THURSDAY, JULY 16, 1891.

ORGANIZERS OF TECHNICAL EDUCATION IN CONFERENCE.

THE progress that has been made during the past year by English County Councils in the application of their grants under the Local Taxation Act to purposes of technical education is attested by the map which accompanies the fourth Annual Report of the National Association for the Promotion of Technical and Secondary Education, and which we reproduce. It will be seen from this map that the counties which have determined to use the whole of the new fund for education form a large majority of the whole number both in England and Wales; and that London and Middlesex enjoy an unenviable, and we hope temporary, distinction, in having been the only counties to grab for the rates the whole of the money which might have been used to organize the secondary and technical education of their districts.

But while the map and the Report offer sufficient evidence of the good intentions of the County Councils, the solid progress already achieved is still more emphatically shown by the Conference of organizing secretaries which followed the annual meeting of the Association on the 3rd of this month. The very post of organizing secretary is the creation of the past few months. A year ago no county had dreamt of appointing an official to look after its education, and the Technical Instruction Act was only in operation in a few scattered centres. Now nearly twenty counties and county boroughs have special educational departments, with paid organizing secretaries. We need hardly point out the wisdom of making such appointments, in view of the unwonted duties cast on County Councils by recent legislation. The task is one which needs all the ability which is available, and this ability is of a highly specialized character, not to be expected of the average County Councillor or Clerk of the Peace, who besides have not the time for the necessary detailed work of organization. To leave the work to clerks would be to court failure, for the work to be attempted within the next few years must be largely tentative, and the direction of the experiments must be in the hands of men of knowledge, ideas, and resource, as well as of tact and judgment.

The selection of such men is not easy, and we are glad to find that the secretaries of the Technical Association are prepared to suggest candidates to County Councils which may be in need of them. The appointments made hitherto have been of two kinds: as temporary organizers, to inquire into claims and applications, to visit every district in the county, and to draw up a detailed scheme as the result of such inquiry; and as permanent secretaries to the Technical Instruction Committees, charged with the work of carrying out the schemes and inspecting the instruction, either personally or through the employment of experts.

About two-thirds of the gentlemen who had been appointed up to the date of the Conference accepted the invitation to be present, the districts represented being Lancashire, Cumberland, Surrey, Sussex, Derbyshire, Devonshire, Oxfordshire, Nottinghamshire, and Hampshire, besides a few county boroughs. The Conference was private and informal, its object being rather the interchange of views and the comparison of notes than the adoption of any formal resolution.

The subject chosen for consideration was the relation of the local taxation grant to secondary schools—the most difficult, as well as the most important, of the questions with which the organizer finds himself face to face when preparing a scheme. Since Matthew Arnold wrote, the disgraceful condition of secondary education in England has been a common-place; but how inefficient many of the schools are, and what tracts of country are entirely without even such facilities as they offer, is probably scarcely realized by any except those who have made a minute study of the educational wants of an average county. The country grammar-school, with small endowment and ill-paid and lethargic head master assisted by a worse paid and more inefficient usher, is all that stands for secondary education in many a market-town. Many are without even the semblance of a school above the elementary rank, and the mass of the inhabitants, it is to be feared, hardly feel the want of anything more. Here and there an energetic master or governing body has succeeded in building up a good school in despite of local apathy and lack of funds, but the fee has to be pitched at a point which excludes wage-earners, and such schools are consequently "middle," not only in the character of their instruction, but also in the class by which they are attended. Meanwhile, the clever boy of the village national school, who might profit the nation by his brains and energy, is doomed, for lack of opportunity, to leave school at twelve for the hopeless rut of farm labour.

A country-side the general education of which is as here described is not a promising field for special technical instruction. A stupid set of uneducated farmers, and a scarcely less stupid class of uneducated labourers, form hardly a good soil in which to plant lectures on agricultural chemistry or the natural history of insect pests. And thus thoughtful observers have been driven everywhere to the conclusion, no less in country than in town, that access to good secondary schools is an even more crying need at the present day than the specialized instruction to which, indeed, a sound general education is the necessary preliminary.

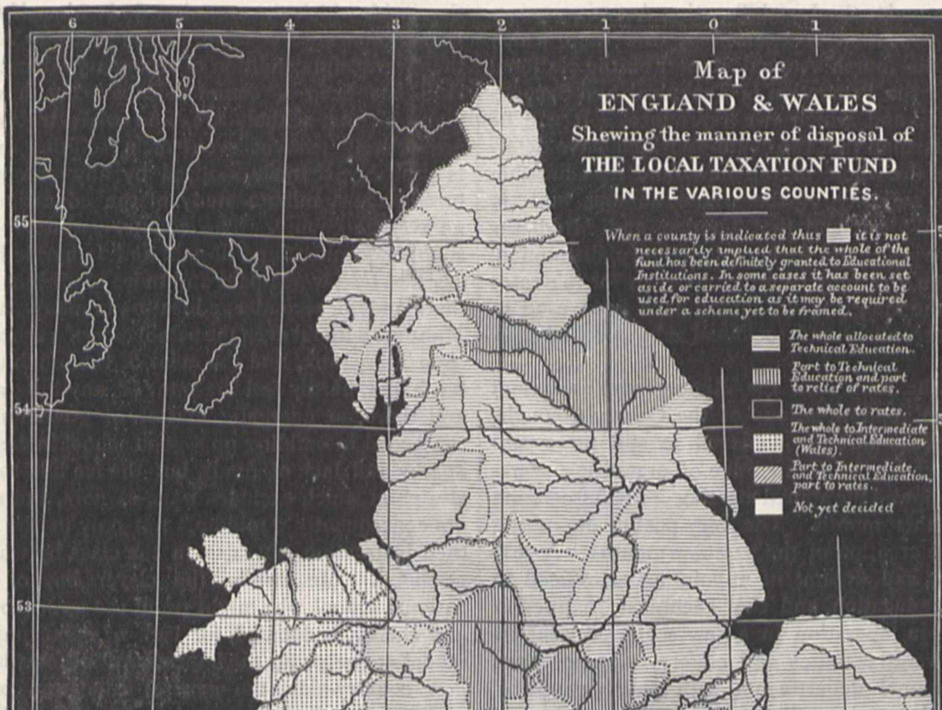
What, in short, is wanted, is that within reach of every inhabitant of every county should be a good secondary school, with fees such as may be reasonably expected to be paid by small farmers and tradesmen, and to which all sons of artisans and labourers who can pass a reasonable examination before the age of twelve can have access by means of scholarships.

The question before the Conference was the best means of promoting this object under the powers given by the Technical Instruction Acts. It will be remembered that the definition of technical instruction in the Act of 1889 is sufficiently wide to cover most of the subjects taught in a secondary school, and it is therefore clear that aid can be given to such schools, provided that the County Council can be represented on the governing bodies, and that the schools are not conducted for private profit. As regards the erection of new schools, it is doubtful if the whole work of building could be undertaken, even if desired, by

M

the County Council, but there is nothing to hinder contributions from being made towards the cost of laboratory, fittings, and apparatus ; while a maintenance grant could be given to defray the expense of the teaching of scientific and technical subjects. It was stated at the Conference that the Charity Commissioners had shown every disposition to facilitate the work, by drafting amending schemes enabling the County Council to be duly represented on the governing bodies.

But the subject which chiefly occupied the attention of the Conference was that of scholarships. That some scheme of scholarships should be devised to carry on picked scholars from elementary to secondary, and from secondary to higher institutions, was unanimously agreed ; and it was further considered that the scholarships to secondary schools should not merely defray the fees, but should provide something towards the cost of maintaining the boy while at school. The advantage of choosing the scholars as young as possible, in order to give them the full advantage of secondary training, was also insisted upon.



The question whether the selection of scholars, by examination or otherwise, should be undertaken by the County Council, or left to the governing bodies of the secondary schools, or to the discretion of the teachers of the elementary schools, elicited some difference of opinion; but on the whole the Conference favoured the plan of examination by a board appointed by the County Council, acting as far as possible in co-operation with the head masters of the secondary schools of the county. On one point all were agreed: viz. that there should be two examinations, or at least two standards—one for the country districts and the other for the towns—lest the whole of the scholarships should be monopolized by the most favoured districts. The opinion was also expressed that it might be sometimes desirable (as apparently would not be illegal under the Technical Instruction (Amendment) Act, 1891) to make scholarships tenable at certain efficient private profit schools, where no public schools are available, although such schools are debarred from receiving direct assistance. Such a course, however, would have to be adopted with the utmost caution.

Finally, the Conference considered the relations of the County Councils to the Technical Association, and a unanimous opinion was expressed in favour of a closer connection, while a suggestion was thrown out for the establishment of a quarterly journal registering the progress made in the various counties, a proposal which we are glad to hear is receiving the careful consideration of the Association.

Altogether, the discussion was felt to be of considerable value to those who have the practical work of organization in hand. We hope that such a Conference will be held annually, even if not more often, for in the novel work which lies before the County Councils points of difficulty will continually occur, on which consultation will be most useful. By the way, why should not the organizing secretaries form a permanent Association, on the model of the two Associations of Head Masters?

THE EVOLUTION OF ANIMALS.

L'Évolution des Formes Animales, avant l'Apparition de l'Homme. By F. Priem. 384 pages. Illustrated. (Paris: Baillière et Fils, 1891.)

IN this addition to the series of volumes known as the "Bibliothèque Scientifique Contemporaine," we have a worthy companion to Prof. Gaudry's "Les Ancêtres de Nos Animaux," published three years ago. To some extent, indeed, the ground is covered by M. Gaudry's more ambitious "Les Enchaînements du Monde Animal," but since the latter is in three volumes, the present work ought to find numerous readers who might be repelled by the length of the other. Moreover, the work before us has the advantage of treating each group of animals throughout geological time in consecutive form, whereas in the "Enchaînements" the Palæozoic Invertebrates are described in one volume, and those of the Secondary period in another, while the Tertiary forms are not recorded at all. Again, our author enters much more fully into the probable origin of one group from another than is the case in Gaudry's work. It is true, indeed, that in most cases these views are not original; but since they are generally taken from the highest authorities on the several groups, they will commend themselves the more strongly to students. In most works on palæontology too little attention is, in our opinion, generally given to the evolution of the various groups of the Invertebrata from one another, and we can, therefore, give a hearty welcome to a volume like the present which is mainly devoted to this fascinating subject.

We need hardly say that Prof. Priem is an out-and-out evolutionist; and we trust that we shall not disparage his work by observing that in some cases—apparently carried away by the very natural desire to make the most of his subject—he appears to have gone rather too far, stating as facts what are at best but probable hypotheses. For instance, we find it definitely stated on p. 273 that the Stegocephalous (Labyrinthodont) Amphibians had a functional parietal eye, whereas there is, of course, no actual proof that this was the case.

The work is rendered attractive by the large number of woodcuts with which it is illustrated. We regret, however, that in some cases—and more especially among the Vertebrates—the execution of these figures is by no means satisfactory. Moreover, in the chapters devoted to the Vertebrates (some of which are the weakest portions of the work) there are figures which are not only bad, but are utterly untrue to nature. Thus on p. 266 the old figure of *Coccosteus*, with the maxillary bone doing duty for the mandible, once more reappears; while on p. 301 we have the reproduction of Goldfuss's erroneous restoration of *Pterodactylus crassirostris*, which is unfortunately given as an illustration of the short-tailed genus *Pterodactylus*, whereas that particular species belongs to the long-tailed genus *Scaphognathus*.

We notice that in many instances M. Priem gives his authority for his statements as to the phylogeny of particular groups, whereas in other cases such references are omitted. This is to be regretted, since it is often somewhat difficult to find out whether the author is promulgating his own views, or quoting those of others.

The volume commences with an introductory chapter on palæontological evolution, in which the phylogeny of the horse, and the well-known passage of *Paludina neumayri* into *P. hœrnesi* are instanced as the best examples we have of the derivation of one form from another. Following this chapter, we have the various groups of animals treated in detail, commencing from the lowest. In the main the classification adopted is fairly well up to date, although we shall note some instances where the author departs from the more usual modern arrangements.

For example, in treating of the classification of the Sponges on p. 36, the author disregards Prof. Sollas's separation of the Calcareous Sponges (Calcispongiæ) as a group of equal value with all the others (Plethospongiæ), so that we find the Soft, Horny, Flinty, and Calcareous Sponges ranked as equivalent groups. Again, in the Cœlenterates (or, as we prefer to call them, Zoophytes), the Palæozoic Corals are still classed under the primary divisions of Tabulata and Rugosa; the former group including such different forms as *Favosites* (belonging to the Zoantharia) and *Heliolites*, *Halysites* and *Chætetes* (usually referred to the Alcyonaria). Later on, however, pp. 62–64, the author recognizes *Heliolites* and its allies as the ancestors of the modern coral-like Alcyonarians, such as the Organ-pipe Coral (*Tubipora*), and we therefore fail to see his reasons for adopting the antiquated classification.

Some of the most interesting chapters in the volume are those devoted to the evolution of the Echinoderms, the author adopting Neumayr's view that the Palæozoic Blastoids, as well as Crinoids, Sea-Urchins, and Star-fishes, are all separate branches springing from the Cystoids of the Palæozoic. The figures illustrating the gradual specialization of the Sea-urchins from the old Palæoechinoids, with their numerous rows of interambulacral plates, through the Triassic *Tiarechinus*, and thence to the Neocomian *Tetracidaris*, with its two rows of apical interambulacrals splitting into four near its equator, and thence to the modern "regular" Urchins, strike us as particularly well selected. Equally instructive is the transition from the "regular" modern Urchins (Neoechinoids) to the "irregular" forms—at first with the retention of the masticating apparatus, and subsequently with its loss.

Merely noticing that full justice is done to Neumayr's views regarding the phylogeny of the Brachiopods, we pass to the Mollusca, which we find treated in considerable detail and well illustrated. The author adopts the modern view of separating *Dentalium* as a distinct order (Scaphopods) from the Gastropods, and considers that both Pelecypods (Bivalves) and Scaphopods are derived from the latter. Nothing is said as to the origin of the Gastropods themselves, or, indeed, of the Cephalopods—probably for the very sufficient reason that nothing definite is yet known. In regard to the mutual relations of the various groups of Cephalopods, the author comes to the conclusion that the Ammonites should form a distinct order, "Ammonoidea," to be placed between the Tetrabranchiates (Nautilus) and Dibranchiates (Cuttlefish). Since, however, he adopts the view that their shells were really external, and that they are probably descended from Nautiloids, there seems but little necessity for this third order. The gradual increasing complexity in the sutures as we pass from Goniatites to Ceratites, and from the latter to true Ammonites, is held sufficient to prove the descent of the latter from the former ; while Goniatites are considered to be the direct offshoots from Nautiloids, which are themselves derived from straight forms like *Orthoceras*. It would require too much space to enter on the consideration of the relations of the various genera of Ammonites to one another ; but we may mention that the author fully adopts the modern views, such as the evolution of the keeled *Amaltheus* of the Jurassic from *Ptychites* of the Trias, and also that the uncoiled forms (*Hamites*, *Scaphites*, &c.) have had several distinct points of origin from true Ammonites. And here we may take the opportunity of mentioning that the terms *Ægoceras* and *Haploceras* applied to genera of Ammonites, are preoccupied by two well-known genera of Mammals, and therefore require changing. In regard to the Dibranchiate Cephalopods, it is considered that Belemnites have been derived from forms allied to Goniatites, and have themselves given origin to the modern Cuttle-fish. If this be the true phylogeny of the Cephalopods, it indicates a gradual increase in the complexity of the shell of the Tetrabranchiates, till it attained its maximum in the Jurassic and Cretaceous. Then the total disappearance of all the external-shelled forms with the exception of the *Nautilus;* while at the same time the Dibranchiates were gradually tending to develop less and less complex internal shells, till these culminated in the simple "pens" and "bones" of the modern cuttles and squids.

Coming to that portion of the work devoted to the Vertebrates, we find, as already mentioned, that the author has been in some places less successful than in the earlier chapters. We have already alluded to the misleading nature of one of the figures in the chapter on fishes, and we have to add that several of the few others with which that chapter is illustrated are highly unsatisfactory. It is probable, indeed, that the author had no opportunity of seeing the second volume of the "British Museum Catalogue of Fossil Fishes" before passing his proofs, as otherwise he would doubtless have modified some of his statements.

