent heat, consisting of ice formation in polar regions and of ice melting in sea-water in lower latitudes, was a potent cause of oceanic currents. He has calculated that the ice melting between Iceland and Jan Mayen generates about 400,000 horse-power annually, which is expended in accelerating the water movements of the east Iceland polar current. The energy set free on ice melting in sea-water maintains a kind of inverted waterfall, an upwelling of bottom water to the surface. Warm currents follow the trend of deepest isobaths, ice currents exist only in shallow seas, where no warm current can melt them. Ice currents and warm currents meet between Iceland and Jan Mayen, west of Spitsbergen, south-east of Newfoundland, and round the margin of the ice-girdled Antarctic. The "outbursts" of Antarctic icebergs which carry them to low latitudes in the Indian Ocean may influence the climate of India and Australia. The latest Antarctic outburst and series of great droughts in India occurred between 1891–98. Prof. Pettersson considered that regular surface observations between 60° and 100° E. and a few series of deep-sea soundings would reveal hydrographical variations with important meteorological bearings. He also pointed out that current measurements at depths of 800–4000 metres in the Atlantic were needed to ascertain the significance of the currents generated by ice attraction. At the conclusion of his paper Prof. Pettersson showed in miniature an experiment to illustrate the effect of melting ice in causing currents in salt water carried out by Mr. J. W. Sandström, assisted by Miss A. Palmquist, who have made a series of useful calculations from the data obtained from this experiment.

Travellers' tales were few, but full of human interest. No one who heard Lieutenant Shackleton will forget the vivid and racy account he gave of the National Antarctic Expedition. Dr. Tempest Anderson's slides and descriptions of the volcanic phenomena of St. Vincent and Martinique were equally effective. Lieut.-Colonel Manifold described his journeying from India across China, and back over different routes through the heart of the Empire. In his paper were many hints of the great activity of other Powers

than Britain in pushing on railway construction and promoting the expansion of their commerce. Dr. H. O. Forbes read a report on the work of his expedition to Sokotra. Dr. J. P. Thompson, the energetic Queensland geographer, contributed a comprehensive account of the geography of the State.

Exploration is now no longer confined to foreign lands, and some of the younger botanists have shown us what can be done when the plant world at home is regarded geographically. From the point of view of pure science they are making an important contribution to the study of the relationship between organisms and environment, and compiling part of the data necessary for the study of macro-organisms—the complex associations of rock, air, water, and organic life considered as a whole, which are the subject-matter of the geographer. From the point of view of applied science they are carrying out an equally valuable work, for a knowledge of the characteristics and distribution of the different plant associations is the best clue to the possibilities and limits of their profitable exploitation for the production of economically important plants and animals. Such botanical surveys might well be subsidised by the Board of Agriculture. The example of the Canadian Geological Survey might be followed, and the work be entrusted to teachers of botany who would carry it out in their vacations.

Dr. Otto Darbishire, of Owens College, discussed the general problem of the relations of botany and geography, and insisted on the necessity for modern travellers having a knowledge of ecology. Dr. W. G. Smith, of the Yorkshire College, who has carried on the work of his deceased brother, who planned a botanical survey of Great Britain, also urged the importance of the observation and mapping of vegetation features in geographical exploration, and illustrated his thesis by reference to the maps already made for Britain. The maps made of the plant associations of the Eden, Tees, Tyne, and Wear basins by Mr. F. J. Lewis, of University College, Liverpool, were shown and described, and Mr. Moss discussed the age and origin of the peat moors of the southern Pennines.

One of the applications of botanical geography to practical affairs was well illustrated in a valuable paper by the chief engineer of the Liverpool Waterworks, Mr. Parry, who has been the pioneer in the afforestation of the catchment areas of water reservoirs, which has been proved to increase the purity of the water supplied to the citizens and to protect their pockets. Mr. E. D. Morel also discussed a problem in applied geography. He pointed out the value of West Africa for the production of raw cotton, and the results that had been obtained by appealing to the commercial instincts of the natives instead of having recourse to coercion. The importance of a study of native land and administrative systems was emphasised.

Mr. E. A. Reeves read a timely paper on the nature of geographical surveying suited to present requirements, when route charts must be replaced by maps based on surveys planned on scientific lines, while not so elaborate or accurate as large trigonometrical surveys. Mr. E. Heawood contributed the one paper on the history of geography. He discussed the newly discovered maps of Henricus Glareanus, who first described a convenient method for constructing the gores of a globe. One of his maps is the earliest known which shows a hemisphere on an equidistant polar projection.

The geography and education sections held a joint sitting to discuss geographical education. Mr. H. J. Mackinder opened with an eloquent exposition of the regional method of teaching geography and of the possibility of weaving into the regional treatment so much as is needed of other sciences by taking these one at a time in the successive stages of the strictly geographical argument. He submitted that geography could be placed in its rightful position only by the simultaneous application of a four-fold policy:—(1) The encouragement of university schools of geography where geographers should be made, of whom many would become secondary teachers; (2) the appointment of trained geographers as teachers in our secondary schools, either for geography alone or for geography and general help in other subjects; (3) the general acceptance of a progression of method in the subject, not expressed in detailed syllabuses issued by the State or other dominant authority which would tend to stereotype teaching, but in a tradition similar to that which at different times has governed the teaching of language and mathematics; (4) the setting of examinations by expert geographical teachers.

Mr. Hugh Richardson gave a valuable account of how he taught his pupils from thirteen to seventeen years of age the use of maps and books, and insisted on the value of laboratory work on which their books gave little help. Mr. Hewlett spoke of aims and difficulties in the teaching of geography, and Mr. Cloudesley Brereton of geography in secondary education.

In the discussion which followed, the main objections urged against Mr. Mackinder's ideas were that sufficient time was not allowed for carrying them out, and that it was impossible to adopt his suggestion that pupils should be grouped in special sets for the geography lessons. The need for teachers who have had a training in geography, and the value of geography as a coordinating subject in the curriculum, seemed to be recognised by all.

A. J. H.

ENGINEERING AT THE BRITISH ASSOCIATION.

THE section had a lengthy programme to work through at Southport, but it must be confessed that there were but few papers of outstanding importance.

On Thursday, September 10, after Mr. Hawksley's presidential address, which naturally dealt mainly with the problem of the supply of water to cities and villages, a paper was read by Mr. C. A. Brereton on the new King Edward VII. bridge over the River Thames, at Kew. The author showed some interesting lantern slides to explain more clearly the method of construction adopted in previous bridges which crossed the river at this site, and also in the case of the new structure. It was not until 1892 that, induced by the increase in the traffic and the inconvenience caused by the narrowness of the old bridge and the steepness of its gradients, the County Councils of Surrey and Middlesex decided to take steps to replace the bridge by a new one; the necessary Act of Parliament was eventually obtained in 1898, the contract was then let to Mr. Gibb, and the work was begun at once.