In his remarks on the difficulty of distinguishing between Dipnoid and Ganoid fishes (p. 265), the author seems to be totally unaware of the difference between the "autostylic" skulls of the former and the "hyostylic" of the latter ; and when, on p. 267, he states that the Dipnoids are a lateral branch of the Crossopterygian Ganoids, he is directly at issue with the writer of the Museum Catalogue, who states (p. xx.) that, "concerning the evolution of the Dipnoi, palæontology as yet affords no information." Again, although Prof. Cope's observations as to the primitive structure of *Pteraspis* and its allies are referred to, we doubt whether the suggestion that the opening on the dorsal side of the head-shield corresponds to the aperture of a parietal eye will commend itself to the students of ichthyology. The chapter on the Batrachians is all too short ; and, bearing in mind their resemblance to the Dipnoids in the autostylic structure of the skull, it is scarcely safe to make the statement (p. 282) that they are derived directly from Ganoids.

From his treatment of reptiles we fear that the author has but a very faint conception of the nature of a Theriodont or a Dicynodont, or else he would surely have made more of their affinity to the Batrachians on the one hand, and to Mammals on the other; while he would have also omitted any reference to the purely adaptive resemblance existing between the skull of *Udenodon* and that of a turtle. M. Priem might also have informed his readers that Dicynodonts are not confined to Africa. On the other hand, we are pleased to see that M. Priem rejects the heresy propounded by some of his countrymen, that Ichthyosaurs were derived primitively from marine reptiles, in favour of the more rational view of their near relationship to the Rhynchocephalians. In stating that the Plesiosaurs are likewise related to the Rhynchocephalians, the author is in accord with modern views, although he should also have referred to the many indications of affinity presented by these reptiles to the Chelonians. When, however, it is stated, on pp. 295, 296, that the latter were probably derived from the toothless Dicynodonts (*Udenodon*), the author at once proclaims his ignorance of some of the leading features of reptilian osteology. The statement on p. 297, that the gigantic Siwalik tortoise had a shell measuring four metres in length, leads us to wonder when this fiction will finally disappear from text-books. The author's treatment of the Pterodactyles and Dinosaurs calls for no separate mention, although we are led to wonder why the Crocodiles are so widely separated from these groups.

The whole chapter on birds is decidedly feeble; and we must certainly take exception to the statement that *Hesperornis* and *Ichthyornis* respectively connect *Archæopteryx* with the Ratitæ and Carinatæ.

Turning to the last chapters, on the Mammals, we find the author adopting the view that the Monotremes have had an origin totally separate from the other two subclasses. We then have a notice of the Secondary Mammals, in which we observe a lamentable lack of attention to recent work on their affinities, and also to the synonymy of the various genera. We also notice that the Jurassic *Plagiaulax* and its allies are still referred to the Diprotodont Marsupials (p. 327); so that on these points the author's evolutionary views are totally out of date. Following the Marsupials, we have a very fair, although brief, account of the most recent conclusions on Mammalian phylogeny, which needs but few remarks. We notice, however, that the author adopts M. Boule's views as to the dual origin of the *Canidæ*, according to which the Foxes (Alopecoids) are considered to have originated from *Cynodictis*, while the Wolves, Jackals, and Dogs (Thooids) trace their descent to *Amphicyon*. To ourselves, indeed, it has always appeared difficult to understand how these two groups of *Canidæ* have become so much alike if they had this dual origin; and this difficulty is increased by the author's statement that those Thooids known as *Cyon* differ from the other members of that group in having originated from *Cynodictis*.

On p. 343 the author makes a slip in stating that the Hydracoidea are now represented only by a single genus; while later on he appears to be uncertain whether the Siwalik beds should be regarded as Upper Miocene (pp. 349, 350) or Upper Pliocene (p. 366). Again, we notice on p. 353 some want of acquaintance with the recent literature relating to the ancestry of the horse, *Orohippus* being identified with *Pliolophus*, whereas the latter is really the same as *Hyracotherium*, while the former is identical with *Pachynolophus*. We are in full accord with the author when he states, on p. 361, that *Chalicotherium* (with which the supposed Edentate *Macrotherium* is now known to be identical) is an aberrant Ungulate, although we must be permitted to differ from him when he adds that it shows signs of affinity with the Edentates.

We must likewise take exception to the statement, on p. 370, that the Indian Nilgai is in any sense the progenitor of the Oxen; while the view expressed on the same page, that the Buffaloes, Bisons, and true Oxen have severally originated from three distinct groups of Antelopes, can be only regarded as another instance of the author's partiality for multiple phylogenies. Although M. Priem is careful not to commit himself to the view that the Cetaceans have been derived from the extinct Enaliosaurian reptiles, yet the prominence which he gives to the statement of that view may be taken as a sign that he has not thoroughly purged himself from that heresy.

Finally, although we have felt bound to call attention to a certain amount of imperfection in the later chapters, yet, as a whole, we can conscientiously recommend the work before us to those readers who are desirous of obtaining in a compact form a summary of the evidence afforded by palæontology of the progressive evolution of animal forms.

R. LYDEKKER.

METALLURGY.

Leçons sur les Métaux. Par Prof. Alfred Ditte. (Paris: Dunod, 1891.)

Traité pratique de Chimie Métallurgique. Par le Baron Hans Jüptner von Jonstorff. Translated from the German by M. Ernest Vlasto. (Paris: Gauthier-Villars, 1891.)

THESE two volumes, recently published, are both of unusual interest. The first, by Prof. Ditte, who is well known to English readers by his "Exposé de quelques Propriétés générales des Corps," may be said to mark a new departure in teaching the chemistry of metals. He points out that the principles of thermochemistry do not merely enable reactions to be explained, but to be predicted, and, on the other hand, when two sets of reactions are simultaneously possible, the laws of dissociation render it possible to rigorously define the conditions of equilibrium which are established in the chemical "systems" under consideration. It is often possible, with the guidance afforded by these laws, to say, in the absence of direct experiment, why one reaction is impossible and another certain to occur; or why a certain reaction begins without difficulty, and is arrested at a definite stage; or why a reaction which takes place readily under certain conditions cannot be effected under others that do not appear to differ greatly from those which were favourable to it. As a pupil of Deville, the author might have been expected to develop, in a treatise such as this, the teaching of his great master, and he has admirably performed his task. The classification of the work is excellent, the metals being first considered collectively, and then in detail with numerous tables of the data and constants which are so frequently required by metallurgists.

The work begins with a very clear account of Berthelot's labours in *mécanique chimique*, special care being devoted to the description of the calorimetric investigations, and to the appliances adopted in these important researches.

It appears to be a great advance for us in this country to read a chemical treatise in which the thermal values of the equations are stated in calories, side by side with the formulæ. As the book is too long to review in detail, it may be well to indicate the nature of one section only, as showing the author's care and thoroughness in the selection and arrangement of the materials. Take, for instance, the few pages devoted to carbides. The author points out that carbon in uniting with metals sometimes gives rise to the formation of true compounds, and at others to solutions of carbon in the metal. He then describes the orange-yellow product obtained by the action of carbon on metallic copper, and passes to the association of carbon with nickel, which does not confer upon nickel the property of being hardened by rapid cooling. The definite carbides of manganese, as well as the indefinite associations of carbon with iron and manganese, receive due attention, and the author proceeds to deal with the carbides of iron, and finally with the well-defined carbides of niobium and tantalium, which have respectively the formulæ Nb_2C_2 and Ta_2C_2.

A terse description is then given of the work of Troost and Hautefeuille on the heat of formation of carbides of iron and manganese, which led to the conclusion that the union of carbon and iron is attended with absorption of heat, while in the case of the union of carbon and manganese heat is evolved, the evidence leading to the belief that Mn_3C is a true compound possessing considerable stability. The action of heat on carbides is then dealt with, and a brief, but sufficient, reference is made to Forquignon's work on the action at a high temperature of hydrogen on cast-iron. The section concludes with a description of the modes of preparing carbides, and with a sketch of the formation and properties of the nitrocarbides, more especially those of niobium and titanium.

The sections of the work devoted to the consideration of tellurides, arsenides, and antimonides, are equally good. With regard to individual metals, in the portions of the work as yet published, only potassium, rubidium, cæsium, ammonium, thallium, sodium, lithium and the metals of the alkaline earths, barium, strontium, and calcium are dealt with, but sufficient evidence of the merits of the book has been given in this brief review to show that the rest of it will be gladly welcomed, for Prof. Ditte has earned his place among the great metallurgists of France.

We should be grateful for curves indicating the effect of definite elements on the physical constants of metals.

Baron Jonstorff's book is of an entirely different character, though it is not, in its way, less excellent or useful. He says that it issues from an ironworks, and is addressed to practical metallurgists. Its aim is, however, somewhat different from that of most treatises on analytical chemistry, the author's intention being not merely to guide the chemist in his analytical methods, but to enable a blast-furnace manager or an iron-master to realize what kind of services the laboratory can render, what questions relating to the routine of work the analyst can solve, and, above all, in what way the questions should be put.

The author deals with the more important special methods of analysis, and of assaying iron and steel, and he gives due attention to the examination of refractory materials—slags, fuel, and gaseous products—and his method is singularly clear and precise. An appendix gives tabular statements which will be useful in daily work.

The book, as a whole, shows incidentally the great difference between the works-laboratory of the present day and that of twenty years ago. There is still much room for improvement, no doubt, but the laboratory of an ironworks has, in many cases, ceased to be little better than a shed, erected, say, behind the boiler-house, with an analyst and a few boys as the scientific staff.

Those who have visited the author in his beautifully situated Styrian works, and have seen his manipulation, as the reviewer has, will appreciate the excellence of his labours, and will be glad that a good translation into French will make their results more generally known.

W. C. Roberts-Austen.

BACTERIA AND THEIR PRODUCTS.

Bacteria and their Products. By Sims Woodhead, M.D. Published in the "Contemporary Science Series." (London: Walter Scott, 1891.)

SCARCELY a year passes in England, France, or in Germany, without the publication of one or more treatises on the fascinating subject of bacteriology. Many of the more recent of these works have been written for the general reader rather than for the student, and have shown a considerable want of accuracy and lucidity, a circumstance which can only be accounted for by the fact that accomplished bacteriologists have not been their authors.

We have now before us "Bacteria and their Products," a work which we might infer from a glance at the cover, and general arrangement, to be certainly intended for the general reader. This view is strengthened by the several object-lessons and homely similes scattered throughout the text, with the fitness of which we totally disagree; witness, for example, the extraordinary comparison of a nodule of Actinomyces with two daisy heads placed base to base, "the sterile flowers in the centre" then corresponding to the club-shaped rays. The comparison is bad, but the botany is worse. Then there is the not very abstruse mathematical problem on p. 24, and the guide-like description of the Pasteur Institute, all intended, we must conclude, for the general reader rather than for the student.

On the other hand, there is a very large collection of facts, much information about fermentation and chemistry (although the interesting and oft-quoted experiments of Raulin are omitted), numerous references, and a very plentiful supply of formulæ, the whole requiring, in order to understand and appreciate them, a reader equipped with a thorough knowledge of the sciences bearing on the subject.

Putting this question aside, however, we candidly confess that we do not admire the style or arrangement of the book. There is a conspicuous want of lucidity, and of that accuracy of observation which one would have expected of the author. For instance, "What are Bacteria?" is the question propounded in chapter ii.; but the answer to this key-stone question is left in much doubt, as the description of the protoplasm, cell membrane, mode of division and reproduction of the "specks," is exceedingly confused. We should not choose Gram's method to demonstrate the capsules of Actinomyces, nor, indeed, any other capsules; and we have reason to doubt, after the beautiful monograph on Cladothrix by Billet, that the brown colour of that organism is due to iron. Again, what does the author mean when, speaking of cilia, he says, they "appear to develop only in those organisms that have special affinity for oxygen, for, as soon as the ciliated forms reach the surface of a fluid, they lose their cilia or they become much less active," &c.? Tables of classification are heaped in with scarcely any attempt to sift and reduce them to a form compatible with the scope of the book. Is this done because, as the author says (p. 47), "to the pathologist, however, these classifications are of comparatively little value"? We maintain that for a work of this kind the author has no right to take a one-sided view, and that to the science of bacteriology the study of morphology is as important as any other side of the subject.

Turning to the description of actinomycosis and anthrax, we are surprised to find McFadyean taken as the guide in the former. Why is not the author his own guide? Or why does he not, at least, use the recent results of Boström? Then in "anthrax" it is stated "that at the point of inoculation in animals there is usually no evidence at all that it has been the point of entrance of the bacilli." This is scarcely compatible with a thorough knowledge of this familiar organism.

Again, in the opening chapter, a number of bacteriologists' names are mentioned. We think the author hardly does justice to those of our own country, for amongst the four names placed by the author in honourable association with the great name of Sir Joseph Lister, neither Lankester, nor Tyndall, nor Lawes and Gilbert, nor Wooldridge, nor Lingard, finds a place. And yet not only are these amongst our highest authorities, but the observations of Lankester and the experiments of Wooldridge constitute cardinal points in the history of bacteriology.

Lastly, the question of illustrations is a difficult one. There are very many photographic processes to choose from, and considering that there are only 20 illustrations, the author might have employed collotypes (compare Fränkel's atlas) or copper blocks; or, having used zinc blocks, should have had them printed on separate sheets, for it ought to be more generally known that it is of no use expecting a good impression from blocks of this description when printed on ordinary paper and in the text.

OUR BOOK SHELF.

Our Country's Flowers. By W. J. Gordon. (London: Day and Son, 1891.)

THIS volume is intended to aid beginners to ascertain the botanical name of any British wild flower or fern with which they may meet. After a list of local English plant-names, the serious work of the book begins with an explanation of how plants are classified, interwoven with which are a sufficient number of the terms used in describing plants to make the book "not too technical, but just technical enough" for the reader who desires to have a "nodding acquaintance" with the wild flowers of his own country. This is given first in a chatty style, and then repeated in a convenient tabular form. Next, the essential characters of the natural orders are given, after which the buttercup order, or Ranunculaceæ, is treated of at some length as a pattern of how identifications can be made. This is followed by a glossary of botanical terms, in some of which, in attempting a condensed and popular style, the writer has somewhat distorted the meaning. "Cambium" is erroneously described as a layer of mucilage, instead of a tissue. The characters of the natural orders are again stated, this time in alphabetical sequence, followed by a chapter on the genera, each of which is accompanied by a woodcut, intended to show its diagnostic character, but it is doubtful whether (at least in some of the orders) this is accomplished, as is also the case with some of the specific diagnoses with which the volume closes.

In the 33 coloured plates 509 species are depicted. This crowding is unsatisfactory, and tends to obscure what might otherwise be very useful. The figure on plate 23, numbered 388, may possibly be intended for 368, the stinging-nettle, or it may be some abnormal state of the inflorescence of a grape-vine. *Centranthus ruber* (204) and *Plantago lanceolata* (346) are also wonderful specimens of those plants. The artist, apparently, is amongst those who do not regard colour (unless it be the quantity thereof) as of value in discriminating species. The volume will, nevertheless, be a pleasant and useful companion to many during a country holiday, and, with the author, we hope will lead on to deeper study.

C. H. W.

A Summary of the Darwinian Theory of the Origin of Species. By Francis P. Pascoe, F.L.S., &c. (London: Taylor and Francis, 1891.)

IT is difficult to understand why the author of this pamphlet should think it worth while to remind his readers periodically that he is an opponent of Darwinism. Some space was recently devoted in these columns to the consideration of a book on the same subject by Mr. Pascoe, and the present production is nothing more than an abstract of this work, delivered in the form of an address to the Western Microscopical Club. We have no new facts nor arguments; there is the same lamentable display of misconception, and the author has simply strung together some sixteen pages of excerpts from the writings of Darwin and others, without any attempt at connected reasoning either for or against the Darwinian theory. The author's position is practically this: here is the whole animal kingdom, consisting of about 600,000 species; you must explain every detail of specific structure, down to the most insignificant, by the theory of natural selection; if you cannot do this, the theory is untenable. The whole of Mr. Pascoe's writings in connection with Darwinism amount to this, and nothing more; he has reiterated this statement, if not literally, at any rate in spirit, on every available opportunity for the last twenty years. The present pamphlet will, let us hope, for the sake of the author's reputation, be the last declaration to the same effect, for there is surely nothing gained either by Darwinism or anti-Darwinism by squandering the systematic powers which he is known to possess in picking out scraps of sentences from the "Origin of Species," &c., and publishing these things "of shreds and patches" under grandiloquent and misleading titles.

R. M.

The Business of Travel: a Fifty Years' Record of Progress. By W. Fraser Rae. (London: Thomas Cook and Son, 1891.)