The bridge consists of three elliptical arches, the centre one being of rather longer span than the two side arches; it has a span of 133 feet, and a headway of 20 feet above Trinity high-water mark, while the two side spans are only 116 feet 6 inches in span, with a headway of 17 feet. The piers from which these three arches spring are carried down into the solid London Clay at a depth of 18 feet below the bed of the river. The width of the carriage way is 36 feet, and there are 9 feet 6 inch footways on either side; the maximum gradient is only 1 in 40. The whole of the arches, and the exterior of the piers, is constructed of solid granite, chiefly Cornwall and Aberdeen, many of the big stones weighing as much as 8 tons each. To provide for the traffic during the construction of the new bridge, a temporary timber bridge was put up alongside the old one; this was completed in the remarkably short time of six months. The cofferdams for the piers of the new bridge were started in December, 1899, and but little difficulty was met with in their construction. All three arches were constructed simultaneously, and therefore it was necessary for all the stones for the arches to be brought on to the ground before the turning of the arches was commenced; every stone was numbered and placed in the receiving yard ready to take its place in the work. The masonry of the arches was commenced in May, 1902, and completed in December of that year—an extremely expeditious piece of work. The total length of the bridge proper is 502 feet, the approaches on the Middlesex and Surrey sides bringing the overall length to 1182 feet. The bridge was opened by His Majesty the King on May 20 last, having taken about three and a half years to construct; one year was occupied in the construction of the temporary bridge and the removal of the old bridge.

The only other paper dealt with on the Thursday was an interesting contribution by Mr. J. Harrison—illustrations of graphical analysis. The author gave an account of a simple graphical method of obtaining equations for the displacement of the valve, and for the sliding of the block in the link in an ordinary Stephenson's link gear. In fact, it

was a graphical method of analysing a Fourier series, the author's methods being exceedingly neat and handy, but requiring very exact and careful draughtsmanship.

The first paper taken on Friday, September 11, was specially written in order to prepare members for the visit of the section on Saturday to the new Manchester Municipal Technical Institute. Principal J. H. Reynolds gave, with the aid of a number of lantern slides, an interesting account of the construction and equipment of this great technical institute. The author's paper was practically a defence of the methods which have been adopted in connection with the equipment of the engineering and other departments of this Institute; the authorities have been attacked for fitting up their laboratories with unnecessarily complicated apparatus, probably beyond the capacity of the class of students they are likely to have, and it must be admitted that there is some justification for this criticism. Members of the section were better able to form their own opinion on this controversy after the visit on Saturday. As regards the strength of materials laboratory, the machines are those ordinarily employed, with the addition of a very powerful appliance for compression purposes, but as it happens to be extremely simple in construction, being nothing more or less than a modified cotton press, it can be used as easily by students (though its capacity runs into hundreds of tons) as if it were a machine of only a few tons capacity. In the steam engine laboratory, however, there is no doubt that the experimental engine, a fine piece of design due to Prof. Nicolson, is on too big a scale for teaching purposes; it may be an admirable instrument for research in the hands of Prof. Nicolson, and therefore the authorities of the college may be justified in the expenditure which must have been incurred both in the original purchase of this engine and in its working expenses, but for the instruction of the students likely to frequent such a technical institute, it would have been far better to have provided half a dozen engines, each, say, of 10 to 15 horse-power, and each of a different type. The changes in essential points in the design of prime movers of all kinds, and in fact of most machinery, come so rapidly, that if a college is to keep its equipment up to date, it should not be of too expensive a character, as it will be necessary pretty frequently to scrap apparatus, and replace it by newer plant more in accordance with the practice and design of the day. Another criticism which might be offered upon the equipment of the whole college is that too much apparatus has been put in at once; it would have been undoubtedly wiser to have arranged for the equipment to be gradually and steadily increased year by year as the number of students increased, and the demand for such increased apparatus arose.

At the conclusion of this paper, and after a brief discussion, the report of the committee on the resistance of road vehicles to traction was taken, and the committee was reappointed for another year. The work of this committee is of such great importance that it will be desirable to direct attention to this report and the work carried out by the committee a little later on in a special article.

Mr. T. Clarkson's paper on improvements in locomobile design was then read. The author is a strong supporter of steam-driven cars; he claimed that there was greater trustworthiness in the case of steam, more certainty in action, more reserve power, that it would to a great extent render unnecessary expensive change speed gears, and that by the use of liquid fuel, burnt in scientifically designed furnaces, there was no smoke and no trouble from the smell produced during the process of combustion. The paper was full of descriptions of exceedingly clever details, such as an ingenious method of automatically controlling the feed when going down or up hill, the pumping of oil under pressure to lubricate every bearing and every moving part, the use of metallic packing, necessary on account of superheated steam being used in the cylinders, and other ingenious devices. If the steam car is ever to be a formidable rival of the oil-driven car, it will certainly be due to the labours of such indefatigable scientific workers as Mr. Clarkson.

The remainder of the day was devoted to a discussion, opened by Lieut.-Colonel Crompton, on the problem of modern street traffic. Unfortunately the discussion came on so late that many had gone away for the day who might otherwise have taken part in it, and no very practical suggestions were made by any of the speakers except that further attention should be paid to the regulation of slow, heavy traffic. It is, however, after all a moot question whether there is so much street obstruction or so much difficulty with the control of modern street traffic as the daily Press would make us believe. Apart from a few of the main thoroughfares in London itself, there is very little delay in our cities caused by congestion of traffic, except in exceptional circumstances and on exceptional days. Colonel Crompton alleged that electric trams were as slow as the old horse omnibuses; if so, his experience of such trams must be very unfortunate; certainly this is not the experience of most people, and in towns like Glasgow, Manchester, and Liverpool, the introduction of electric traction has certainly much increased the speed at which one can pass from one part of the town to another, and in these cities the problem of street traffic is not complicated as it is in a few of the leading thoroughfares in London by the crawling cab nuisance. Probably without inconvenience to the general public many of the cabs in London might be withdrawn, and certainly by a judicious arrangement of underground tube railways, and by the extension of the electric tramway service, the greater part of the cumbersome, slow-moving, obstructive omnibuses might be driven from the streets, and it is in this direction, rather than in expensive widenings and overhead bridges, that the problem of congestion in the central streets of London will have to be met.

Monday, September 14, was devoted almost entirely to electrical papers. The first of these was one by Mr. W. B. Woodhouse on protective devices for high tension electrical systems. The author, who has had considerable experience in work of this nature, briefly described the necessary protective appliances, such as circuit breakers and the devices for preventing or relieving excessive rises of pressure, which are required in high tension electrical power systems. He described several fuses and switches and overload relays which had been found effective in actual practical operation; as regards switches, he was of opinion that the oil-break switch did break circuit at the moment of zero current, and that for this reason it was the one which should be generally adopted. This paper led to an interesting discussion, in which Mr. G. Kapp and Prof. Ayrton were the chief speakers.

Then followed two papers on aluminium as an electrical conductor, one by Mr. J. B. C. Kershaw and the other by Prof. Wilson. Both authors have been experimenting on the effects produced by exposure of aluminium wires and rods to atmospheric influence. Mr. Kershaw's experiments have been conducted on the Lancashire coast, just south of Southport, and Prof. Wilson's in London, on the roof of King's College. Both experimenters found that the aluminium had suffered considerably; Mr. Kershaw found serious corrosion due to the sea air, especially on the under side of the wires, where drops of water had hung for a long time. Prof. Wilson's experiments were a continuation of an earlier series of tests which were described at a previous meeting, and dealt with the effect of atmospheric corrosion on the conductivity of the metal; the later experiments confirm the results obtained in the earlier ones, namely, that an alloy of aluminium with copper alone was inadvisable for electrical purposes when exposed to the atmosphere, as its conductivity diminished steadily, though more slowly after a time.

Of the other papers taken, the most important was that by Mr. B. Hopkinson on the parallel working of alternators; the paper—a highly technical one—it is impossible to summarise. The author dealt with the practical problem of keeping the oscillations, with their accompanying fluctuations in the flow of energy to or from the main or 'bus bars, within moderate limits, and he treated the matter both from the mathematical point of view and in its practical applications.

On Tuesday, September 15, a lengthy programme was dealt with, and we can only refer to a few of the papers. Mr. W. F. Goodrich, in a paper on twenty-five years' progress in final and sanitary refuse disposal, gave some valuable figures as to the progress which has been made in this branch of sanitary engineering. No less than 180 towns are now using destructors; in 63 of these the steam generated is used in electricity works, and in 40 in connection with the pumping plants of the town sewage works, while in 3 cases the power available is utilised by water-

works pumping engines. As a result of numerous tests it might be roughly estimated that every ton of refuse burnt generated about one ton of high pressure steam, and that with the modern high temperature destructor cells the smell and dust nuisances were practically banished.

Liquid fuel was the subject of Mr. A. M. Bell's communication; much information was given as to the various sources of supply and also as to the best types of oil-burning apparatus, and the author quoted some striking figures obtained in recent tests. In a test at Messrs. John Brown and Co.'s works, 16.09 lb. of water were evaporated per pound of Texan oil burnt, the boiler having an efficiency of 84 per cent.; of course a certain proportion, the author says never more than 3 per cent., of the steam is needed for spraying the oil; with a Stirling boiler, which had an evaporation at standard conditions of 10.55 lb. of water per pound of Welsh coal burnt, the evaporation had been increased to 15.42 lb. per pound of Texan oil, when the furnace was suitably modified for oil consumption. It was pointed out in the discussion that still more economical results could be obtained when this oil was used in internal combustion engines.

Dr. H. R. Mill gave the section some interesting data as to the rate of fall of rain at Seathwaite, and pointed out that in these west coast regions of heavy annual fall the maximum rate of fall was nothing like so great as may occur during heavy summer thunderstorms in drier parts of the country, where it may equal at times 3 inches in the hour.

The last paper of the day was one by Mr. R. Pearson on natural gas in Sussex, and it will astonish most persons to learn what a large amount of gas is now obtained in this district. At Heathfield some eighty houses are using it for lighting and heating purposes, and gas engines utilising it develop a horse-power on a consumption of about fifteen cubic feet of the natural gas per hour. With the development of the Kentish coal-fields and the Sussex gas and oil-fields, both by no means improbable in the early future, there is no doubt that the south-eastern corner of England would undergo an industrial revolution; much as one might regret to see its lovely rural and pastoral character disappear, everyone would welcome the advent of manufacturing industry into this somewhat sleepy corner of the kingdom.

The section had, in consequence of its lengthy programme, to sit on the morning of Wednesday, September 16, when a number of very interesting communications were dealt with. Members of the staff of Messrs. Willans and Robinson contributed two papers—Mr. C. H. Wingfield described experiments on the permanent set in cast-iron as bearing on the design of piston-ring springs, and Mr. Izod a piece of apparatus for testing the brittleness of steel. Both papers are the outcome of the constant experimental research going on in the modern up-to-date engineering workshop, and are a sufficient answer to the reproaches of those who, knowing little or nothing of what they write about, are constantly declaring that trade is leaving the country owing to the apathy and stupid conservatism of our manufacturers. Both communications should be carefully studied by those engaged in the study of the strength of materials.

Mr. W. Odell described some experiments he had carried out to determine the power wasted by the windage of fly-wheel and dynamo armatures, and he stated that a 9-foot disc running at 500 revolutions a minute would absorb about 10 H.P. Mr. W. Cramp read a paper on single phase repulsion motors, a matter of great practical importance in electric tramway work; he claimed that the problem had been solved, and that a single phase alternating current motor had been designed quite equal to a direct current motor.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE anthropological section met in the Town Hall, Southport, under the presidency of Prof. Johnson Symington, F.R.S., of Queen's College, Belfast, and, as usual, attracted large audiences. The programme was a full one, and the principal communications were in the department of Egyptian, Mediterranean, and British archæology, a fact which is partly attributable to the widespread feeling—very clearly expressed by the President of the Association in the course of one of the discussions—that the human sciences, in the older and more academic sense, fall properly within the scope of the Association's work, and merit scientific recognition.

Most important, perhaps, among these new accessions to the section's programme was the group of papers on work in Roman Britain, an area where a subject, which elsewhere can be treated in the full light of written history, has to be explored almost wholly by the methods of prehistoric archæology; and the appointment, with a small grant, of a committee of the Association "to cooperate with local effort on Roman sites in Britain" cannot fail to strengthen both the subject and the section at large.

The president's address, which dealt with the relations between brain and skull, and with the problems which result, has been already printed in full (October 1, p. 539), and gave a broad and philosophic tone to the opening discussion; but the subsequent papers on points of anthropography dealt almost wholly with detailed work of a somewhat specialist kind. Dr. Wm. Wright's account of the skulls from round barrows in east Yorkshire, now in the Mortimer Museum at Driffield, led to the conclusion that the old dictum enunciated by Thurnam—"round barrow, round skull"—is not even approximately accurate for this area, for the cephalic index ranges from 69 to 92, and almost all the European varieties of cranial shape are represented. A marked resemblance, however, was frequently noted between the skulls from any one barrow.

Mr. W. L. H. Duckworth's investigation of the physical anthropology of Crete and Greece, though still incomplete, has brought together a large mass of new material of many periods for the reconsideration of the ethnology of the Ægean area. The bones from the pre-Mycenæan ossuaries of Palæokastro, in eastern Crete, show a purely Mediterranean type, which is shared by those from Mycenæan interments on the Greek mainland; whereas even in Crete, and universally on the mainland, the modern population betrays by its brachycephaly a large admixture of Albanian, Venetic, or Slav intruders. Eastern Crete, however, is more brachycephalic now than the central districts, and this Mr. Duckworth is inclined to attribute to intrusions from Asia Minor. A further grant made by the Association will, it is hoped, enable Mr. Duckworth to continue this very promising inquiry.

Dr. E. J. Evatt's observations on the pads and papillary ridges on the palm of the hand showed that the fœtal disposition of these pads resembles that in the mouse and some other lower animals, which is probably morphologically equivalent. In the adult the pads are to be regarded as vestigial. The papillary ridges are produced by the invasion of the corium by the underlying layer; the interlocking of the two probably serves to connect them more strongly; and the patterns are due to the stresses of prehension acting on ridges which originally lay transversely.

Mr. N. Annandale, in describing a collection of skulls from the Malay Peninsula, noted the great development of the cerebellar part of the occiput, and a widespread abnormality of growth of the third molar.

The committees on a pigmentation survey of the school children of Scotland, and on anthropometric investigations among the native troops of the Egyptian Army, presented interim reports of a formal character. In the latter case the 17,000 measurements already taken cannot apparently be worked up for publication without expert clerical assistance, and it is much to be hoped either that this may be provided without undue delay, or that the committee may see its way to hand over its data to one or other of the biometrical centres which have such assistance at their disposal.