THIS year the well-known firm of Thomas Cook and Son celebrate their fiftieth anniversary, and Mr. Fraser Rae has taken the trouble to write the present work in order to mark the occasion. The firm, it seems, had very small beginnings. Its history may be said to date from the day when, in 1841, Mr. Thomas Cook, walking along a country road, suddenly reflected that a certain temperance meeting at Loughborough would probably be a brilliant success if a special excursion train could be run between that place and Leicester. Apparently, no such thing as a special excursion train had ever before been heard of. The idea was carried out, and attracted so much attention that Mr. Cook—who was at that time a wood-turner—was often asked afterwards for advice in the organizing of railway excursions; and by and by he devoted himself wholly to the task of developing "the business of travel." His son has been for many years the sole managing partner, but to the elder Mr. Cook belongs the credit of having conceived the system with which his name is now associated. To what vast proportions the system has grown everyone knows; but there are probably few who know much about the various stages through which it has advanced to its present position. Mr. Fraser Rae tells the story clearly and effectively, and most readers, when they have finished his narrative, will be disposed to agree with him in thinking that the jubilee of a firm which has played so prominent a part is an event of interest in the social history of the nineteenth century. Messrs. Cook, by their energy and enthusiasm, have given a powerful stimulus to the popular love of travel; and they may fairly claim that their establishment ranks to some extent among the influences which are tending to break down international prejudices.

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.*]

The Albert University.

I DESIRE to associate myself with Prof. Carey Foster and, to a great extent, with Prof. Ray Lankester in the statements made and the opinions expressed by them in your last issue. Present circumstances force me to do so as briefly as possible; but I should be the less satisfied to keep altogether silent because I had something to do with the drafting of the "Albert" charter in 1887.

For my part, that draft was never regarded as an effective solution of the problem of a University *for* London. I thought of it only as a handy weapon for forcing the appointment of a Royal Commission, and for shaking the London University Senate out of its happiness in the steady increase of untaught candidates for degrees.

A Commission was extorted; and it had the impartiality, at least, of ignorance. Its inquiry was short and hurried, yet it learned enough of what had been done for academic organization by the London Colleges, during sixty years, to condemn the sufficiency and self-sufficiency of the London University. That the Commission, notwithstanding, should first give the London University an opportunity of transforming itself for London's good, was natural and proper in all the circumstances.

We know what followed. The London University Senate was slow, very slow, to move at all towards meeting the London Colleges. But at last it woke up, and then after a time began to display a novel spirit of conciliation. Fifteen months ago, a real accommodation seemed to have been attained between the Councils of the Colleges on the one hand and the University Senate on the other. Even when the Senate thereafter, yielding to an irrelevant clamour from Provincial Colleges, decided to give these also a direct representation (in the teeth of the Commission's instruction and without warning to the London Colleges), I was one of those who here were still willing to try what could be made of the top-heavy and lumbering scheme. But trial there was never to be; for Convocation, which probably would reject any measure of reform, gathered itself up and made swift end of this one.

It looks now as if the "Albert University" were straightway to be upon us instead. I will not inquire into the agencies that have brought this result into such near view. Nor will I in your columns follow up my present and my late colleague's arguments against the prospective creation with others that seem to me of serious import. But I may be allowed to endorse emphatically what Prof. Lankester has said as to the absence of sanction by the professorial body here to the "Albert" draft charter. And nothing could be more to the point than Prof. Foster's observation that the "Albert" scheme has never been submitted to a meeting of the Governors of the College—which means, to the College as a corporate body.

Prof. Lankester is clearly right in contending that the whole question should now have been, or should still be, referred back to the Commission. I must, however, as a Scot, remark upon his assumption that the Northern Universities are professorially governed—free especially (as he urged in a former letter) from the mischievous lay influence of mere graduates. The fact is, that, ever since 1860, graduates, in "General Council" and also by direct representation in the "University Court," have not been without voice or influence; while, by the later reform of the other year, not only is graduate and other lay influence increased, but also the professorial powers of general management are largely diminished or even (as respects finance, &c.) abolished. There were more reasons than evidently Prof. Lankester knows of for curtailing the old professorial supremacy in Scotland. But it does not follow that in England, and more especially in London, there should not be a much franker recognition of professorial (that is, expert) knowledge of educational ends and means than appears in the "Albert" draft charter. G. CROOM ROBERTSON.

University College, London.

P.S.—Since these remarks were put in print, a decision of the Privy Council has been announced in favour of an "Albert" (or "Metropolitan") University. They lose, therefore, most of whatever interest they may have had; but they may still appear, so far as I am concerned, if the Editor pleases. I regret the decision, and think the promoters of it may yet have reason to wish that their action had been less hurried. At the same time, one may acknowledge the remarkable energy and fertility of resource with which the enterprise has been conducted to its thus far successful issue.—G. C. R.

IF I may be allowed another word on this subject, I should like to say that, having been all along a keen advocate of the establishing of a strong professorial University in London, not necessarily in slavish imitation of the German system (of which I happen to know something), but combining the main features of its professoriate (of which I think I showed my appreciation in a paper read at Bath in 1888, before Section B of the British Association) with the essential elements of the present University of London, and believing that the draft charter of the Senate, which was presented to Convocation, contained in it the potentialities, out of which (with the exercise of a little common-sense to soften down such asperities as might cause friction in its initiatory working, together with a little patience to allow for the time necessary in all evolutionary changes) a strong professorial University could be developed, I voted for the Senate's scheme, and still think the adverse vote of Convocation the greatest disaster that has befallen the University in the half-century of its existence.

Of all the bitter things said by Prof. Lankester in his former letter, nothing was more to the point than his sarcastic challenge to the existing University to reform itself, if it can, with the "dead weight of graduates tied round its neck, and called Convocation." But must an institution, which has admittedly done so much good, be swamped because of the accident of a flaw in its constitution? Is there no power to remove this millstone from its neck? If anything can exceed one's admiration for Prof. Lankester's candour in penning the letter, which appears in NATURE this week (July 9, p. 222), it is the satisfaction one must feel at finding that the projected repetition of "federal futility" which is at present in a state of incubation at the Council Office, has no attraction for him. It is to be hoped that the main question will be referred back to the Royal Commission, and that the Commissioners will give such advice to the "powers that be," that the shortsighted decision of Convocation may be overruled, as Prof. Lankester has suggested twice over, and that (to use the words spoken to me, the morning after the vote, by a distinguished Oxford man, whose academical experience no one could challenge) "the Government will take up the matter, and pass an Act doing what sensible people wish to see done," by co-ordinating and harmonizing, instead of segregating, the present machinery for higher education in the metropolis, including the great medical schools.

Prof. Karl Pearson's idea of the "fusion" of the two Colleges (see NATURE, June 4, p. 102), as distinct from "federation," is splendid in theory; but will it work? Can the fluxing material be found, which shall make the iron and the clay interfuse without either Gower Street or Somerset House, or both, sacrificing those traditions which are the strongest element in that *individuality* which each values so highly and both seem so anxious to conserve? A. IRVING.

Wellington College, July 10.

Name for Resonance.

ALTHOUGH inadvisable as a rule to correct errors in a report for which one is not responsible, there is one little mistake on p. 238 this week, which, uncorrected, may lead to the extinction of a useful suggestion.

In discussing the subject of "electric resonance" recently at Cambridge, I found that the term conveyed no correct meaning to the untechnically instructed. Its natural meaning implies echo or reverberation, and has a definite relation to sound. Now, although a sort of reverberation or repetition is part of the effect intended to be denoted by the phrase resonance, yet the most essential feature of that phenomenon, and the one most to be emphasized in the recent extensions of the term, viz. the accord of frequency or similar tuning between two vibrators, is not connoted at all. Hence, even in acoustics the term is hardly satisfactory, while its extension to other departments of physics may be misleading.

It was suggested, however, by Dr. Arthur Myers, that the existing word *σύντονος* has almost exactly the right connotation, and has no special limitation to sound; while the derivatives *syntony*, *syntonic*, and *syntonise* may readily become English without exciting repulsion.

The adjective "symphonic," suggested by the reporter of the Physical Society, does not strike me as so good, because it specially refers to sound again, and because the word "symphony" has already another definite meaning.

July 10. OLIVER J. LODGE.

Force and Determinism.

I DO not think there are many non-physicists who will attempt to gainsay the fact that, under physical constraint, the direction of motion may be determined without affecting the quantity of the energy concerned, and without expenditure of energy. This is seen when the earth and sun revolve around their common centre of gravity, or when I twirl my stick around my finger and thumb; the earth and sun in the one case, and the ferrule and knob of my stick in the other case, being bound into one system physically. But I do think that an able and clear-headed physicist like Dr. Oliver Lodge would be doing a great service to non-physicists if he would, in your widely-circulated columns, explain and solve, shortly and in non-technical language, the difficulties which trouble some of them; aiding them, for example, to comprehend the exact force of the words expenditure of energy, and helping them to see that in all known cases of change of direction of motion such change is effected under physical constraint. It is when they are told by a certain class of metaphysicians, who quote, or misquote, physics in support of their assumptions, that physical motion is controlled by will-power or volition, always acting at right angles to direction of motion, and therefore leaving the amount of energy unchanged; it is *then*, I say, that they begin to grow restive, and to demand definite and verifiable evidence that such metaphysical constraint is (*pace* Sir John Herschel) a necessary or philosophical conception, and that it is impossible to explain the phenomena without having recourse to it. If Dr. Lodge would consent to help non-physicists in this way, and would indicate what are the "important psychological consequences" to which he alludes, he would be doing some of us a good turn. C. LLOYD MORGAN.

University College, Bristol.

As Prof. Lodge says he is glad to see that his statement, "although expenditure of energy is needed to increase the speed of matter none is required to alter its direction," called in question, and as he has so kindly answered one letter on the subject, may I ask him to criticize the following remarks?

The theory of kinematics is based on certain geometrical concepts, which may be summed up in the term space, and on the concept of time. The laws of motion, together with the assertion that mass is not a function of space or time, may logically be regarded as implicitly defining mass and force. Energy may similarly be defined, in terms of these kinematic concepts, as $\Sigma\frac{1}{2}mv$. For I think the progress of science is tending to show that the term "potential energy" is only a cloak to cover our ignorance of the kinetic energies which for the moment have escaped our ken. But in any case the statement quoted is logically only a truism, deduced from the definitions of its terms, and is therefore indisputable in all mechanical theorems. But if it is to be applied outside the sphere of pure mechanics, the moral will lie in the application of it—that is, it will be necessary to examine, before applying it to any new subject-matter, whether the definitions from which it was deduced apply to that subject-matter or not.

For example, by the third law of motion, mechanical force only acts *between two masses*, the momenta generated in them being equal and opposite. If, therefore, psychic force is to come under the definition of mechanical force, it can only act *between* two particles. And, therefore, if psychic force is to do no work, by reason of its always acting in a direction normal to the path of a particle, it can only act between two particles whose paths happen to have a common normal—an occurrence which must be infinitely rare. EDWARD T. DIXON.

12 Barkston Mansions, South Kensington, July 4.

Magnetic Anomalies.

THE discovery of very strong magnetic anomalies between Charkov and Kursk in Russia, to which A. de Tillo has lately referred in the *Comptes rendus* and in NATURE, raises the question whether the values there observed are strictly local, or extend over a relatively wide area. Thus, it would be of great interest to know if, on moving, say, some metres away from a station, the declination and inclination hold the same value. If not, there is clearly some cause which acts at a short distance; but if constancy is observed, a great step would be taken towards the settlement of the question as to the existence of strong variations common to a wide area.

When magnetic anomalies are observed, the first thing to be done is to ascertain whether the values found in a given locality have a definite meaning—that is, whether they do not change for slight displacements; otherwise, the determination of the magnetic elements has no meaning, as it is impossible to refer them to geographical co-ordinates.

The overlooking of this precaution has often led to serious mistakes. ALFONSO SELLA.

Biella, July 4.

Physical Religion.

As a constant reader of NATURE from its commencement, and the possessor of its forty-three and a half volumes, I venture (after reading the review of "Physical Religion" in this week's number) to ask if it is intended to develop it into a theological journal. Because, however smart it may be to abolish Abraham without "even taking the trouble to discuss" him, or to dispose of *Lux Mundi* in a contemptuous sentence, it is hardly in accordance with scientific methods.

It is curious that many "Agnostics," though by their own showing (if they would talk Latin instead of Greek) they are *Ignoramuses* at best, should be so certainly sure of everything, when a little reflection and modesty might satisfy them that as "*Know-nothings*" (in plain English) they have no more right to *deny* than to *assert*.

The standing motto of your title might be improved by the addition of "Ne supra crepidam sutor."

Hampstead Heath, July 11. B. WOODD SMITH.

SOME APPLICATIONS OF PHOTOGRAPHY.[1]

ONE of the subjects to which I propose to invite your attention this evening is the application of instantaneous photography to the illustration of certain mechanical phenomena which pass so quickly as to elude ordinary means of observation. The expression "instantaneous photography" is perhaps not quite a defensible one, because no photography can be really instantaneous—some time must always be occupied. One of the simplest and most commonly used methods of obtaining very short exposures is by the use of movable shutters, for which purpose many ingenious mechanical devices have been invented. About two years ago we had a lecture from Prof. Muybridge, in which he showed us the application of this method—and a remarkably interesting application it was—to the examination of the various positions assumed by a horse in his several gaits. Other means, however, may be employed to the same end, and one of them depends upon the production of an instantaneous light. It will obviously come to the same thing whether the light to which we expose the plates be instantaneous, or whether by a mechanical device we allow the plate to be submitted to a continuous light for

[1] Friday Evening Discourse, delivered at the Royal Institution of Great Britain, on February 6, 1891, by Lord Rayleigh, F.R.S., Professor of Natural Philosophy, R.I.

only a very short time. A good deal of use has been made in this way of what is known as the magnesium flash light. A cloud of magnesium powder is ignited, and blazes up quickly with a bright light of very short duration. Now I want to compare that mode of illumination with another, in order to be able to judge of the relative degree of instantaneity, if I may use such an expression. We will illumine for a short time a revolving disk, composed of black and white sectors; and the result will depend upon how quick the motion is as compared with the duration of the light. If the light could be truly instantaneous, it would of necessity show the disk apparently stationary. I believe that the duration of this light is variously estimated at from one-tenth to one-fiftieth of a second; and as the arrangement that I have here is one of the slowest, we may assume that the time occupied will be about a tenth of a second. I will say the words one, two, three, and at the word three Mr. Gordon will project the powder into the flame of a spirit-lamp, and the flash will be produced. Please give your attention to the disk, for the question is whether the present uniform grey will be displaced by a perception of the individual black and white sectors. [Experiment.] You see the flash was *not* instantaneous enough to resolve the grey into its components.

I want now to contrast with that mode of illumination one obtained by means of an electric spark. We have here an arrangement by which we can charge Leyden jars from a Wimshurst machine. When the charge is sufficient, a spark will pass inside a lantern, and the light proceeding from it will be condensed and thrown upon the same revolving disk as before. The test will be very much more severe; but, severe as it is, I think we shall find that the electric flash will bear it. The teeth on the outside of the disk are very numerous, and we will make them revolve as fast as we can, but we shall find that under the electric light they will appear to be absolutely stationary. [Experiment.] You will agree that the outlines of the black and white sectors are seen perfectly sharp.

Now, by means of this arrangement we might investigate a limit to the duration of the spark, because with a little care we could determine how fast the teeth are travelling—what space they pass through in a second of time. For this purpose it would not be safe to calculate from the multiplying gear on the assumption of no slip. A better way would be to direct a current of air upon the teeth themselves, and make them give rise to a musical note, as in the so-called siren. From the appearance of the disk under the spark we might safely say, I think, that the duration of the light is less than a tenth of the time occupied by a single tooth in passing. But the spark is in reality much more instantaneous than can be proved by the means at present at our command. In order to determine its duration, it would be necessary to have recourse to that powerful weapon the revolving mirror; and I do not, therefore, propose to go further into the matter to-night.

Experiments of this kind were made some twenty years ago by Prof. Rood, of New York, both on the duration of the discharge of a Leyden jar, and also on that of lightning. Prof. Rood found that the result depended somewhat upon the circumstances of the case, the discharge of a small jar being generally more instantaneous than that of a larger one. He proved that in certain cases the duration of the principal part of the light was as low as one twenty-five-millionth part of a second of time. That is a statement which probably conveys very little of its real meaning. A million seconds is about twelve days and nights. Twenty-five million seconds is nearly a year. So that the time occupied by the spark in Prof. Rood's experiment is about the same fraction of one second that one second is of a year. In many other cases the duration was somewhat greater; but in all his experiments it was well under the one-millionth part of a second. In certain cases you may have multiple sparks. I do not refer to the oscillating discharges of which Prof. Lodge gave us so interesting an account last year; Prof. Rood's multiple discharge was not of that character. It consisted of several detached overflows of his Leyden jar when charged by the Rhumkorff coil. One number mentioned for the total duration was one six-thousandth part of a second; but the individual discharges had the degree of instantaneity of which I have spoken.