The committee appointed to organise anthropometric research presented a short but very useful report. A single year's work has sufficed to collect and collate the experience of practically all the centres at which anthropometric work is being carried on, as to objects of research, methods, instruments, schedules, and the like, and it is next proposed to inquire under what conditions of maintenance and administration a collection of anthropometric statistics could be established as the nucleus of more systematic investigations. The preface to the report, by Prof. Cleland,

the chairman of the committee, is a valuable summary of the objects and methods of anthropometric work.

The president's brief account of Grattan's craniometric methods illustrates well the need for some such coordination of inquiry as the above-named committee proposes to supply. Grattan's work in radial craniometry, and his very ingenious craniometer, which is now in Prof. Symington's keeping, remained unpublished and unknown until long after similar methods had been rediscovered independently by other workers.

In general ethnography the papers were also few and of various quality. Dr. W. H. R. Rivers's researches on the psychology and sociology of the Todas formed the subject of a committee report, which was supplemented by two papers on special points by the investigator. By the same genealogical method as he employed in Torres Straits, Dr. Rivers has succeeded in unravelling the complicated scheme of kinship and marriage restrictions. This system is of the kind known as "classificatory," every male of an individual's clan being either his grandfather, father, brother, son, or grandson, and so forth. Marriage is regulated by kinship, being prohibited between the children of brothers and between the children of sisters, but being customary between children of brother and sister, and when a girl becomes the wife of a boy she is understood to become also the wife of his brothers. Infanticide certainly was practised formerly, but it is strenuously denied now.

In a separate paper Dr. Rivers described the elaborate ritual of the Toda dairy, in which the dairyman is the priest, and the whole industry endued with a religious character.

The account of the ancient monuments of northern Honduras, &c., presented by Dr. T. W. Gann, described a large number of temples, pyramids, fortifications, underground buildings, monoliths, and ancient enclosures for various purposes, and also the pottery, implements, and ornaments attributable to their builders; with notes on the burial customs and general civilisation of the ancient inhabitants, and observations on the modern ethnography and of the influence of European civilisation on the aborigines.

Dr. J. E. Duerden communicated a note on a type of wooden image which is widely distributed in cave deposits in the West Indian islands.

Miss Pullen Burry's account of the rapid evolution of the Jamaica black gave a favourable picture of the social condition of the negro population. Obeah-worship is practically extinct, peasant-proprietorship has inspired a taste for agriculture, and life and property are safe even in the remoter districts.

Mr. C. Hill Tout and Mr. David Boyle sent papers on the ethnology of the Siciutl Indians of British Columbia and on the Canadian Indians of to-day, but the committee on an ethnographical survey of Canada, of which they are members, presented no report this year.

An account of the legends of the Dieri and kindred tribes of Australia, by Messrs. A. W. Howitt and Otto Siebert, contained much new and valuable matter, but did not lend itself to presentation in full. It will be published shortly in the *Journal* of the Anthropological Institute.

Other papers, of a more or less ethnographical character, raised questions of general importance, and provoked useful discussion.

Mr. W. Crooke's examination of the progress of Islam in India and its causes laid stress on the successful Mohammedan propaganda, which, together with the higher social status of the caste-free Mohammedan, has resulted in considerable conversion of Hindus to Islam, and also on the circumstance that hereditary vigour, maturer marriage, and more varied and invigorating diet tend to make the Mohammedan individual more fertile and more long-lived than the Hindu.

Prof. R. S. Conway, in discussing the ethnology of early Italy and its linguistic relations with that of Britain, dealt almost wholly with the linguistic evidence of early Italian place- and tribe-names, recurring thus, after a considerable interval, to a department of anthropological inquiry which has been overmuch neglected in this section. He distinguished two main sets of ethnics, one ending in -CO the other in -NO. The occurrence of ethnics in -CINO (*i.e.* -NO superimposed upon -CO) shows that the -NO stratum is the later, and its geographical distribution leads Prof. Conway to connect it with the irruption of the northern group of peoples into Peninsular Italy, who had knowledge of iron and buried their dead. To these, contrary to the view of Mommsen and his school, Prof. Conway holds that the *Romani*, or at all events their aristocracy, belonged, and he explains the peculiar geographical distribution of the Italic dialects of Umbria and the Volscian area by the probable effects of this northern invasion, coinciding, as he supposes, in point of time with the Tyrrhenian colonisation of Etruria. He compares the linguistic contrasts which separate the -CO and -NO folk in Italy with those which distinguish Goidels and Brythons in north-western Europe, and suggests that the westward and the southward movements which can be traced are to be referred to the same centre of disturbance.

Mr. D. MacRitchie argued, from the survival of the use of skin-covered canoes in N.W. Europe, to the existence of a racial type of Mongoloid Europeans. It should be noted, however, that one might sit in a skin-covered canoe without having Mongoloid physique.

In contrast with the somewhat meagre output in ethnography, the archæological communications were unusually numerous and attractive.

Mr. Llewellyn Treacher's paper on the occurrence of stone implements in the Thames Valley between Reading and Maidenhead (read also in Section C), and Mrs. Stopes's account of her late husband's collections from implementiferous gravels at Swanscombe, in Kent, summarised much useful work on limited areas. Mrs. Stopes's other paper, on saw-edged palæoliths, submitted a wide induction from copious data; so copious and varied, indeed, that the preliminary question intruded itself whether nature, as well as man, had not some hand in their preparation.

Mr. Annandale was on safer ground in his collection of survivals of primitive implements in the Faroes and Iceland, and exhibited a great variety of types. Their distribution is by no means uniform, those found in the Faroes being generally absent from Iceland, and *vice versâ*. Mr. Annandale suggests that this may be due to differences in the history of the original settlers in the two areas.

A paper by Mr. G. Clinch described the megalithic monument of Coldrum, in Kent, which comprise a central cromlech, without capstone, but with a double chamber, and an irregular line of large blocks of stone on the western side, with traces of a tumulus. No excavation has been attempted as yet, and the monument is partly destroyed by a cart-way, but the author compares it with a larger megalithic structure, of Neolithic date, at Sievern, in Hanover, and concludes in favour of a late Neolithic date for Coldrum. He lays stress on points of similarity which he detects between Coldrum and Stonehenge. Discussion and criticism were impaired in this, as in some other cases, by the absence of the author.

Mr. H. Balfour gave an account of a model of the Arbor Low stone circle, which had been prepared by Mr. H. St. G. Gray as the outcome of the recent excavation of this monument by a committee of the Association. It would be well if every such excavation were so conducted as to permit a similar reproduction for convenient reference hereafter.

Prof. W. Ridgeway offered a suggestive theory of the origin of jewellery, namely, that mankind was led to wear such objects by magic rather than by æsthetic considerations.