It is not a difficult matter to adapt the electrical spark to instantaneous photography. We will put the lantern into its proper position, excite the electric sparks within it, causing them to be condensed by the condenser of the lantern on to the photographic lens. We will then put the object in front of the lantern-condenser, remove the cap from the lens, expose the plate to the spark when it comes, and thus obtain an instantaneous view of whatever may be going on. I propose to go through the operation of taking such a photograph presently. I will not attempt any of the more difficult things of which I shall speak, but will take a comparatively easy subject—a stream of bubbles of gas passing up through a liquid. In order that you may see what this looks like when observed in the ordinary way, we have arranged it here for projection upon the screen. [Experiment.] The gas issues from the nozzle, and comes up in a stream, but so fast that you cannot fairly see the bubbles. If, however, we take an instantaneous picture, we shall find that the stream is decomposed into its constituent parts. We arrange the trough of liquid in front of the lantern which contains the spark-making apparatus—[Experiment]—and we will expose a plate, though I hardly expect a good result in a lecture. A photographer's lamp provides some yellow light to enable us to see when other light is excluded. There goes the spark; the plate is exposed, and the thing is done. We will develop the plate, and see what it is good for; and if it turns out fit to show, we will have it on the screen within the hour.

In the meantime, we will project on the screen some slides taken in the same way and with the same subject. [Photograph shown.] That is an instantaneous photograph of a stream of bubbles. You see that the bubbles form at the nozzle from the very first moment, contrasting in that respect with the behaviour of jets of water projected into air (Fig. 1).

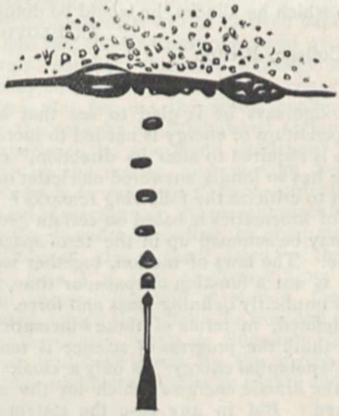


FIG. 1.

The latter is our next subject. This is the reservoir from which the water is supplied. It issues from a nozzle of drawn-out glass, and at the moment of issue it consists of a cylindrical body of water. The cylindrical form is unstable, however, and the water rapidly breaks up into drops, which succeed one another so rapidly that they can hardly be detected by ordinary vision. But by means of instantaneous photography the individual drops can be made evident. I will first project the jet itself on the screen, in order that you may appreciate the subject which we shall see presently represented by photography. [Experiment.] Along the first part of its length the jet of water is continuous. After a certain point it breaks into drops, but you cannot see them because of their rapidity. If we act on the jet with a vibrating body, such as a tuning-fork, the breaking into drops occurs still earlier, the drops are more regular, and assume a curious periodic appearance, investigated by Savart. I have some photographs of jets of that nature. Taken as described, they do not differ much in appearance from those obtained by Chichester Bell, and by Mr. Boys. We get what we may regard as simply shadows of the jet obtained by instantaneous illumination; so that these photographs show little more than the outlines of the subject. They show a little more, on account of the lens-like action of the cylinder and of the drops. Here we have an instantaneous view of a jet similar to the one we were looking at just now (Fig. 2). This is the continuous part; it gradually ripples itself as it comes along; the ripples increase; then the contraction becomes a kind of ligament connecting consecutive drops;

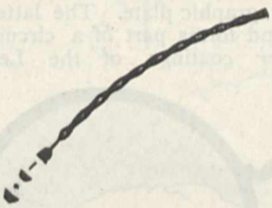


FIG. 2.

the ligament next gives way, and we have the individual drops completely formed. The small points of light are the result of the lens-like action of the drops. [Other instantaneous views also shown.]

The pictures can usually be improved by diffusing somewhat the light of the spark with which they are taken. In front of the ordinary condensing lens of the magic lantern we slide in a piece of ground glass, slightly oiled, and we then get better pictures showing more shading. [Photograph shown.] Here is one done in that way; you would hardly believe it to be water resolved into drops under the action of a tremor. It looks more like mercury. You will notice the long ligament trying to break up into drops on its own account, but not succeeding (Fig. 3).

There is another, with the ligament extremely prolonged. In this case it sometimes gathers itself into two drops (Fig. 4).

[A number of photographs showing slight variations were exhibited.]

The mechanical cause of this breaking into drops is, I need hardly remind you, the surface tension or capillary force of the liquid surface. The elongated cylinder is an unstable form, and tends to become alternately swollen and contracted. In speaking on this subject I have often been embarrassed for want of an appropriate word to describe the condition in question. But a few days ago, during a biological discussion, I found that there is a recognized, if not a very pleasant, word. The cylindrical jet may be said to become *varicose*, and the varicosity goes on increasing with time, until eventually it leads to absolute disruption.

There is another class of unstable jets presenting many points of analogy with the capillary ones, and yet in many respects quite distinct from them. I refer to the phenomena of sensitive flames. The flame, however, is not the essential part of the matter, but rather an indicator of what has happened. Any jet of fluid playing into a stationary environment is sensitive, and the most convenient form for our present purpose is a jet of coloured in uncoloured water. In this case we shall use a solution of permanganate of potash playing into an atmosphere of other water containing acid and sulphate of iron, which exercises a decolourising effect on the permanganate, and so retards the general clouding up of the whole mass by accumulation of colour. [Experiment.] Mr. Gordon will release the clip, and we shall get a jet of permanganate playing into the liquid. If everything were pefectly steady, we might see a line of purple liquid extending to the bottom of the trough; but in this theatre it is almost impossible to get anything steady. The instability to which the jet is subject now manifests itself, and we get a breaking away into clouds something like smoke from chimneys. A heavy tuning-fork vibrating at ten to the second acts upon it with great advantage, and regularizes the disruption. A little more pressure will increase the instability, and the jet goes suddenly into confusion, although at first, near the nozzle, it is pretty regular.

It may now be asked "What is the jet doing?" That is just the question which the instantaneous method

FIG. 3.

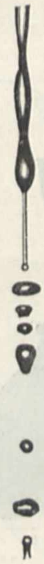


FIG. 4.

enables us to answer. For this purpose the permanganate which we have used to make the jet visible is not of much service. It is too transparent to the photographic rays, and so it was replaced by bichromate of potash. Here the opposite difficulty arises; for the bichromate is invisible by the yellow light in which the adjustments have to be made. I was eventually reduced to mixing the two materials together, the one serving to render the jet visible to the eye and the other to the photographic plate. Here is an instantaneous picture of such a jet as was before you a moment ago, only under the action of a regular vibrator. It is *sinuous*, turning first in one direction and then in the other. The original cylinder, which is the natural form of the jet as it issues from the nozzle, curves itself gently as it passes along through the water. It thus becomes sinuous, and the amount of the sinuosity increases, until in some cases the consecutive folds come into collision with one another. [Several photographs of sinuous jets were shown, two of which are reproduced in Figs. 5 and 6.]

The comparison of the two classes of jets is of great interest. There is an analogy as regards the instability, the vibrations caused by disturbance gradually increasing as the distance from the nozzle increases; but there is a great difference as to the nature of the deviation from the equilibrium condition, and as to the kind of force best adapted to bring it about. The one gives way by becoming varicose; the other by becoming sinuous. The only forces capable of producing varicosity are symmetrical forces, which act alike all round. To produce sinuosity, we want exactly the reverse—a force which acts upon the jet transversely and unsymmetrically.

I will now pass on to another subject for instantaneous photography--namely, the soap film. Everybody knows that if you blow a soap bubble it will break—generally before you wish. The process of breaking is exceedingly rapid, and difficult to trace by the unaided eye. If we can get a soap film on this ring, we will project it upon the screen and then break it before your eyes, so as to enable you to form your own impressions as to the rapidity of the operation. For some time it has been my ambition to photograph a soap bubble in the act of breaking. I was prepared for difficulty, believing that the time occupied was less than the twentieth of a second. But it turns out to be a good deal less even than that. Accordingly the subject is far more difficult to deal with than are those jets of water or coloured liquids which one

Fig. 5.

Fig. 6.

can photograph at any moment that the spark happens to come.

There is the film, seen by reflected light. One of the first difficulties we have to contend with is that it is not easy to break the film exactly when we wish. We will drop a shot through it. The shot has gone through, as you see, but it has not broken the film; and when the film is a thick one, you may drop a shot through almost any number of times from a moderate height without producing any effect. You would suppose that the shot in going through would necessarily make a hole, and end the life of the film. The shot goes through, however, without making a hole. The operation can be traced, not very well with a shot, but with a ball of cork stuck on the end of a pin, and pushed through. A dry shot does not readily break the film; and as it was necessary for our purpose to effect the rupture in a well-defined manner, here was a difficulty which we had to overcome. We found, after a few trials, that we could get over it by wetting the shot with alcohol.

We will try again with dry shot. Three shots have gone through and nothing has happened. Now we will try one wetted with alcohol, and I expect it will break the film at once. There! it has gone!

The apparatus for executing the photography of a breaking soap film will of necessity be more complicated than before, because we have to time the spark exactly with the breaking of the film. The device I have used is to drop two balls simultaneously, so that one should determine the spark and the other rupture the film. The most obvious plan was to hang iron balls to two electro-magnets, and cause them to drop by breaking the circuit, so that both were let go at the same moment. The method was not quite a success, however, because there was apt to be a little hesitation in letting go the balls. So we adopted another plan. The balls were not held by electro-magnetism, but by springs (Fig. 8) pressing laterally, and these were pulled off by electro-magnets. The proper moment for putting down the key and so liberating the balls, is indicated by the tap of the beam of an attracted disk electrometer as it strikes against the upper stop. One falling ball determines the spark, by filling up most of the interval between two fixed ones submitted to the necessary electric pressure. Another ball, or rather shot, wetted with alcohol, is let go at the same moment, and breaks the film on its passage through it. By varying the distances dropped through, the occurrence of one event may be adjusted relatively to the other. The spark which passes to the falling ball is, however, not the one which illuminates the photographic plate. The latter occurs within the lantern, and forms part of a circuit in connection with the *outer* coatings of the Leyden jars,[1] the

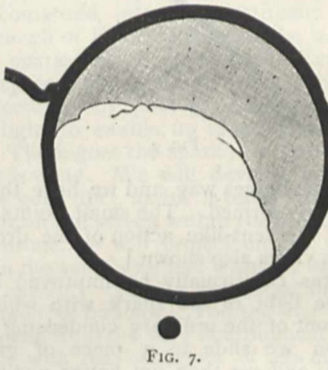


Fig. 7.

whole arrangement being similar to that adopted by Prof. Lodge in his experiments upon alternative paths of discharge. Fig. 8 will give a general idea of the disposition of the apparatus. [Several photographs of breaking films were shown upon the screen; one of these is reproduced in Fig. 7.][2]

This work proved more difficult than I had expected; and the evidence of our photographs supplies the explanation—namely, that the rupture of the film is an extraordinarily rapid operation. It was found that the whole difference between being too early and too late was represented by a displacement of the falling ball through less than a diameter, viz. $\frac{1}{4}$ inch nearly. The drop which we gave was about a foot. The speed of the ball would thus be about 100 inches per second; therefore the whole difference between being too soon and too late is represented by $\frac{1}{300}$ second. Success is impossible, unless the spark can be got to occur within the limits of this short interval.

Prof. Dewar has directed my attention to the fact that Dupré, a good many years ago, calculated the speed of rupture of a film. We know that the energy of the film is in proportion to its area. When a film is partially broken, some of the area is gone, and the corresponding potential energy is expended in generating the velocity of

[1] In practice there were two sets of three jars each.

[2] The appearance of the breaking bubble, as *seen* under instantaneous illumination, was first described by Marangoni and Stephanelli, *Nuovo Cimento*, 1873.

the thickened edge, which bounds the still unbroken portion. The speed, then, at which the edge will go depends upon the thickness of the film. Dupré took a rather extreme case, and calculated a velocity of 32 metres per second. Here, with a greater thickness, our velocity was, perhaps, 16 yards a second, agreeing fairly well with Dupré's theory.

I now pass on to another subject with which I have lately been engaged—namely, the connection between aperture and the definition of optical images. It has long been known to astronomers and to those who study optics that the definition of an optical instrument is proportional to the aperture employed; but I do not think that the theory is as widely appreciated as it should be. I do not know whether, in the presence of my colleague, I may venture to say that I fear the spectroscopists are among the worst sinners in this respect. They constantly speak of the dispersion of their instruments as if that by itself could give any idea of the power employed. You may have a spectroscope of any degree of dispersion, and yet of resolving power insufficient to separate even the D lines. What is the reason of this? Why is it that we cannot get as high a definition as we please with a limited aperture? Some people say that the reason why large telescopes are necessary is, because it is only by their means that we can get enough light. That may be in some cases a sufficient reason, but that it is inadequate in others will be apparent, if we consider the case of the sun. Here we do not want more light, but rather are anxious to get rid of a light already excessive. The principal *raison d'être* of large telescopes is, that without a large aperture definition is bad, however perfect the lenses may be. In accordance with the historical development of the science of optics, the student is told that the lens collects the rays from one point to a focus at another; but when he has made further advance in the science he finds that this is not so. The truth is that we are in the habit of regarding this subject in a distorted manner. The difficulty is, not to explain why optical images are imperfect, no matter how good the lens employed, but rather how it is that they manage to be as good as they are. In reality the optical image of even a mathematical point has a considerable extension; light coming from one point cannot be concentrated into another point by any arrangement. There must be diffusion, and the reason is not hard to see in a general way. Consider what happens at the mathematical focus, where, if anywhere, the light should all be concentrated. At that point all the rays coming from the original radiant point arrive in the same phase. The different paths of the rays are all rendered optically equal, the greater actual distance that some of them have to travel being compensated for in the case of those which come through the centre by an optical retardation due to the substitution of glass for air; so that all the rays arrive at the same time.[1] If we take a point not quite at the mathematical focus but near it, it is obvious that there must be a good deal of light there also. The only reason for any diminution at the second point lies in the discrepancies of phase which now occur; and these can only enter by degrees. Once grant that the image of a mathematical point is a diffused patch of light, and it follows that there must be a limit to definition. The images of the com-

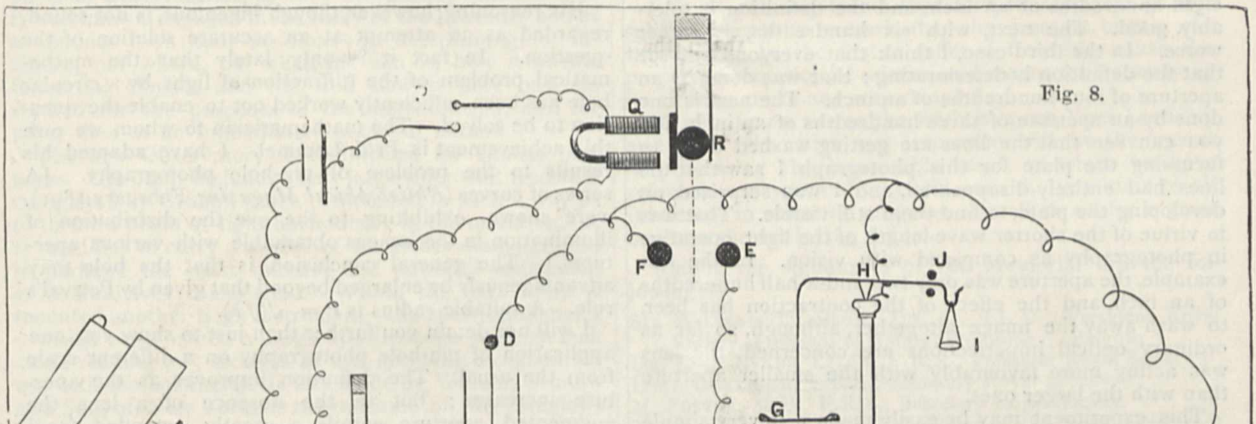


Fig. 8.

A, B, Electrodes of Wimshurst machine.
C, D, Terminals of interior coatings of Leyden jars.
E, F, Balls on insulating supports between which the discharge is taken.
G, Attracted disk of electrometer.
H, Knife edge. I, Scale pan.
J, Stops limiting movement of beam.
K, Sparking balls in connection with exterior coatings of jars. [These exterior coatings are to be joined by an imperfect conductor, such as a table.]
L, Lantern condenser. M, Soap film.
N, Photographic camera. O, Daniell cell.
P, Key. Q, Electro-magnets. R, Balls.

[1] On this principle we may readily calculate the focal lengths of lenses without use of the law of sines (see *Phil. Mag.*, December 1879).

ponents of a close double point will overlap; and if the distance between the centres do not exceed the diameter of the representative patches of light, there can be no distinct resolution. Now their diameter varies inversely as the aperture; and thus the resolving power is directly as the aperture.

My object to-night is to show you by actual examples that this is so. I have prepared a series of photographs of a grating consisting of parallel copper wires separated by intervals equal to their own diameter, and such that the distance from centre to centre is $\frac{1}{10}$ inch. The grating was backed by a paraffin lamp and large condensing lens; and the photographs were taken in the usual way, except that the lens employed was a telescopic object-glass, and was stopped by a screen perforated with a narrow adjustable slit, parallel to the wires.[1] In each case the exposure was inversely as the aperture employed. The first [thrown upon the screen] is a picture done by an aperture of eight hundredths of an inch, and the definition is tolerably good. The next, with six hundredths, is rather worse. In the third case, I think that everyone can see that the definition is deteriorating; that was done by an aperture of four hundredths of an inch. The next is one done by an aperture of three hundredths of an inch, and you can see that the lines are getting washed out. In focussing the plate for this photograph I saw that the lines had entirely disappeared, and I was surprised, on developing the plate, to find them still visible. That was in virtue of the shorter wave-length of the light operative in photography as compared with vision. In the last example, the aperture was only two-and-a-half hundredths of an inch, and the effect of the contraction has been to wash away the image altogether, although, so far as ordinary optical imperfections are concerned, the lens was acting more favourably with the smaller aperture than with the larger ones.

This experiment may be easily made with very simple apparatus; and I have arranged that each one of my audience may be able to repeat it by means of the piece of gauze and perforated card which have been distributed. The piece of gauze should be placed against the window so as to be backed by the sky, or in front of a lamp provided with a ground-glass or opal globe. You then look at the gauze through the pin-holes. Using the smaller hole, and gradually drawing back from the gauze, you will find that you lose definition and ultimately all sight of the wires. That will happen at a distance of about $4\frac{1}{2}$ feet from the gauze. If, when looking through the smaller hole, you have just lost the wires, you shift the card so as to bring the larger hole into operation, you will see the wires again perfectly.

That is one side of the question. However perfect your lens may be, you cannot get good definition if the aperture is too much restricted. On the other hand, if the aperture is much restricted, then the lens is of no use, and you will get as good an image without it as with it.

I have not time to deal with this matter as I could wish, but I will illustrate it by projecting on the screen the image of a piece of gauze as formed by a narrow aperture parallel to one set of wires. There is no lens whatever between the gauze and the screen. [Experiment.] There is the image—if we can dignify it by such a name—of the gauze as formed by an aperture which is somewhat large. Now, as the aperture is gradually narrowed, we will trace the effect upon the definition of the wires parallel to it. The definition is improving; and now it looks tolerably good. But I will go on, and you will see that the definition will get bad again. Now, the aperture has been further narrowed, and the lines are getting washed out. Again, a little more, and they are gone. Perhaps you may think that the explanation lies in the faintness of the light. We cannot avoid the loss of light which accompanies the contraction of aperture, but to prove that the result is not so to be explained, I will now put in a lens. This will bring the other set of wires into view, and prove that there was plenty of light to enable us to see the first set if the definition had been good enough. Too small an aperture, then, is as bad as one which is too large; and if the aperture is sufficiently small, the image is no worse without a lens than with one.

What, then, is the best size of the aperture? That is the important question in dealing with pin-hole photography. It was first considered by Prof. Petzval, of Vienna, and he arrived at the result indicated by the formula, $2r^2 = f\lambda$, where $2r$ is the diameter of the aperture, λ the wave-length of light, and f the focal length, or rather simply the distance between the aperture and the screen upon which the image is formed.

His reasoning, however, though ingenious, is not sound, regarded as an attempt at an accurate solution of the question. In fact it is only lately that the mathematical problem of the diffraction of light by a circular hole has been sufficiently worked out to enable the question to be solved. The mathematician to whom we owe this achievement is Prof. Lommel. I have adapted his results to the problem of pin-hole photography. [A series of curves (*Philosophical Magazine*, February 1891), were shown, exhibiting to the eye the distribution of illumination in the images obtainable with various apertures.] The general conclusion is that the hole may advantageously be enlarged beyond that given by Petzval's rule. A suitable radius is $r = \sqrt{(f\lambda)}$.

I will not detain you further than just to show you one application of pin-hole photography on a different scale from the usual. The definition improves as the aperture increases; but in the absence of a lens the augmented aperture entails a greatly extended focal length. The limits of an ordinary portable camera are thus soon passed. The original of the transparency now to be thrown upon the screen was taken in an ordinary room, carefully darkened. The aperture (in the shutter) was 0·07 inch, and the distance of the 12 × 10 plate from the aperture was 7 feet. The resulting picture of a group of cedars shows nearly as much detail as could be seen direct from the place in question.

[1] The distance between the grating and the telescope lens was 12 feet 3 inches.

THE SMITHSONIAN ASTRO-PHYSICAL OBSERVATORY.

THE Smithsonian Institution, as we have already announced, has established as one of its departments a Physical Observatory which, with the instruments, has been supplied from the Smithsonian Fund. It occupies at present a temporary structure, though funds have been subscribed for a permanent building when Congress shall provide a suitable site. For the maintenance of the Observatory an appropriation has been made by Congress which became available on July 1. The actual instrumental work of the new Observatory will necessarily devolve largely upon a senior and a junior assistant, who can devote their entire time to research, and it is hoped that with the improved apparatus it will be possible to prosecute advantageously investigations in telluric and astro-physics, and particularly those with the bolometer in radiant energy.

In accepting the position of assistant secretary of the Smithsonian Institution in 1887, Mr. Langley retained the Directorship of the Observatory at Allegheny for the purpose of completing the researches begun there, and after his appointment as Secretary of the Institution, he still continued the titular Directorship, though but a limited amount of time could be spared from his official duties at the capital. With the completion of the equipment of the little Observatory at Washington, he, however, formally resigned, on April 30, the Directorship at Allegheny, which he had held since 1887; and he will, so far as his administrative occupations permit, give personal attention to the general direction of the investigations.

The class of work which is referred to does not ordinarily involve the use of the telescope, and that which is contemplated is quite distinct from what is carried on at present at any other Observatory in the United States. The work for which the older Government Observatories at Greenwich, Paris, Berlin, and Washington were founded, and in which they are now chiefly engaged, is the determination of relative positions of heavenly bodies, and our own place with reference to them. Within the past twenty years all these Governments, except that of the United States, have established astrophysical Observatories, as they are called, which are, as is well known, engaged in the study of the heavenly bodies as distinct from their positions—in determining, for instance, not where, but what, the sun is, how it affects terrestrial climate and life, and how it may best be studied for the purposes of the meteorologist, and for other uses of an immediately practical nature.

The new Observatory is established for similar purposes. Its outfit includes a very large siderostat (recently completed by Grubb), which is mounted in such a way as to throw a beam of light horizontally in the meridian. It is intended to carry a mirror of 20 inches diameter, and is perhaps the most massive and powerful instrument of its kind ever constructed. Within the dark room is mounted another large instrument—the spectrobolometer—which is, in effect, a large spectroscope with 20-inch circle reading to 5 seconds of arc, specially designed for use with the bolometer. It was made by William Grunow and Son, of New York, as the outcome of Mr. Langley's experience with smaller apparatus during his earlier investigations. The most important part of the instrumental equipment is completed by specially designed galvanometers, scales, and a peculiar resistance box; and these three instruments, used in conjunction with the bolometer, and perhaps with the aid of photography, will be employed in the investigations upon light, heat, and radiant energy in general, for which the Observatory is primarily intended, though some departments of terrestrial physics may also receive attention.

THE NEW GALLERY OF BRITISH ART.

WE believe that the Committee appointed by the Corporation to consider the question of the grant of a site on the Embankment for the new gallery will soon make its report. The *Pall Mall Gazette* of Tuesday says:—"There is a vacant piece of just one acre at Blackfriars, on the land acquired some years ago and cleared of the old City gas-works by the Corporation. This land originally cost some £260,000; and on portions of it have been erected the City of London School and Sion College. The value of the entire holding has increased to at least £550,000; so that if the proposed piece, which is valued at about £120,000, were made over by the Corporation for the Art Gallery, the City would still be a gainer of some £170,000 by the transaction."

In the meantime, public opinion is rapidly growing, not only in favour of some of our national buildings devoted to art finding a home in the City, but also against the site at South Kensington—bought for scientific purposes, and required to meet existing needs—being diverted from its proper and natural use.

Both these views are expressed in the following Memorial, which, although circulated chiefly among men of science during the last few days, contains the names of many representative men in other branches. It has been transmitted to the Lord Mayor during the present week.

Memorial to the Right Honourable the Lord Mayor of London.

WE, the undersigned, having heard that there is a possibility of the City of London finding a site on the Embankment for the National Gallery of British Art, which a munificent donor has proposed to build, venture to approach Your Lordship with our earnest request that you will yourself support, and use your best endeavours to urge upon the City authorities, the very great importance of giving effect to this proposal.

The memorial already presented to the Prime Minister will have made Your Lordship aware of the many strong objections, from the scientific point of view, to the site which was suggested for the gallery in the first instance.

It is unnecessary for us, therefore, to say more on this subject, except to remark that the greatest city in the world must be the first to suffer if, from any cause, the proper presentation of science and means for its study by its citizens are in any way crippled.

By affording a site on the Embankment, Your Lordship and the authorities you represent will be the means of preventing the lamentable result to which we have referred, and you and they will earn the gratitude of all interested in scientific progress, as well as confer a great boon on the art-loving public.

Among the signatories of the Memorial are the following:—

SIR WILLIAM THOMSON, D.C.L., LL.D., President Royal Society, Professor of Natural Philosophy, Glasgow.
DR. JOHN EVANS, LL.D., F.R.S., Treasurer Royal Society.
LORD RAYLEIGH, F.R.S., Secretary Royal Society.
M. FOSTER, M.D., F.R.S., Secretary Royal Society.
THOMAS H. HUXLEY, F.R.S., Dean of the Royal College of Science, London.
LIEUT.-GENERAL R. STRACHEY, F.R.S., C.I.E., Chairman Meteorological Council.
NEVIL STORY MASKELYNE, F.R.S., M.P., Professor of Mineralogy, University of Oxford.
SIR JOHN LUBBOCK, Bart., M.P., F.R.S., Chairman London County Council, Past-President British Association.
SIR RICHARD QUAIN, Bart., M.D., F.R.S.
SIR WILLIAM ROBERTS, F.R.S., M.D.
WILLIAM CROOKES, F.R.S., President Institute Electrical Engineers.
WILLIAM SUMMERS, M.P.
J. W. L. GLAISHER, M.A., F.R.S.
ALFRED NEWTON, F.R.S., Professor of Zoology, University of Cambridge.
T. E. THORPE, F.R.S., Professor of Chemistry, Royal College of Science, Treasurer Chemical Society.
JOHN W. JUDD, F.R.S., Professor of Geology, Royal College of Science.
WILLIAM HUGGINS, D.C.L., F.R.S., President-Elect of the British Association.
SIR G. G. STOKES, Bart., M.P., Past-President Royal Society, Lucasian Professor, University of Cambridge.
SIR HENRY E. ROSCOE, LL.D., F.R.S., M.P., Past-President British Association.
W. GRYLLS ADAMS, F.R.S., Professor of Physics, King's College, Past-President Physical Society.
J. FLETCHER MOULTON, Q.C., F.R.S.
E. A. SCHÄFER, F.R.S., Professor of Physiology, University College, London.
HERBERT MCLEOD, F.R.S., Professor of Chemistry, Cooper's Hill.
HUGO MÜLLER, F.R.S., Past-President Chemical Society.
ARTHUR W. RÜCKER, F.R.S., Professor of Physics, Royal College of Science, London, Treasurer Physical Society.
WILLIAM CAWTHORNE UNWIN, F.R.S., Professor of Engineering, City and Guilds of London Institute.
W. E. AYRTON, F.R.S., Professor of Physics, City and Guilds of London Institute, President Physical Society.

O. Henrici, F.R.S., Professor of Mathematics, City and Guilds of London Institute.
Henry E. Armstrong, F.R.S., Professor of Chemistry, City and Guilds of London Institute, Secretary Chemical Society.
R. B. Clifton, M.A., F.R.S., Professor of Natural Philosophy, University of Oxford.
J. Burdon Sanderson, F.R.S., Professor of Physiology, Oxford.
William Odling, F.R.S., Professor of Chemistry, Oxford.
William Esson, F.R.S., Oxford.
Edward B. Poulton, F.R.S., Oxford.
E. Ray Lankester, F.R.S., Deputy Professor of Anatomy, Oxford.
G. Carey Foster, F.R.S., Professor of Physics, University College, London; Past President Physical Society.
J. Hopkinson, F.R.S., Wheatstone Professor of Electricity, King's College, London.
Captain Abney, C.B., F.R.S.
The Very Rev. G. G. Bradley, D.D., C.B., Dean of Westminster.
William Black.
Lewis Morris.
W. H. M. Christie, F.R.S., Astronomer-Royal.
William Morris.
Walter Crane.
W. J. Russell, F.R.S., Professor of Chemistry, St. Bartholomew's Hospital, Past-President Chemical Society.
The Lord Tennyson, F.R.S., Poet Laureate.
Hallam Tennyson.

CARDINAL HAYNALD.

THE death of Cardinal Haynald, Archbishop of Kalocsa, is announced in the daily papers as having taken place on Saturday, the 4th inst. It was not an unexpected event, as his health had been gradually getting worse for some two or three years. Last year he celebrated the jubilee of his priesthood, and Dr. A. Kanitz, Professor of Botany in the University of Klausenburg, made it the occasion of publishing a eulogy on him as a botanist. This was translated into French by Prof. E. Martens, of Louvain. Although an excellent botanist, Cardinal Haynald was better known as a patron of botany than as a contributor to botanical literature. For the following particulars of his life and work we are mainly indebted to Dr. Kanitz's memoir.

Cardinal Haynald was born about 1816. His taste for botany was inherited from his father, who himself possessed a fine herbarium. During his stay at Vienna, in the Augustinæum, a theological college, he became acquainted with Edward Fenzl, then assistant curator of the botanical department of the Court, under whose tuition his botanical studies took a more practical shape. His priestly duties, however, did not allow him to follow his favourite study until he was appointed Bishop of Transylvania, when he began to investigate the flora of this country with indefatigable zeal. He became Archbishop of Karthago, and afterwards of Kalocsa, and after the accession of Leo the Tenth to the Papal chair, a Cardinal. He was a long time a prominent member of the Hungarian House of Magnates, and from 1873 also a member of the Royal Hungarian Academy of Science. Although always overburdened by the sacerdotal, political, and social duties of his high position, he found time to continue his botanical studies. He published only a few botanical papers, partly on Hungarian plants, and partly biographical sketches of botanists with whom he was more intimately acquainted, as Fenzl, Parlatore, and Boissier. His greatest merit, however, from a scientific point of view, was the assistance which he gave to botanical studies in Hungary by establishing a great private herbarium, which he placed in the most liberal way at anybody's disposal, and by the magnanimous generosity with which he always supported botanical enterprise, both in Hungary and abroad. The herbarium at his residence at Kalocsa was not only the richest in Hungary, but one of the largest private collections on the Continent. It was largely formed by the purchase of the herbaria of Heuffel, Schott, Kotschy, and Sodiro. Besides these and the plants collected by himself, he acquired most of the collections which have been distributed by subscription.

Hungary loses in Cardinal Haynald one of her greatest patriots, who was an honour to his profession, as well as to science, of which he was always a generous benefactor. Schur named after him a genus of grasses, founded on *Secale villosum*, Linn., which is reduced by Bentham and Hooker to Agropyrum, and Kanitz a genus of Lobeliaceæ.

OXFORD SUMMER MEETING OF UNIVERSITY EXTENSION STUDENTS.

THE process by which University Extension is carried throughout the country and made a vehicle for the further education of the adult student is well known, and is gradually becoming more and more appreciated in proportion as those who are responsible for the method improve the lines on which it is carried out. The machinery employed embraces lectures, classes, travelling libraries, &c., but one element vitally necessary to the University student is not supplied by these aids. This element is that of residence, and it was a happy suggestion on the part of the originators to propose that, for one month in the Long Vacation, arrangements should be made by which those who have profited by being brought into contact with a University lecturer should enjoy the additional advantage of being brought under the charm that haunts the colleges and cloisters of Oxford and Cambridge.

The Oxford summer meeting commences on July 31, and is continued throughout the month of August; but, for the benefit of students who are unable to be present during so long a period, the course is divided into two sections, the second commencing on August 12. It has been found desirable to remove as far as possible the fragmentary and isolated character of the lectures given at these meetings, and therefore, while the course will be complete and independent in itself, it will also form the first part of a cycle of study which for its full development will embrace a period of four summers.