All peoples value for magical purposes small stones of peculiar form or colour long before they can wear them as ornaments; *e.g.* Australians and tribes of New Guinea use crystals for rain-making, although they cannot bore them. So, in Greece, the crystal was used to light sacrificial fire, and was so employed in the Church down to the fifteenth century. The Egyptians under the twelfth dynasty used it largely, piercing it along its axis. From this bead came the artificial cylindrical beads made later by the Egyptian, from which modern cylindrical glass beads are descended. The beryl, a natural hexagonal prism, lent itself still more readily to the same form, and the cylinders found without any engraving on the wrists of the dead in early Babylonian graves had a similar origin. The Orphic Lithica gives a clear account of the special virtue of each stone, and it is plain that they acted chiefly by sympathetic magic. The Greeks and Asiatics used stones primarily as amulets, and to enhance the natural power of the stone a device was cut on it. The use of the stone for sealing was simply secondary, and may have arisen first for sacred purposes.

Shells are worn as amulets by modern savages, *e.g.* cowries in Africa; red coral is a potent amulet worn by travellers by sea; pearls are a potent medicine in modern China; seeds of plants are medicine everywhere; and the claws of lions are worn as amulets all through Africa, and are "great medicine," and imitations of them are made.

When gold becomes first known it is regarded exactly like the stones mentioned. Thus the Debæ, an Arab tribe, who did not work gold, but had abundance in their land, used only the nuggets, stringing them for necklaces alternately with perforated stones.

Magnetic iron and hæmatite were especially prized, the power of attraction in magnetic iron, as in the case of amber, causing a belief that there was a living spirit within. Hence iron in general was regarded with peculiar veneration, and not because it was a newer metal, as is commonly stated.

In a paper on the origin of the brooch, and the probable use of certain rings at present called "armlets," Mr. E. Lovett suggested, as the prototype of the ring-and-pin contrivance for fastening a cloak, the use, by a hunting people, of the mammalian *Os innominatum* and *Os calcis*. He noted, further, that very many rings of early date, usually described as "armlets," are too small to allow the entrance of a hand. As such rings are frequently found associated with pins of similar materials, commonly regarded as "hair-pins," and as ring and pin are sometimes found *in situ* on the breast of a skeleton, he infers that they represent a simple ring-and-pin fastening of the kind described above. An apron-fastener of this type, composed of an iron ring and a horse-shoe nail, is still worn in some of the blacksmith's shops in Scotland. The next step of development follows when the pin is perforated at the thick end and attached to the ring by a fibre to prevent it from being lost. This stage is actually represented in China. A further step is taken when the pin itself is hinged upon the ring, for security, by bending its flattened head round the ring, a form which is abundant in Celtic times. The inconvenience which accompanies the ring-and-pin brooch, that the fabric must be drawn so far through the ring, was remedied by leaving a gap in the ring; the "penannular" brooch results.

Miss Bulley exhibited a number of examples of crosses, chiefly Celtic, and traversed familiar ground in inferring from them the existence of a distinct type of symbol in which a circumscribed circle is of equal importance with the cross itself. Coptic and Syrian crosses show the same type as the Celtic, though not so markedly. The subject, if treated at all, needs much more thorough examination.

Mr. John Garstang's account of Egyptian burial customs summarised the results of his discovery of a necropolis of the Middle Empire (about 2200 B.C.) at Beni-Hasan, in Upper Egypt, which contained burying places of minor officials and distinguished women, and illustrated the funeral ritual of the middle classes of the locality. These tombs are not large enough for mural decoration, but they are furnished with numerous wooden models—boats, granaries, and men and women engaged in field-work and household duties—which explain many points connected with the burial of the dead. The objects seem to have borne no relation to the profession of the deceased, but are simply of religious motive—the elaborate provision for a future journey.

Dr. C. S. Myers described the antiquities of Kharga in the Great Oasis, which include a well-preserved temple of Hibis, which is one of the most important monuments of the Persian dynasty in Egypt, and an early Nestorian necropolis, with streets of tombs and funeral chapels of unburnt brick, plastered and frescoed with symbolic ornament and Biblical scenes.

Prof. Flinders Petrie summarised the principal results of his recent excavations at Abydos in two demonstrations entitled "The Beginning of the Egyptian Kingdom" and "The Temples of Abydos." The discovery of the prehistoric age of Egypt, and its division into regular sequences of remains, fills up a period of more than 2000 years before the establishment of the dynastic *régime*, and reveals a wealthy and elaborate civilisation which was already decadent when it was overthrown by the dynastic conquerors. Five different types of man can be distinguished in pre-dynastic times, one of which Prof. Petrie is inclined to identify as Libyan, and akin to a characteristic type in early Greece. The connection of the close of the prehistoric scale of sequences with the early kings has been closely settled by the pottery, and its history shown in the stratified ruins of the earliest town of Abydos; four of the ten kings' names have been found of the dynasty which preceded that of Menes, and also the names of all the eight kings of the dynasty of Menes himself. The growth of the use of writing can be traced on the seals, and the æsthetic revolution which accompanied the establishment of the dynastic kingdom is seen to lead directly to the fixed artistic types which dominate Egypt thenceforward. The Royal tombs likewise are traced in sequence of elaboration from the prehistoric pit grave, first to the brick *mustaba*, and then to the stone-built pyramid of the third dynasty.

At Abydos, on the site of the Osiris temple, ten successive shrines of earlier dates have been unearthed through a depth of 20 feet of soil; the latest is that of Amasis, of the twenty-sixth dynasty, and the earliest that of the first. The principal results were of the last-named period, and included a remarkable school of fine ivory carving, and striking examples of two-colour glazing.

The liberal support which the Association has given throughout to British exploration in Crete was more than justified by the reports of the last season's work. Mr. Duckworth's anthropographic inquiry has been noted already; Dr. Arthur Evans gave a full account of his latest discoveries in the Palace of Knossos, and Messrs. Bosanquet and Myres described the excavation of a pre-Mycenæan town and sanctuary at Palaikastro, in eastern Crete, conducted by the British School of Archæology in Athens, and supported, like the work at Knossos, by the Cretan Exploration Fund.

At Knossos the year's campaign, which was expected to conclude the excavation, took a wholly unlooked-for development, in the discovery, first, of a north-west wing of the palace, including a rudimentary theatre formed by converging staircases, not unlike that found already in the Palace of Phæstos; second, of a detached house to the north-east, with much fine pottery, and a remarkable columnar hall with a *tribuna* and apse at one end, which appears to anticipate the features of the later *basilica*; third, of many scattered deposits between and below the floor levels of the palace, which serve to elaborate and explain the detailed chronology of the whole mass of buildings. One of these deposits, found near the east pillar-room, contained a quite unparalleled accumulation of native-made figurines in a kind of Egyptian glaze-ware, the débris of a sanctuary dedicated to a snake-goddess. In the same deposit occurred also a remarkable marble cross, which seems to have been the central aniconic object of the shrine, and examples of a fresh form of linear script. In view of these important results, it becomes necessary to complete the investigation of the ground below the later floors throughout the palace, as well as to continue the search for the Royal tombs, which has hitherto only led to the discovery of a late and much plundered necropolis to the northward.

At Palaikastro the settlement discovered in 1902 proves to be a considerable town of regular plan, dating from the later Minoan period, with extensive Mycenæan rebuildings. The detailed finds indicate widespread commerce from Egypt to Lipari, and considerable prosperity and comfort at home. The preponderance of submarine subjects in the decorative art suggests that the persistent Cretan sponge industry was already of importance, and a visit paid by Mr. Bosanquet to the island of Kouphonisi, off the south-east coast of Crete, proved the existence of an extensive and clearly pre-Phœnician purple fishery, going back into Minoan times. The pre-Mycenæan sanctuary explored by Mr. Myres on the hill overlooking Palaikastro yielded a remarkable series of votive terra-cottas, and much new evidence as to pre-Mycenæan costume.