That these lectures propose something more than to add piquancy to an agreeable picnic will be shown from the following slight sketch of the subjects treated—and treated by authorities of acknowledged reputation. To take the lectures on natural science first: in physiology, Mr. Poulton will discuss the recent criticisms of Weismann's theory of heredity, and Mr. Gotch will lecture on the functions of the heart. In chemistry, Prof. Odling lectures on the benzene ring, and under the supervision of Mr. Marsh a course of practical chemistry will be conducted in the laboratory of the University Museum. In geology, a course of practical instruction will be given by Prof. Green and Mr. Badger, to include excursions in the neighbourhood of Oxford. A class in practical astronomy will be welcomed at the University Observatory; while electricity finds an able exponent in Mr. G. J. Burch. But the distinguishing feature of this meeting is the attention given to agricultural science "designed for agricultural audiences under County Council schemes." This designation seems somewhat vague, and it will be very interesting to see the character of the audience attracted by this title. Four lectures are offered: the first is entitled, "The application of Science to the art of Agriculture." This description is sufficiently wide, but does not indicate whether the lecture is intended as a sample of those which State-aided Board schools in agricultural districts might well offer to lads who have passed through the successive standards, or as one addressed to the sons of farmers, and supplying that form of instruction which it is the duty of agricultural colleges to impart. Another lecture is offered on the management of poultry. This is more definite and more hopeful; and when we remember that the students who come up for these summer meetings are, for the most part, ladies, who can well be supposed to take an intelligent interest in this part of farming operations, we must admit that the subject is well chosen. Manures of various characters form the subject of the other two lectures, and will be doubtless of a sufficiently technical character.

The literature and history lectures are of special interest, and by the combination of many lecturers are made to cover with great completeness the mediæval period. Mr. Frederic Harrison gives, as an inaugural lecture, a survey of the thirteenth century, and strikes the keynote of this section; while in the entire course, which embraces some sixty lectures, we meet the names of Prof. Dicey, of Mr. York Powell, of Mr. Boas, and a host of others, affording alike a sufficient guarantee for the excellence of the work, and a happy augury for the success of the meeting.

THE PROPOSED TEACHING UNIVERSITY FOR LONDON.

ON Monday, at the Council Office in Downing Street the Universities Committee of the Privy Council, consisting of the Lord President of the Council (Viscount Cranbrook), the Earl of Selborne, Lord Monk Bretton, Lord Basing, and Lord Sandford, reassembled for the purpose of giving their decision on the petition of King's and University Colleges for the grant of a charter for the establishment of a Teaching University for London.

The Earl of Selborne, in giving the opinion of their Lordships upon the draft charter of the proposed University, said, with regard to the opposition of the existing University of London, that some of the objections made might be treated as disallowed. It had been understood by their Lordships that a minimum course of two years' study at the new University would be required. If that was so, their Lordships were satisfied, and would say no more upon the point. The objections put forward by the medical faculty were generally disallowed. The word "London" would have to be omitted from the charter, but the University might be called either "the Albert University" or "the Metropolitan University." With regard to the suggestion that ten members of the Faculty of Medicine should be elected to the Council, their Lordships were of opinion that the medical schools should fill five places upon that body, or, if it were preferred, that each school should elect one member for the Medical Board of Study. If the Royal Colleges and the medical schools agreed to come in together, however, the number of members on the Council might be raised. Their Lordships did not approve of the proposed strength of the Council, and thought that four of the places might be accorded to the Faculty of Law. Teachers in any branch of science, their Lordships considered, should be admitted as members of the Science Faculty, and the six places on the Council which it was proposed to give to the Royal Colleges should be supplied according to the 29th paragraph of the Royal Commissioners' Report. If the medical schools and colleges declined to come in at first, provision ought to be made to allow them to do so in the future. Their Lordships thought that a place upon the Council might be given to the Apothecaries' Society, but they were not disposed to insist upon that being done The view of their Lordships upon the question of honorary degrees was that no such degrees should be granted in medicine, and that the holding of an honorary degree should be no qualification for election to the Council. The ordinary degree in medicine should not be granted until the whole of the prescribed conditions had been fulfilled.

NOTES.

THE decision of the Universities Committee of the Privy Council with regard to the proposed new University for London is one that might have been expected from a body of non-experts. It is hasty, and will give satisfaction to no one by whom the subject has been seriously considered. It may throw back the higher teaching in London for half a century.

MR. WALTER BESANT, in an imaginary "Page from the Kaiser's Diary," notes that there are not to be seen at Court any of "the people who make the real greatness of the country—its traders, its manufacturers, its men of science, art, and literature." It has been remarked that in this respect the City Corporation, last Friday, followed the example of the Court, no representative of science, or literature, or art, as such, having been invited to the Guildhall banquet. It would have been better to follow the precedent set at the time of the Czar's visit, when a large number of the leading scientific men were asked to the reception at the Foreign Office, and were personally presented.

AT the ensuing British Association meeting at Cardiff, it is proposed to hold in Section A, if possible in conjunction with Section G, a discussion on "Units and their Nomenclature," having special regard to the new electrical and magnetic units now becoming necessary for practical purposes.

THE Secretary of State for India in Council has appointed, on the nomination of the Government of India, the following persons to represent it on the permanent governing body of the Imperial Institute, for the year ending April 30, 1892:—W. T. Thiselton-Dyer, C.M.G., F.R.S., Director, Royal Gardens, Kew; General James T. Walker, R.E., C.B., F.R.S., late Surveyor-General of India; John W. P. Muir-Mackenzie, Under-Secretary to the Government of India Revenue and Agricultural Department.

SIR J. D. HOOKER has been elected a Foreign Member of the Academy of Sciences in Buda-Pesth.

THE Secretary of State for the Colonies has appointed, on the nomination of Kew, Mr. C. A. Barber, late Scholar of Christ's College, Cambridge, and University Demonstrator in Botany, to be Superintendent of the recently created Agricultural Department of the Leeward Islands. The Superintendent will reside in Antigua, and will have the general supervision of the botanical stations at Antigua, Dominica, Montserrat, and St. Kitts-Nevis.

THE Council of University College, Liverpool, have appointed Mr. Francis Gotch, of Oxford, to their new Chair of Physiology.

THE Foreign Office has expressed the wish that the "Flora of Tropical Africa," prepared at Kew under the editorship of Prof. Oliver, and of which three volumes have appeared, should be continued and completed. It is calculated that four more volumes will be required, and the Treasury has sanctioned a scheme by which the necessary funds will be provided.

THE Accademia dei Lincei of Rome has awarded to Prof Saccardo, of Padua, in acknowledgment of his labours in mycology, the Royal prize of 10,000 francs intended for the encouragement of morphological researches.

The Government has appointed the Council of the Society of Arts as a Royal Commission to direct the formation of the British Section at the Chicago Exhibition. If we may judge from the preparations which are being made in America, the Exhibition is likely to be one of great splendour. One of its attractions will be a collection of objects relating to ethnology and archæology. This is being organized by Prof. Putnam.

A Committee, as we recently stated, has been appointed for the reorganization of the Natural History Museum in Paris. By some who interest themselves in the question it is proposed that the Museum should be made the only institution in Paris for the study of natural history. According to this scheme, all natural history chairs in the Sorbonne and elsewhere would be suppressed, while all chairs in the Museum which do not belong to natural history proper would also disappear. The professors would have to examine all candidates in natural science.

A Committee appointed by the Photographic Society of Great Britain has presented a report on the proposal that the photographic societies of the United Kingdom should unite more closely for the better promotion of their common interests. The Committee advises that it should be open to photographic societies to affiliate themselves to the Photographic Society of Great Britain; and suggestions are made as to the way in which affiliation should be effected.

The fifth session of the Edinburgh Vacation Courses will begin on August 3. M. Espinas, Professor of Philosophy and Dean of the Faculty of Letters in the University of Bordeaux, has been charged by his Government to report upon the educational scheme and methods of these courses, and also desires to inquire into Scottish higher education generally. Dr. H. de Varigny, who will deliver a series of lectures on general biology, is also to report to the French Government on the University Extension movement. The expected presence of these and other foreigners has suggested the idea that it might be well to hold, at Edinburgh, a small informal Congress, or rather a short series of meetings, for the discussion of curricula, higher educational methods, and other questions of immediate interest. Particulars on this subject will shortly be announced.

The Royal Society of Antiquaries of Ireland hold their general meeting in the Town Hall, Killarney, on August 11. Excursions are planned for every day, except Sunday, from August 11 to 20.

The Royal Archæological Institute will hold its annual meeting at Edinburgh from August 11 to 18. Sir Herbert Maxwell will preside.

The German Anthropological Society will hold its twenty-second annual meeting at Danzig, from August 3 to 5.

Her Majesty's Commissioners for the Exhibition of 1851, assisted by a committee of gentlemen experienced in scientific education, have made the following appointments to Science Scholarships for the year 1891. The scholars have been *bonâ-fide* students of science for at least three years, and were nominated for the Scholarships by the authorities of their respective Universities or Colleges. The Scholarships are of the value of £150 a year, and are tenable for two years (subject to a satisfactory report at the end of the first year) in any University at home or abroad, or in some other institution to be approved of by the Commissioners. The scholars are to devote themselves exclusively to study and research in some branch of science the extension of which is important to the industries of the country. A Scholarship was offered to the University of Sydney, but the Council found themselves unable to nominate a suitable candidate. Nominating institution—University of Edinburgh, scholar—John Shields, institution to which scholar proposes to attach himself—University of Edinburgh and a Continental University, probably Leipzig; University of Glasgow, James H. Gray (*a*), University of Glasgow; University of St. Andrews, William Frew, University of Munich; Mason Science College, Birmingham, John Joseph Sudborough, University of Heidelberg; University College, Bristol, Frederick Benjamin Fawcett (*a*), University College, Bristol; Durham College of Science, Newcastle-on-Tyne, William M'Connell, jun. (*a*), Durham College of Science; Yorkshire College, Leeds, Harry Ingle, a German University, probably Wurzburg; University College, Liverpool, Robert Holt (*a*), University College, Liverpool; Owens College, Manchester, Thomas Ewan, Owens College, first year; University College, Nottingham, Edwin H. Barton (*b*), South Kensington; Firth College, Sheffield, Annie J. Hoyles (*a*), Firth College, Sheffield; University College of South Wales and Monmouthshire, Franke Herbert Parker, first year same College, second year a German University; Queen's College, Belfast, Benjamin Moore, University of Leipzig; Royal College of Science for Ireland, Frederick William Dunn, first year University of Glasgow, second year Berlin; M'Gill University, Montreal, Percy Norton Evans, University of Berlin, and probably other German Universities; University of Melbourne, William Huey Steele (*a*), University of Melbourne. (*a*) These scholars have been recommended to spend part of the term of scholarship at some other institution. (*b*) This appointment is conditional on the candidate passing examination for B.Sc. London.

Those who require power for electric lighting may be interested to know that Messrs. Priestman Brothers have a good account to give of the success of their oil-engine. Many orders have been received for engines varying in size from 1 to 25 actual h.p. for electric lighting, and Messrs. Priestman, in order to meet the growing demand, have largely extended their works.

According to a telegram sent through Reuter's Agency from San Francisco, July 11, an enormous cavern in Josephine County, Oregon, at a point twelve miles north of California and forty from the coast, has been discovered. It has two openings, and contains many passages of great beauty. There are numbers of semi-transparent stalactites, several giant milk-white pillars, and a number of pools and streams of clear, cool water. A week was spent in exploring the cavern, and innumerable passages and chambers were discovered. On penetrating one of these passages for a distance of several miles, the exploring party came across a lake of clear water and a waterfall thirty feet high. All kinds of grotesque figures were found in the various chambers; but the only signs of animal life were discovered a short distance from the entrance, where a few bones were found, indicating that bears had carried their prey there. The cavern appears to be fully as large as the Mammoth Cave in Kentucky.

Dr. D. Prain, Curator of the Calcutta Herbarium, has published in the Journal of the Asiatic Society of Bengal, and separately, a memoir on new Indian *Labiatæ*. Nearly fifty species, belonging to upwards of twenty genera, are added to those described in the "Flora of British India." They are mostly from frontier extensions of the Empire, some from the east, some from the west; and nearly half of the species are new to science. Specially interesting among these is Prain's new genus *Microtæna*, founded upon the *Plectranthus Patchouli*, Clarke—a plant cultivated in Assam; and a second species, collected by Griffith, probably in Assam. The first has since been found wild in Muneypore, Burma, Tonkin, and South-Eastern China. Two very distinct species of the same genus have also been recently discovered by Dr. A. Henry, in Central China.

The new "Flora of France," which is being prepared by Prof. G. Bonnier, with the assistance of a number of botanists, will be published under the auspices of the Minister of Public Instruction of France.

The annual publication of the very useful "Correspondance botanique" ceased with the death of its editor, Prof. E. Morren, of Liége. With the aim of supplying its place, the International Library, 4 Rue de la Sorbonne, Paris, has now issued a "Nouvelle Correspondance botanique: liste des botanistes de tous les pays, et des établissements, sociétés, et journaux de botanique."

PRINCE ROLAND BONAPARTE has issued, at his own expense, a handsome book on Corsica, recording his travels and the history of the island. He also gives a full bibliography relating to the subject.

A NEW quarterly scientific journal has made its first appearance in Paris, under the title *Revue des Sciences naturelles de l'Ouest*, devoted to the interests of zoology, botany, geology, mineralogy, anthropology, embryology, and teratology.

A MONTHLY journal of natural science, which may have many opportunities of doing good work, has just been started in Malta. It is called *The Mediterranean Naturalist*, and is edited by Mr. John H. Cooke, F.G.S.

THE "Dictionnaire d'Agriculture," by J. A. Barral and H. Sagnier, will soon be completed. Vol. iv. is nearly ready, and will be quickly followed by Vol. v.

A NEW edition of the Great Eastern Railway Company's "Tourist Guide to the Continent," edited by Mr. Percy Lindley, has been published. New editions of Mr. Lindley's "Walks in the Ardennes" and "Walks in Epping Forest" have also been published; and he has compiled two other useful little hand-books, "Walks in Holland" and "Holidays in Belgium."

MESSRS. GUY AND CO., Cork, send us "Guy's South of Ireland Pictorial Guide," in which are described and illustrated much fine scenery and various things interesting to students of natural history and archæology.

MESSRS. DULAU AND CO. have issued a catalogue of the works on geology which they are offering for sale.

THE results of an investigation concerning the cause of the insolubility of pure metals in acids are contributed by Dr. Weeren to the current number of the *Berichte*. De la Rive, so long ago as the year 1830, pointed out that chemically pure zinc is almost perfectly insoluble in dilute sulphuric acid. Hitherto, however, the hypotheses put forward attempting to account for this singular fact have been anything but satisfactory. The theory of Dr. Weeren is extremely simple, and is fully supported by the most varied experiments, physical and chemical. It may be stated as follows: "Chemically pure zinc and also many other metals in a state of purity are insoluble or only very slightly soluble in acids, because, at the moment of their introduction into the acid, they become surrounded by an atmosphere of condensed hydrogen, which under normal circumstances effectually protects the metal from further attack on the part of the acid." It is found that when a piece of pure zinc is immersed in dilute sulphuric acid, a slight action does occur during the first few succeeding moments, zinc sulphate and free hydrogen being formed in minute quantity. The free hydrogen, however, instead of escaping, becomes condensed by the molecular action of the zinc upon the surface of the latter, and is retained there with great tenacity as a thin mantle of highly compressed hydrogen gas, capable of affording perfect protection against further inroad of the acid. The experiments from which this simple and very probable explanation has been derived were briefly as follows. The amount of chemically pure zinc dissolved by the acid was first determined. It was, of course, an exceedingly minute quantity. Considering this amount as unity, it was next sought to determine what difference would be effected by performing the experiment *in vacuo*, when of course the escape of the hydrogen would be greatly facilitated. The solubility was found under these circumstances to be increased sevenfold. Next the experiment was performed at the boiling temperature of the dilute acid, first when ebullition was prevented by increasing the pressure, and secondly when ebullition was unhindered, thus again facilitating the removal of the hydrogen film. In the first case, when ebullition was prevented, the solubility was practically the same as in the cold; while in the second case, with uninterrupted ebullition, the solubility was increased twenty-four times. Finally, experiments were made to ascertain the effect of introducing into the acid a small quantity of an oxidizing agent capable of converting the hydrogen film to water. When a little chromic acid was thus introduced the solubility was increased 175 times, and when hydrogen peroxide was employed the solubility was increased three-hundred-fold. The explanation of the ease with which the metal becomes attacked when the ordinary impurities are present is that the hydrogen is not then liberated upon the surface of the zinc, but rather upon the more electro-negative impurities, leaving the pure zinc itself open to the continued attack of the acid. The same of course occurs when a plate of platinum is placed in contact with a plate of pure zinc in the acid. The action of nitric acid, the only common acid which does attack pure metals, is evidently due to the oxidation of the hydrogen film by further quantities of the acid, with formation of water and production of the lower oxides of nitrogen, and even under certain circumstances of ammonia.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. R. Armstrong; two Senegal Touracous (*Corythaix persa*) from West Africa, presented by Sir Brandforth Griffith, Bart.; two Rock Thrushes (*Monticola saxatilis*) from Italy, presented by the Rev. Hubert D. Astley; two Larger Hill-Mynahs (*Gracula intermedia*) from China, deposited; two Mule Deer (*Cariacus macrotis*), three Summer Ducks (*Æx sponsa*), seven Mandarin Ducks (*Æx galericulata*), five Chilian Pintails (*Dafila spinicauda*), two Australian Wild Ducks (*Anas superciliosa*), a Spotted-billed Duck (*Anas pœcilorhyncha*), three Night Herons (*Nycticorax griseus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE STELLAR CLUSTER χ PERSEI.—Mr. O. A. L. Pihl has completed a micrometric examination, begun in 1870, of the group χ of the great star cluster in Perseus, and the results are published by Grondahl and Son, Christiania. His survey includes all stars down to 10·6 magnitude, and a number of fainter ones down to 11·7 magnitude, the total number of stars measured being 236. The positions obtained, joined to those determined in the *h* group by Prof. Krüger, with the Bonn heliometer, form one continuous survey of both components of the cluster. Prof. Vogel has determined the positions of 178 stars in the central part of the χ group, but Mr. Pihl's investigation covers more than four times the area. A comparison of the right ascensions of the stars measured by these two observers brought to light differences of a systematic character which appeared to be neither the result of observational errors nor of calculation. Upon closely inspecting the measures, Mr. Pihl found that his value for right ascension was less than Prof. Vogel's in the case of those stars which were brighter than the star to which positions were referred; whereas for all stars fainter than this his value was larger, and the fainter the star the greater the difference.