The papers on Roman Britain, already mentioned, were as follows:—

Mr. T. Ashby, jun., gave a retrospect of excavations at Caerwent, in Monmouthshire (1899–1903), on the site of the Romano-British city of Venta Silurum, which a recently discovered inscription shows to have been the administrative centre of the Silures in Roman times. The external walls are clearly traceable, with three gates partially preserved, and an inner earthwork which seems to have been the original fortification. The buildings within are chiefly private houses, sometimes wholly enclosing a rectangular

courtyard, an arrangement which is unique in England. Some interesting mosaics have been found, and near the north gate the remains of an amphitheatre *within* the city walls.

Mr. John Garstang described the Roman fortress Bremettenacum (Ribchester), to which an excursion was made in the course of the meeting. Excavations made in 1898–9 have shown that this station was one of a series of fortresses which, with the wall of Hadrian, formed the northern frontier defences of Roman Britain. It is entirely of the earlier character, severely rectangular, with internal buttresses, mural towers, and double-arched gates, and filled within with rows and streets of stone-built barracks and stables.

Mr. Garstang also gave a preliminary account of the Roman fort at Brough, where exploratory excavations have been made quite recently. Like Ribchester, it belongs to the earlier type of fort, and was situated in the favourite position at the junction of two streams. In clearing a deep enclosure within the walls, two inscribed altars were found, and portions of a large inscribed tablet set up by a Præfect of the First Cohort of Aquitani under Julius Verus, Governor of Britain in the time of Antoninus Pius.

The committee on excavations on the Roman site at Gellygaer, near Cardiff, reported that the work was now completed, the results published, and the movable finds installed in the Cardiff Museum.

The committee appointed to report on the excavations at Silchester summarised the last season's work, and strongly urged that, in the small part of the site which remains to be explored, special care should be taken to secure accurate registration of the stratification (if any exists) of the smaller finds, and to investigate the relation in which the rectangular street plan stands to the irregular trapezium of the town wall.

As a result of this and similar recommendations, the Silchester committee of the Association has been reconstituted as a committee "to cooperate with local effort on Roman sites in Britain," and starts work anew with a small grant, to be expended in facilitating special researches of the kind suggested at Silchester, on sites where local or other subscriptions are already providing the funds for a general exploration. The opportunities for work already offered at Silchester on the plant-remains, the frequent occurrence on Roman sites of animal or human bones which need special precautions and expert examination, and the necessity for more detailed and accurate registration of the smaller finds than has been customary hitherto, even in the best conducted excavations, are examples of classes of observation which are only too liable to be neglected by local explorers, and the committee will be doing good service if it can secure for them the attention which they deserve.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—An examination in mathematics and physics will be held at St. John's College on March 16, 1904, for the purpose of electing a fellow in those subjects. Candidates will be given an opportunity of showing their knowledge of experimental physics. All persons are eligible who shall have passed all the examinations required for the degree of Bachelor of Arts on the day of election (April 20).

CAMBRIDGE.—The general board of studies has issued a report proposing a more comprehensive organisation of geographical studies and examinations in the university. The proposals include the establishment of a board of geographical studies, a geographical education fund, to which the university and the Royal Geographical Society each contribute 200*l.* a year, a special examination in geography for the ordinary B.A. degree, and a diploma in geography for advanced work in the subject. The stipend of the reader in geography is fixed at 200*l.*, and his lectures and those of the other teachers to be employed will be under the direction of the board, on which the council of the Royal Geographical Society will be represented.

A memorial urging the desirability of some similar organisation of anthropological study has been presented by thirty members of the senate, and is at present under the consideration of the council.

Twenty-two candidates have passed the half-yearly examination in sanitary science, and have thus become entitled to the university diploma in public health.

On October 21, 886 freshmen, including 13 "advanced students," were matriculated. The corresponding number for last year was 868.

Mr. F. F. Blackman, St. John's, has been appointed deputy for the reader in botany, Mr. F. Darwin, F.R.S.

The Ven. E. H. Gifford, D.D., senior classic and fifteenth wrangler in 1843, has been elected an honorary fellow of St. John's College.

The grace for the establishment of the Stokes lectureship and the Cayley lectureship in mathematics, for which a temporary endowment was recently offered to the university by certain anonymous donors, will be offered to the senate to-day (October 29).

MR. R. J. T. BRYANT, Leyton Technical Institute, has been appointed organiser of higher education to the Borough of Lowestoft.

IT is stated in the *Petit Journal* that Harvard University has come into possession of a legacy of about 5,000,000*l.*, the whole of the estate of the late Mr. Gordon Mackay.

ON the invitation of Yale University, Prof. Sherrington, F.R.S., of Liverpool University, has undertaken to deliver the second series of Silliman memorial lectures next year.

PROF. H. S. HELE-SHAW, F.R.S., has been appointed, through the Colonial Office, to organise technical education in the Transvaal and the Orange River Colony, and to consider the future university scheme of these colonies. The appointment is not a permanent one, and Prof. Hele-Shaw has been granted leave of absence by the council of the University of Liverpool until September next.

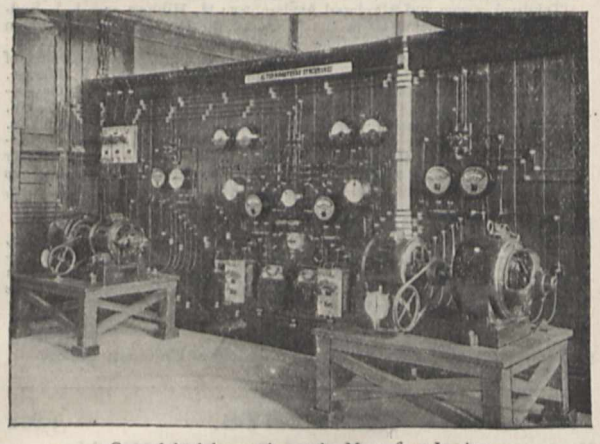
THE County of Essex Education Committee announces that an elementary course of instruction in dairy bacteriology will be given in its biological laboratories at Chelmsford. The course will commence on Thursday, November 5, and will be continued on the ten succeeding Thursdays. The course seems to be a comprehensive one, and should be of considerable value. Normal classes for the training of teachers in natural and experimental science have also been instituted by the committee at Chelmsford. These classes are intended for the practical instruction and training of persons resident in Essex who desire to qualify themselves to teach under the County Council. The classes meet on Saturdays from 10 to 5 o'clock during the winter months.

THE inaugural address to the students of the medical department of University College, Sheffield, was delivered by Sir Michael Foster, K.C.B., on October 15. He directed attention to the variety and complexity of the studies considered necessary for medical students; and he remarked that the question whether the burden was becoming too great for the student, and what things in the curriculum could with advantage be thrown on one side, must be considered, for the least important subjects would have to give way in the future.

THE Home Counties Nature-Study Exhibition will be opened in the offices of the Civil Service Commission, Burlington Gardens, W., to-morrow, October 30, at 3 p.m. Lord Avebury will preside. Admission tickets at special rates can be obtained by teachers and pupils by application to the honorary secretary, Mr. W. M. Webb, 20 Hanover Square, W. The programme includes conferences for teachers on practical methods of nature-study in elementary and secondary schools. The latest scientific developments of the Urban-Duncan microbioscope will be shown on the evenings of Friday and Saturday, and well-known lecturers on natural history subjects, such as Mr. Douglas English, Mr. Richard Kearton, Mr. R. B. Lodge, and Mr. Oliver Pike will give addresses from time to time, and exhibit their slides during the exhibition. Special meetings of the Middlesex Field Club and Nature-Study Society and of the Selborne Society will be held at the exhibition on Monday and Tuesday.

WE have received an admirably illustrated booklet describing the Montefiore Electrotechnical Institute of the University of Liége, and containing a programme of the courses of instruction. In glancing through the illustra-

tions, one is struck by the excellence of the equipment of the laboratories and workshops. We reproduce on a reduced scale an illustration showing the installation for the study of synchronous motors and problems connected with the paralleling of alternators. The character of the wiring is a noticeable feature; the switchboard looks more like a diagram than an actual board, having all the leads plainly visible and easily accessible, which must prove a considerable advantage in teaching and experimental work. The apparatus and machinery installed cover practically the whole field of electrotechnical measurements, a separate



One of the laboratories at the Montefiore Institute.

installation, complete in itself, being provided for the study of each branch. In addition to these "industrial laboratories" there are well-equipped standardising laboratories, chemical and photometric laboratories, drawing offices, and lecture theatres. Altogether the institution appears to be thoroughly equipped for teaching electrical technology.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, October 6.—Prof. W. Boyd Dawkins, president, in the chair.—Dr. Henry **Wilde**, F.R.S., read a paper on the resolution of elementary substances into their ultimates and on the spontaneous molecular activity of radium. The author referred to several of his papers published by the Society on the genesis of elementary substances and on the multiple proportions of their atomic weights, wherein certain gaps appeared in the several series in his tables, which have since been filled up by scandium, germanium, helium, argon, neon, krypton and xenon. The remarkable properties of radium were held to represent further realisations of the predictions made in the author's earlier papers. The author had previously indicated the interruption in the regularity of his multiple series H2*n* through the absence of elements of atomic weights 160 and 184 respectively. As there is only one place vacant higher in this series for an analogue of calcium, strontium and barium, radium was identified by the author as the tenth elementary condensation of H2*n*, with an atomic weight of 184, and a specific gravity of 4·8, as shown in his tables. The author had shown in former papers that helium was the unknown typical molecule of the same series, with an atomic weight of 2, and had previously indicated the probability of the resolution of the higher members of each series into their elementary typical molecules. The production of helium from radium by Profs. Rutherford, Soddy and Ramsay confirmed the author's prevision in the case of the series H2*n*, and this result may lead to the resolution of the higher members of other series into their ultimates.—Fossil plants from the Ardwick series of Manchester, by Mr. E. A. Neville **Arber**. The author has carefully reinvestigated the fossil plants from the Ardwick series of rocks collected by the late Mr. Binney, and which are now in the University Museum of Cambridge. He has also examined the numerous fossil plants from this series in the Manchester Museum, and has come to the conclusion that the Ardwick series of rock does not belong, as stated, to the Upper Coal-measures, but forms a definite transition series between the Upper and Middle Coal-measures of Lancashire. Such a transition series has been already recognised in the Coal-measures of South Wales, Somerset, and Staffordshire.

October 20.—Prof. W. Boyd Dawkins, president, in the chair.—Mr. Henry **Sidebottom** read a paper on recent Foraminifera from the coast of the island of Delos, in which he enumerated some seventy species of Miliolidæ, including four new species and several interesting variations. The new species and variations were fully described, and drawings both of the specimens and their sections exhibited. Mr. Sidebottom stated that the dredgings from this locality were extraordinarily rich in Foraminifera.

PARIS.

Academy of Sciences, October 19.—M. Albert Gaudry in the chair.—On the state of vaporised carbon, by M. **Berthelot**. At a temperature of 1200°–1500°, carbon possesses an appreciable vapour pressure, which is so small that, even after several hundred hours in a vacuum, the amount vaporised amounts only to a few milligrams. This carbon is amorphous, and contains no trace either of diamond or graphite.—On the periods of double integrals and their relations with the theory of double integrals of the second species, by M. Émile **Picard**.—On the estimation of argon in atmospheric air, by M. Henri **Moissan**. Pure metallic calcium, prepared by a method previously described by the author, is used to absorb the nitrogen; this metal also absorbs the traces of hydrogen which are always present if a mixture of lime and magnesium powder has been used in the preliminary treatment. Samples of air from various sources gave, with one exception, very concordant figures between 0·931 and 0·938 per cent. by volume, the exception being a sample of air taken on the Atlantic, which gave 0·949 per cent.—On the products of condensation of tetramethyldiamidophenyloxanthranol with benzene, toluene, and dimethylaniline, by MM. A. **Haller** and A. **Guyot**.—On the acclimatisation and culture of pintadines, or true pearl oysters, on the coasts of France, and on the forced production of fine pearls, by M. Raphaël **Dubois**. Successful experiments have been carried out with *Margaritifera vulgaris*, which has been acclimatised and made to yield pearls which, although small, are of good quality.—On linear equations of finite differences, by M. Alf. **Guldberg**.—On a reflection refractometer, by M. Th. **Vautier**. An interference refractometer composed of three mirrors is described, allowing of the complete separation of the two interfering light bundles.—On the composition of zinc peroxide, by M. **Kuriloff**. The only definite peroxide of zinc appears to be $ZnO_2.Zn(OH)_2$.—The phagocyte organ of the crustacean decapods, by M. L. **Cuénot**.—On the phases of folding in the French intra-alpine zones, by M. W. **Kilian**.—The part played by compression in the localisation of the tendons, by M. R. **Anthony**.—On the relations existing between the Surra and the Nagana, according to an experiment of Nocard, by MM. **Vallée** and **Carré**. The authors confirm the views of MM. Laveran and Mesnil as to the non-identity of Surra and Nagana.—Parthenogenesis and treatment of rheumatism, by M. L. **Pénières**.—Experimental researches on the sense of smell in the old, by M. **Vaschide**. In old people the sense of smell is better preserved in women than in men, but in all cases there is a marked diminution in olfactory sensibility due to age.

NEW SOUTH WALES.