A ring and a bar micrometer were used in the observations, and the reductions were made by the ordinary method of taking half the sum of the moments of ingress and egress in the calculation—a mode of proceeding which depends upon the supposition that the half sum denotes the instant of the passage of the star through the middle of the ring or bar. This supposition, however, is shown to be erroneous. For stars of a less magnitude than 5·5 there is always a detention in the apparent time of emersion, which increases with the faintness of the stars observed. The cause of the error, therefore, is physiological, and due to the occulting micrometers employed. The law regulating it having been found, the necessary corrections have been applied to the measures, thus rendering the work of greater use.

The memoir represents the work of a business man over a period of twenty years, and with an instrument having an aperture of $3\frac{1}{4}$ inches. It contains much of interest, and will doubtless be appreciated as an important contribution to the knowledge of the stars in a cluster which is certainly one of the grandest of telescopic objects.

ON THE VEGETATION OF TIBET.

In the May number of the *Journal de Botanique* MM. Bureau and Franchet describe a number of new plants from the collections recently brought home by M. Bonvalot and Prince Henry of Orleans, and give a general summary of their character, of which the following is an abstract:—

The collection was made almost entirely in a narrow band of territory reaching from Lhassa eastward near the 30th parallel of north latitude by way of Batang and Sitang to Tatsienlow, in the province of Szechwan, in West China, from which place their route was deflected at a right angle to Yunnan.

Considered in its general aspect, the flora of this region, as shown in the collection, is marked by the stunted form of the shrubs and dwarf character of the herbaceous vegetation. Of the forest trees, Coniferæ and others, no specimens were brought. It is characteristically a vegetation of high peaks, where drought and strong winds are the main climatic features. The Papaveraceæ are represented especially by dwarf, large-flowered kinds of *Meconopsis*. The greater number of the species of *Corydalis* are not more than two or three inches high. The Cruciferæ, such as *Parrya ciliaris*, in the same way are dwarf and large-flowered. *Silene cæspitosa* may be compared with the most dwarf states of *S. acaulis* of our own high mountains. The honeysuckle of Tibet constitutes only a small bush about a foot high, with intertangled branches. But it is especially in the Rhododendrons and Primulas that this dwarf character is remarkable. All the Rhododendrons and Primulas found between Lhassa and Sitang—*R. principis*, *R. primulæflorum*, *R. nigropunctatum*, *Primula leptopoda*, *P. diantha*, and *P. Henrici* may be ranged amongst the dwarfest types of the genera to which they belong. It is the same with *Incarvillea*. The Tibetan species belong to a group found also in Kansu and Central Yunnan, with stem almost obliterated and corolla very large.

Passing eastward in Szechwan the flora puts on a different character. The leaves become larger, the number of flowers to each plant increases. There are many Rosaceæ, Orchids, and species of Pedicularis; amongst the Compositæ the genus Senecio is particularly well represented, and there are several Everlastings that approach the Edelweiss of the Swiss Alps.

The flora of this eastern part of Tibet and western region of Szechwan has a strong affinity both with that of the Sikkim Himalaya and that of Central Yunnan. *Meconopsis Henrici* represents the Himalayan *M. simplicifolia*, Hook. et Thoms.; *Astragalus litargensis*, *A. acaulis*, Benth., *Rubus xanthocarpus*, *R. sikkimensis*; *Brachyactis chinensis*, *B. menthodora*; *Gnaphalium corymbosum* answers to *G. nubigenum*; *Androsace bisulca* to *A. microphylla*; and there are many other similar parallels between the plants of Tibet and Sikkim, and in the same many parallels may be found between the new species found by our travellers in Tibet and those gathered by Delavay in Yunnan.

SOCIETIES AND ACADEMIES.

London.

Royal Society, June 18.—"An Apparatus for testing the Sensitiveness of Safety-lamps." By Frank Clowes, D.Sc. Lond., Professor of Chemistry, University College, Nottingham. Communicated by Prof. Armstrong, F.R.S.

The following apparatus has been devised to render easy the process of testing the sensitiveness of different forms of safety-lamps when used for detecting firedamp. To enable satisfactory tests to be made in the laboratory, it was necessary to insure (1) the easy and rapid production of mixtures of firedamp and air in known proportions; (2) to insure economy of the artificially prepared methane, which represented firedamp; and (3) to examine the flame of the lamp under conditions as satisfactory as those existing in the mine.

A wooden cubical box of about 100 litres capacity was constructed so as to be as nearly gas-tight as possible. It was then made absolutely gas-tight by painting it over with melted paraffin wax, which was afterwards caused to penetrate more perfectly by passing an ordinary hot flat-iron over the surface.

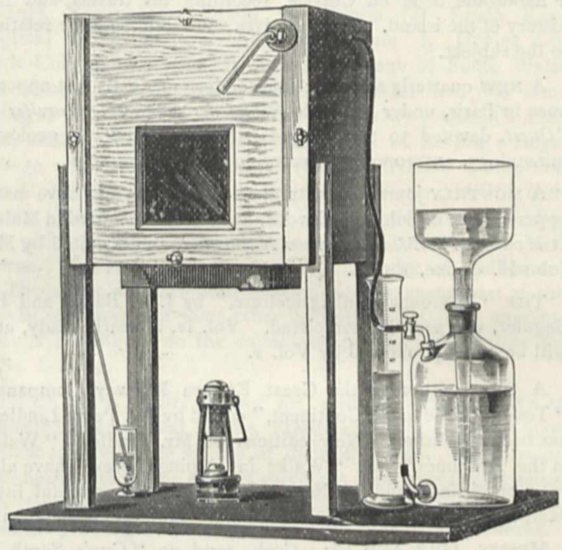


Fig. 1.

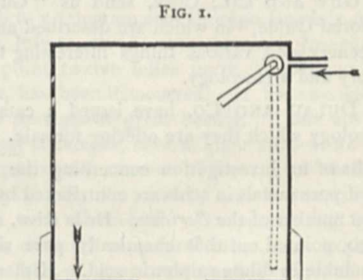


Fig. 2.

This testing chamber was furnished with a small inlet tube at the top, and with a similar outlet tube below. It had a plate-glass window in front for observing the lamp in the interior, and a flanged opening below for introducing the safety-lamp. This opening was closed by a water-seal consisting of a small zinc tray supported by buttons, and containing about 2 inches depth of water, into which the flange dipped. A mixer was arranged, which consisted of a light flat board, nearly equal in dimensions to the section of the chamber, and suspended by an axis from the upper corner of the chamber. The mixer was moved rapidly backwards and forwards from the side to the top of the interior of the chamber, by grasping a handle projecting through the front of the chamber.

When a mixture of air with a certain definite precentage of firedamp was required, the methane, prepared and purified by ordinary chemical methods, was introduced into the chamber in the requisite quantity by the top inlet. It displaced an equal volume of air, which escaped through the lower outlet, the exit end of which was sealed by being immersed just beneath a water surface. A vigorous use of the mixer secured a uniform mixture of gas and air throughout the interior of the chamber in the course of a few seconds. The lamp was then introduced into the chamber, and placed in position behind the glass window. The simplicity of arrangement of the water-seal rendered the necessary opening of the chamber very brief, and the introduction and removal of the lamp many times in succession was not found to produce any appreciable effect upon the composition of the atmosphere inside the chamber. The appearance and dimensions of the "cap" over the flame were noted as soon as the cap underwent no further change. A lamp was left burning in the chamber for a considerable length of time, and its indications underwent no change, owing to the large capacity of the chamber and the very limited amount of air required to support the combustion of the small flame always used in gas-testing. The whole interior of the chamber and mixer were painted dead-black, so as to render visible pale and small caps against a black ground.

The methane was introduced from an ordinary gas-holder. A volume of water, equal to that of the methane to be displaced, was poured into the top of the gas-holder. The gas-tap of the holder was then momentarily opened, so as to produce equilibrium of pressure between the methane and the atmosphere. The gas-tap having then been placed in connection with the upper inlet of the chamber, the water-tap was opened, and the measured volume of water was allowed to flow down and drive the methane into the chamber. As soon as bubbles of air ceased to appear through the water at the outlet, the chamber was closed; the mixer was then vigorously worked for a few seconds, and the mixture of gas and air was ready for the introduction of the lamp. Before introducing the methane for a fresh mixture, the atmosphere of the chamber was replaced by fresh air by removing the water-tray from beneath the opening at the bottom of the chamber, and blowing in a powerful stream of air from a bellows to the top of the chamber.

The chamber was supported on legs, which were arranged so as to place it at a convenient height for observations through the window, and also for the introduction and removal of the safety-lamp.

The observations were usually made in a darkened room, but the flame-caps were easily seen in a lighted room, provided direct light falling on the eye or chamber was avoided.

The capacity of the chamber was 95,220 c.c.; accordingly, the following volumes of methane were introduced: for ½ per cent. mixture 476 c.c., for 1 per cent. 952 c.c., for 2 per cent. 1904 c.c., for 3 per cent. 2856 c.c., for 4 per cent. 3808 c.c., and for 5 per cent. 4760 c.c. It will be seen that a series of tests, in which the above-mentioned percentage mixtures were employed, involves an expenditure of only 15 litres of methane, a quantity far smaller than that required by any other method of testing as yet described.

Of many forms of safety-lamp tested in the above apparatus, the one which most satisfactorily fulfilled the two purposes of efficient illumination and delicacy in gas-testing was Ashworth's improved Hepplewhite-Gray lamp. This lamp is of special construction, burns benzoline from a sponge reservoir, and its flame is surrounded with a glass cylinder, which is ground rough at the hinder part; this latter device prevents the numerous reflected images of the flame, and the generally diffused reflections which are seen from a smooth glass surface, and which render the observation of a small pale flame-cap very difficult, if not impossible.

The wick of this lamp, when at a normal height, furnishes a flame of great illuminating power. When lowered by a fine screw adjustment the flame becomes blue and non-luminous, and does not interfere therefore with the easy observation of a pale cap. The following heights of flame-cap were observed, which fully bear out the unusual sensitiveness of this flame. With 0·5 per cent. of methane 7 mm.; with 1 per cent. 10 mm.; with 2 per cent. 14 mm.; with 3 per cent. 20 mm.; with 4 per cent. 25 mm.; and with 5 per cent. 30 mm. The cap, which with the lower proportions was somewhat ill-defined, became remarkably sharp and definite when 3 per cent. and upwards of methane was present. But even the lowest percentage gave a cap easily seen by an inexperienced observer.

It appears from the above record of tests that the problem of producing a lamp which shall serve both for efficient illuminating and for delicate gas-testing purposes has been solved. The solution is in some measure due to the substitution of benzoline for oil, since the flame of an oil-lamp cannot be altogether deprived of its yellow luminous tip, without serious risk of total extinction; and this faint luminosity is sufficient to prevent pale caps from being seen.

From further experiments made in the above testing-chamber with flames produced by alcohol and by hydrogen, it was found to be true in practice, as might be inferred from theory, that, if the flame was pale and practically non-luminous, the size and definition of the flame-cap was augmented by increasing either the size or the temperature of the flame. It is quite possible by attending to these conditions to obtain a flame which, although it is very sensitive for low percentages of gas, becomes unsuitable for the measurement of any proportion of gas exceeding 3 per cent. This must, for the general purposes of the miner, be looked upon as a defect; but it is not a fault of the lamp already referred to. It is of interest to note that with the Pieler spirit-lamp a flame-cap an inch in height was seen in air containing only 0·5 per cent. of methane.