Royal Society, August 5.—Mr. F. B. Guthrie, president, in the chair.—The economic effects of sanitary works, by Mr. J. Haydon **Cardew**. The principal object of the paper was to give municipal and health authorities some basis to work upon in devising sanitary services and forecasting their economic effects.—On the protection of iron and other metal-work, by Mr. William M. **Hamlet**. The author dealt with an investigation of the causes of the rapid rusting away of the iron casing at one of the Australian artesian bores, where abundance of carbonic acid gas was evolved at 100° F.; the water also contained alkaline carbonates and bicarbonates with sodium chlorides, silica, &c., amounting to between thirty and forty grains of total solid matter to the gallon. Probably a specially hard and resistant alloy

will be required to stand the prolonged and severe action of the water in question.—On the elastic radial deformations in the rims and arms of flywheels, and their measurement by an optical method, by Mr. A. **Boyd.** In this paper actual measurements of the deflections of the rims during rotation were given, so that the shape of the rim at any speed within the elastic limit of the material could be seen. The flywheels tested were of different design. The curves for a curved armed wheel showed a large inflection between the arms, the maximum deflection being close to the arms. The tests on four armed wheels showed very clearly the great advantage of having the joint along the arms, the effect of the joint in a four-armed wheel, jointed along the arms, being in fact almost negligible.—The aboriginal fisheries at Brewarrina, by Mr. R. H. **Mathews.**

September 2.—Mr. F. B. Guthrie, president, in the chair.—The following papers were read:—The separation of iron from nickel and cobalt by lead oxide (Field's method), by Mr. T. H. **Laby.** An inquiry into the accuracy of Field's method, as it has distinct advantages over methods commonly in use, viz. a *single* precipitation of the iron, and the absence, after the removal of added lead, of all reagents, such as sodium or ammonium salts. Combined with the electrolytic determination of nickel or cobalt, the method becomes rapid. Standard solutions of carefully purified iron, nickel, and cobalt nitrates were prepared. With these solutions twenty-two analyses were made, showing a recovery of more than 99 per cent. of nickel and cobalt.—Pot experiments to determine the limits of endurance of different farm-crops for certain injurious substances, part ii., maize, by Messrs. F. B. **Guthrie** and R. **Helms.** The authors communicated the results of experiments having for their object the determination of the tolerance of maize for sodium chloride, sodium carbonate, ammonium sulphocyanide, sodium chlorate, and arsenious acid.—Bibliography of Australian lichens, by Mr. E. **Cheel.**—On the Narraburra meteorite, by Prof. **Liversidge,** F.R.S. A general account of the characteristics of this metallic meteorite, weighing more than 70 lb., which was discovered in 1855 on the Yeo Yeo Creek, twelve miles east of Temora, N.S. Wales.

Linnean Society, August 26.—Dr. T. Storie Dixson, president, in the chair.—Studies in Australian entomology. No. xii. New Carabidæ (Panageini, Bembidiini, Platysmatini, Platynini, Lebiini, with revisional lists of genera and species, some notes on synonymy, &c.), by Mr. T. G. **Sloane.**—Revision of the Australian Curculionidæ belonging to the subfamily Cryptorhynchides, part vi., by Mr. A. M. **Lea.**—Notes on *Byblis gigantea*, Lindl. [N.O. Droseraceæ], by Mr. Alex. G. **Hamilton.**

DIARY OF SOCIETIES.

SATURDAY, OCTOBER 31.

ESSEX FIELD CLUB, at 6.30.—Exhibition of a Series of Photographs of Fungi, by means of the Lantern: Mr. Somerville Hastings.—Seed Dispersal: Prof. G. S. Boulger.

MONDAY, NOVEMBER 2.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—On the Application of the X-Rays to the Examination of "Safety Fuses": C. Napier Hake.—Scarlet Phosphorus—A New Chemically Active Variety of Red Phosphorus, and its Use in the Manufacture of Matches: Drs. Marquart and Schulz.—New Compound of Phosphorus for the Production of Matches: F. Bale.—Densities of Concentrated Nitric Acid at different Temperatures: Prof. V. H. Veley, F.R.S., and J. J. Manley.—On a Comparison of Different Types of Calorimeters: J. S. S. Brame and Wallace A. Cowan.

TUESDAY, NOVEMBER 3.

ZOOLOGICAL SOCIETY, at 8.30.—On some New Species of Aquatic Oligochæta from New Zealand: Prof. W. B. Benham.—List of the Mammals collected by Mr. A. Robert at Chapadá, Matto Grosso. (The Percy Sladen Expedition to Central Brazil): Oldfield Thomas, F.R.S.—List of the Coleoptera collected by Mr. A. Robert at Chapadá, Matto Grosso. (The Percy Sladen Expedition to Central Brazil): C. J. Gahan and G. J. Arrow.

WEDNESDAY, NOVEMBER 4.

GEOLOGICAL SOCIETY, at 8.—Metamorphism in the Loch Lomond District: E. H. Cunningham-Craig.—On a New Cave on the Eastern Side of Gibraltar: Henry Dyke Acland.

ENTOMOLOGICAL SOCIETY, at 8.—On some Aberrations of Lepidoptera: Percy I. Lathy.

SOCIETY OF PUBLIC ANALYSTS, at 8.—On the Salinity of Waters from the Oolites: W. W. Fisher.—Notes on (1) Some Indian Oils; (2) Differentiation of Linseed Oil from Boiled Oils: Dr. J. Lewkowitsch.—Note on the Purification of Hydrochloric Acid and Zinc from Arsenic: Dr. L. T. Thorne and E. H. Jeffers.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Northern Nigeria: Sir Frederick D. Lugard, K.C.M.G.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 5.

CHEMICAL SOCIETY, at 8.—Conductivity of Substances Dissolved in Certain Liquefied Gases. Preliminary Notice: B. D. Steele and D. McIntosh.—The Reduction of Hydrazoic Acid: W. T. Cooke.—The Behaviour of Metallic Oxides towards Fused Boric Anhydride: C. H. Burgess and A. Holt, Jun.—Some Reactions of Vanadium Tetrachloride: B. D. Steele.—Studies on Comparative Cryoscopy. Part I.: The Fatty Acids and their Derivatives in Phenol Solution: P. W. Robertson.—The Vapour Pressures of Sulphuric Acid Solutions. Preliminary Note: B. C. Burt.—The Viscosity of Liquid Mixtures. Preliminary Note: A. E. Dunstan and W. H. C. Jemmett.—Additive Compounds of *s*-Trinitrobenzene and Alkylated Arylamines: H. Hibbert and J. J. Sudborough.—A Contribution to the Study of the Reactions of Hydrogen Peroxide: J. McLachlan.—The Constitution of Certain Silicates: C. Simmonds.—Constitution of Ethyl Cyanacetate. Condensation of Ethyl Cyanacetate with its Enolic Form: P. Remfry and J. F. Thorpe.—Interaction between Chloric and Hydriodic Acids: J. McCrae.—3:5:-Dichloro-1:1:2-Trimethyldihydrobenzene. A Correction: A. W. Crossley.—The Estimation of Hydroxylamine: H. O. Jones and F. W. Carpenter.—A Study of the Isomerism and Optical Activity of Quinquevalent Nitrogen Compounds: H. O. Jones.—The Action of Water and Dilute Caustic Soda Solutions on Crystalline and Amorphous Arsenic: W. T. Cooke.—The Union of Carbon Monoxide and Oxygen, and the Drying of Gases by Cooling: A. F. Girvan.

ROENTGEN SOCIETY, at 8.30.—President's Address.

LINNEAN SOCIETY, at 8.—On the Structure of the Leaves of the Bracken, *Pteris aquilina*, in relation to environment: L. A. Boodle.—On the Life-history of a New Monophlebus from India, with a Note on that of a Vedalia predaceous upon it; with Remarks on the Monophlebinæ of the Indian Region: E. P. Stebbing.

FRIDAY, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione at University College.

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