Physical Society, June 26.—Prof. W. E. Ayrton, F.R.S., President, in the chair.—The following communications were made:—The construction of non-inductive resistances, by Prof. W. E. Ayrton, F.R.S., and Mr. T. Mather. In making some transformer tests about three years ago, the authors had occasion to consider the construction of electric conductors the impedances of which should be practically equal to their resistances. This condition could only be fulfilled by making the inductance small in comparison with the resistance; and, as the former does not depend on the material employed (excepting iron) it was important to use substances of high specific resistance. Carbon or platinoid being available, the latter was chosen on account of its low temperature coefficient. One form of resistance exhibited consisted of strips of thin sheet platinoid about 6 metres long and 4 centimetres wide. Each was bent at the middle and doubled back on itself, thin silk being placed between the contiguous parts and narrow ribbon used to bind the parts together. Twelve such strips arranged in series had a resistance of 2·95 ohms, and would carry a current of 15 amperes without changing its resistance more than $\frac{1}{10}$ per cent. This strip-resistance was made by Messrs. C. G. Lamb and E. W. Smith, who at that time (1888) were students in the Central Institution, and to whom the author's best thanks are due for the praiseworthy manner in which they surmounted the difficulties which presented themselves. Another form of resistance designed for portability consisted of bare-wire spirals, each length having a left-handed spiral placed within a right-handed one of slightly larger diameter, and the two being connected in parallel. This device was found to reduce the inductance to $\frac{1}{10}$ or $\frac{1}{20}$ of that of a single spiral according as the diameters of the spirals approach towards equality. Where the spirals are made of platinoid wire, the ratio of inductance to resistance is very small, averaging about $\frac{1}{500000}$.—On the influence of surface loading on the flexure of beams, by Prof. C. A. Carus-Wilson. Referring to the practical treatment of problems on beam flexure as based on Bernoulli's hypothesis that the bending moment is proportional to the curvature, the author pointed out that this assumes that the cross-sections remain plane after flexure, and neglects the surface loading effect. The present paper describes experiments made to determine the actual state of strain in a beam doubly supported, and carrying a single load at the centre, the effect of surface loading being taken into account. The method of investigation assumes that (1) the true state of strain at the centre of a beam may be found by superposing on the state of strain due to bending only, that due to surface loading without bending; (2) the state of strain due to surface loading only, may be found with close approximation to truth by resting the beam on a flat plane instead of on two supports; (3) the strain due to bending alone, may be obtained from the Bernoulli-Saint-Venant results. Before proceeding to describe the experiments, a short account of the mathematical work previously done on the subject was given. The nearest approach to the particular case here dealt with had been worked out by Prof. Boussinesq, who had shown that for an infinite elastic solid bounded on one side by a plane surface and loaded along a line on that surface, the stress (y) on an element on the normal through the middle point of the line varies inversely as its distance (x) from the surface. The formula thus arrived at was $y = 0·64\frac{P}{x}$, whilst for a finite beam centrally loaded the author's experiments gave $y = 0·726\frac{P}{x}$. The experiments were made on glass beams mounted in a steel straining frame, and placed between the crossed Nicols of a polariscope. Steel rollers 2 mm. in diameter served as supports, and the central load was applied by a screw acting on a roller of similar diameter. Deflections of the beam were measured by a micrometer screw at a point opposite the central load, and traversing screws enabled the whole frame to be moved so as to bring any portion of the beam in the field of view. Circularly polarized light was sometimes used, and a micrometer eye-piece served to measure the distances between interference fringes produced by loading. By carefully chosen experiments the author had shown that if a beam of glass be laid on a flat surface and loaded across its upper surface, the shear at any point on the normal at the point of contact of the load is inversely proportional to the distance from the point of contact. In the first experiment the crossed Nicols were set at 45° to the axis of the loaded bar; a quarter-wave plate was then placed between the bar and the analyzer, and the position of the black spot at the point where the effect of the shear on the polarized light was equal and opposite to that produced by the quarter-wave plate was noted. A second quarter-wave plate was then superposed on the first; the black spot moved upwards to a point where the shear was double that at the first position. This position having been determined, one quarter-wave plate was removed, and the load diminished until the original spot moved up to the second position, and the processes repeated. By this means a series of positions at which the shears were in the proportions 1, 2, 4, 8, &c., were determined. Plotting the results showed the curve connecting the shear and the distance from the point of contact to be hyperbolic. Other experiments showed that the shear at any point was proportional to the load. By maintaining a constant load and measuring the distances between the interference fringes below the point of contact the hyperbolic law was confirmed. The effect of bending a beam is, according to hypothesis, to put the upper portion in longitudinal compression, and the shear (vertical stretch) varies as the distance from the centre of the beam; the shear due to surface loading is a vertical squeeze, and, as shown above, varies hyperbolically. When, therefore, the beam is subjected to both actions, the straight line representing the bending strain may intersect the hyperbola representing the shear due to surface loading in two points, and since, at the corresponding points in the central section, the shears are equal and opposite, the elements are only subjected to voluminal compression, and will exert no bi-refringent action. Hence, when viewed through crossed Nicols, black spots will be seen on a white field. Keeping the load constant and diminishing the span should cause the spots to approach each other, and when the line is tangential to the hyperbola, the spots coincide. These deductions were confirmed by experiment, and it was found that for a span of less than four depths, no point of zero shear exists on the central section. The strains in beams subjected to surface loading were thus shown to be of a character different from those usually assumed, the neutral axis instead of coinciding with the axis of the beam, being lifted up in the centre, and its shape depending on the load and span. Other ingenious and interesting experiments on beams were described, in some of which the lines of principal stress were mapped out. Remarkable results were obtained, showing that although the tension lines given by Rankine and Airy are nearly correct, the curves of compression may be very different, and have very curious shapes. Prof. Perry thought the local loading effect would not be so important in long beams, and inquired whether in ordinary test pieces local loading would affect the breaking strength. He also asked what effect the fact of the load making contact over a surface instead of along a line would have on the results, and in reply Prof. Carus-Wilson said the effect was to raise the asymptote of the hyperbola representing the surface loading stress above the surface of the beam.—On pocket electrometers, by C. V. Boys, F.R.S. This communication described modifications of electrometers adapted for portability. As quartz fibres increase the delicacy and diminish the disturbing influences affecting instruments, much smaller controlling forces can be employed than when silk is used for suspensions. He had, he said, pointed out some time ago the great advantages arising from making galvanometers small. Applying similar reasoning to electrometers, he remarked that making an instrument one-tenth the size of an existing one reduced the moment of inertia of the needle to $\frac{1}{10^5}$, whilst the deflecting couple for given potentials would only be $\frac{1}{10}$ of its former value. The small instrument would for the same periodic time be 10,000 times more sensitive than the large one, provided the disturbing influence could be reduced in the same proportion. This, however, was not ordinarily possible, for any method of making contact with the needle, such as by a fine wire dipping into acid or mercury, prevented very small controlling forces being used. Still, by suitable devices a large proportion of the full advantage could be obtained; a freely suspended needle without liquid contacts was essential to success. The first instrument described was one in which the needle was cylindrical, contiguous quarters being insulated and connected to the opposite ends of a minute dry pile placed within the needle; opposite quarters were thus at the same potential, and at a different potential to the other pair of quarter cylinders. This was suspended within a glass tube silvered on the inside and divided into four parts by fine longitudinal lines. In such an instrument the needle and quadrants are reciprocal, and the deflection depends on the product of the difference of potential between the quadrants and that between the parts of the needle. Owing to the dry pile not being constant, the instrument was found untrustworthy, but when working at its best a Grove cell would give 30 or 40 millimetres deflection. The next step was to make a cross-shaped needle of zinc and platinum, and rely on contact electricity to keep the parts of the needle at different potentials. This bold experiment proved remarkably successful, for the instrument was very sensitive. A disk-shaped needle with quadrants, alternately zinc and platinum, was then employed, and by this a small fraction of a volt could be measured. The weight of the disk was only $\frac{1}{30}$ of a gramme, and the instrument could be turned upside down or carried about in the pocket with impunity. Another small instrument with the stationary quadrants of zinc and copper was exhibited, and by rotating them through an angle of 90°, so as to bring them in a different position relative to the parts of the needle, a deflection of several degrees of arc was produced. In the course of his remarks Mr. Boys made several suggestions relating to ballistic electrometers and electrostatic Siemens dynanometers, and pointed out the possibility of instruments such as he had exhibited being of use in elucidating the obscure points in connection with so-called "contact electricity." The President complimented Mr. Boys on the beautifully simple and remarkably sensitive electrometers exhibited. He remembered that some years ago Mr. Gordon made a very small electrometer, but its insulation was insufficient for electrostatic work. He agreed with Mr. Boys as to the advantages of small instruments, providing sparking across or tilting of the needle could be prevented. On the other hand, he thought the use of small potential differences on the needle was a step in the wrong direction, when great sensibility was required. Prof. Perry asked if the needle could not be kept charged by occasional contacts with a charged acid cup. Mr. Boys said he had originally intended using a fairly highly charged needle, but had not yet done so. He also suggested that an electrometer of very small capacity might be made by reducing the quadrants surrounding a disk-needle, until they became like small tuning-forks.—A paper on electrification due to the contact of gases with liquids, by Mr. J. Enright, and one on the expansion of chlorine by heat, by Dr. Arthur Richardson, were taken as read.

Entomological Society, July 1.—Mr. Frederick DuCane-Godman, F.R.S., President, in the chair.—Mr. Jacoby exhibited a specimen of a species of Coleoptera belonging to the family *Galerucidæ*, with the maxillary palpi extraordinarily developed.—Canon Fowler, on behalf of Mr. Wroughton, Conservator of Forests, Poona, exhibited specimens of a bug imitating an ant, *Polyrachis spiniger*, and of a spider imitating a species of *Mutilla*, and read the following notes:—"I have taken a good many specimens of a bug which has achieved a very fair imitation of *Polyrachis spiniger* (under the same stone with which it may be found), even to the extent of evolving a pedicle and spines in what, were it an ant, would be its metanotum. Curiously enough, however, these spines are apparently not alike in any two specimens. Is it that this bug is still waiting for one of its race to accidentally sport spines more like those of

P. spiniger, and thus to set the ball of evolution rolling afresh? or is it that the present rough copy of *spiniger's* spines is found sufficient to deceive? The bug has also been found in the Nilgherries. Mr. Rothney remarks on the above species:—'I have not found the species mimicking *Mutilla*; but in Calcutta and Barrackpore, where *P. spiniger* is a tree ant, forming its net by spinning together the twigs of a shrub, the mimicking bug also assumes arboreal habits, and may be found on the trunks of trees with the ants.'"—Mr. Porritt exhibited living specimens of *Eupithecia extensaria* and *Geometra smaragdaria*: the position assumed by the former proved conclusively that it had rightly been placed in the genus *Eupithecia*.—Mr. Crowley exhibited two specimens of a *Papilio* from the Khasia Hills, belonging to an undescribed species allied to *P. papone*, sub-generic section *Chilades*. Colonel Swinhoe remarked that he possessed a specimen from Northern Burmah. Mr. Moore and others took part in the discussion which followed.—Mr. Dallas Beeching exhibited a specimen of *Plusia moneta*, recently taken by himself at High Woods, Tonbridge, and specimens of *Gonepteryx cleopatra*, lent him for exhibition, which were alleged to have come from the same locality.—Dr. Algernon Chapman exhibited the larva of *Micropteryx calthella*, and read notes on hem.—Colonel Swinhoe read a paper entitled "On New Species of Heterocera from the Khasia Hills."—Mr. Crowley read a paper entitled "On a New Species of *Prothoe*."—Mr. C. J. Gahan read a paper entitled "On the South American species of *Diabrotica*, Part 2," being a continuation of Dr. Baly's paper on the same genus published in the Society's Transactions for 1890, Part 1.—Mr. W. F. Kirby communicated a paper entitled "Notes on the Orthopterous family *Mecopodidæ*."—Prof. Westwood communicated a paper entitled "Notes on *Siphonophora artocarpi*."

EDINBURGH.

Royal Society, June 15.—Mr. T. B. Sprague in the chair.—Dr. Johnson Symington and Dr. H. A. Thomson communicated a paper on a case of defective endochondral ossification in a human fœtus.—Dr. J. Berry Haycraft read a paper on the alkaline and acid salts of the blood and urine, and especially those of phosphoric acid.—Dr. J. M. Macfarlane presented the second part of a paper on the structure, division, and history of vegetable and animal cells, in which he stated that as a result of extended observation he still adhered to the view that a typical cell consists of protoplasm, nucleus, nucleolus, and endonucleolus, the whole usually surrounded by a cell wall; that the nucleolus is the important part equally in division and in sexual union of cells; that after division had ceased, successive fragmentation of endonucleolus, nucleolus, and nucleus occurred, though to a varying degree in different cells; that thus a multi-endonucleolar was followed by a multinucleolar, and this by a multinuclear state. He regarded the nucleolus of every cell as the sexual centre directly derived from union of the chromatic substance of the male and female pronuclei of the ovum, and that from the nucleolus extremely fine radiating threads of chromatic substance passed out along the achromatic fibrils, which last he viewed as a finely differentiated reticulum of the ground protoplasm. By union of the radiating chromatic threads, the author considered that the nuclear membrane was formed, while continuations radiated outwards from this through the cell-protoplasm to convey stimuli to and from the sex-centre or nucleolus. He further stated that many facts and direct observations made tended to show that the radiating threads from the nucleus, and ultimately therefore from the nucleolus, of one cell are connected with corresponding ones from other cells, and this, if fully verified, would cause us to regard an organism as a sexual whole, and the male and female reproductive cells as being specially set aside to hand down hereditary and acquired conditions. He showed that this had a special bearing on the next communication submitted—a comparison of the minute structure of plant hybrids with that of their parents, and its bearing on biological problems. At a previous meeting of the Society (May 4) he directly demonstrated, by three parallel lantern exhibitions of micro-photographs, that the tissues of root, stem, leaf, and flower parts in the hybrid named by Dr. Masters *Philageria Veitchii*, are exactly intermediate, when of corresponding age, between those of the parents; and further, that when a structure is developed in one parent, but is absent in the other—*e.g.* the sepal honey gland of *Lapageria*—the hybrid shows it of half the size. He now referred to eleven other hybrids whose tissues he had worked over in detail, and selected points from about sixty others, examined more or less minutely. By triplets of micro-photographs the author not only demonstrated that a hybrid is, to its minutest details, a blended reproduction of both parents, but that where the parents show diverse morphological details, these may be handed down to the hybrid of half the size, or one only may be inherited. He advanced a theory to explain this, and then compared the tissues of *Cytisus Adami* (see also *Gard. Chron.*, July 1890, p. 94), which he regarded as a true graft hybrid. He concluded by referring to the colour, flowering period, and constitutional vigour of plant hybrids, and to the light shed by these inquiries on the effects of environment, on the influence of sex, and on heredity.—Prof. Tait communicated paper, by Prof. Stokes, on an optical proof of the existence of suspended matter in flames. The method consists in condensing sunlight on the flame. The light is scattered by the solid particles in an extremely thin layer both where the beam enters the flame and where it leaves it. It is polarized in the plane of reflection. The effect is not found in some flames—such as a Bunsen flame tinged with burning sodium. In the latter case this seems to be due to the fact that the sodium is in the form of vapour—not of solid particles.

SYDNEY.

Royal Society of New South Wales, May 6.—Annua Meeting.—Dr. A. Leibius, President, in the chair.—The Report stated that 25 new members had been elected during the year, and the total number on the roll on April 30 was 457. During the year the Society held eight meetings, at which the following papers were read:—Presidential address, by Prof. Liversidge, F.R.S.—On a compressed-air flying machine, by L. Hargrave.—On the treatment of slips on the Illawarra Railway at Stanwell Park, by W. Shellshear.—On native names of some of the runs, &c., in the Lachlan district, by F. B. W. Woolrych.—Remarks on a new plant rich in tannin, by Charles Moore.—Record of hitherto undescribed plants from Arnheim's Land, by Baron Ferd. von Mueller, F.R.S.—The theory of the repetition of angular measures with theodolites, by G. H. Knibbs.—On some photographs of the Milky Way recently taken at Sydney Observatory, by H. C. Russell, F.R.S.—Australian aborigines: varieties of food and methods of obtaining it, by W. T. Wyndham.—On the application of the results of testing Australian timbers to the design and construction of timber structures, by Prof. Warren.—Geological notes on the Barrier Ranges silver-field, by C. W. Marsh.—Some folk-songs and myths from Samoa, by the Rev. T. Powell and Rev. G. Pratt, with an introduction and notes by Dr. John Fraser.—The coal-fields of New South Wales and their associated eruptive rocks, by T. W. E. David.—Some remarks on the Australian languages, by Dr. John Fraser.—On the 74-ounce compressed-air flying machine, by L. Hargrave.—The Medical Section held seven meetings, at which nine papers were read; the Microscopical Section held seven meetings, at which interesting exhibits were shown.—The Clarke Medal for the year 1891 had been awarded to Prof. F. W. Hutton, Canterbury College, Christ Church, New Zealand.—The Council had issued the following list of subjects with the offer of the Society's bronze medal and a prize of £25 for each of the best researches if of sufficient merit:—(To be sent in not later than May 1, 1892) On the iron-ore deposits of New South Wales; on the effect which settlement in Australia has produced upon indigenous vegetation, especially the depasturing of sheep and cattle; on the coals and coal measures of Australasia. (To be sent in not later than May 1, 1893) Upon the weapons, utensils, and manufactures of the aborigines of Australia and Tasmania; on the effect of the Australian climate upon the physical development of the Australian-born population; on the injuries occasioned by insect pests upon introduced trees.—A most successful *conversazione* had been held in the Great Hall of the University on December 10, at which 800 guests were present.—The Chairman read the Presidential Address, and the officers and Council were elected for the ensuing year, Mr. H. C. Russell, F.R.S., Government Astronomer, being President.

PARIS.

Academy of Sciences, July 6.—M. Duchartre in the chair.—On the lunar inequality of long period due to the action of Venus, and depending upon the argument $l + 16l' - 8l''$, by M. F. Tisserand. According to Delaunay, in calculations of this inequality it is possible to neglect powers of the inclination of the orbit of Venus higher than the second. M. Tisserand shows, however, that terms which contain the fourth power of the inclination may have a sensible influence, and diminish the coefficient of the inequality in question by a tenth of its value—that is, by about 1″·6.—On the manner in which the velocities are distributed from the entrance of a cylindrical tube of circular section widened at the mouth up to the points where uniformity is established, by M. J. Boussinesq.—The flight of insects studied by photochronography, by M. Marey. The author describes an apparatus which he has used to obtain photographs of flying insects. It allows exposures to be made so short as $\frac{1}{25000}$ of a second. His observations indicate that the wings of insects in flight, by meeting obliquely the resistance of the air in to-and-fro movements, act in a very similar manner to the sculls used to propel rowing-boats.—Study of the tetra-iodide of carbon, by M. Henri Moissan. By acting on carbon tetrachloride with boron tri-iodide, the trichloride of boron and the tetra-iodide of carbon are obtained by double decomposition. A detailed account is given of this reaction. The carbon tetraiodide thus prepared forms comparatively large crystals of a beautiful red colour, very similar to the rubies synthetically prepared by MM. Fremy and Verneuil. Several new reactions with this compound are described.—Compounds of camphors with the aldehydes: on a new mode of formation of alkyl camphors, by M. A. Haller.—The Eocene formations of Algeria, by MM. Pomel and Ficheur. It has been previously shown that the Eocene formations of Algeria may be divided into the three groups, lower, middle, and upper. The observations now stated indicate that the Middle Eocene formations only extend over a narrow zone, and that they are characterized by Nummulites of the groups *Numm. lævigata* and *Numm. perforata*. The Lower Eocenes are defined from a nummulitic point of view by *Numm. planulata*, *Numm. biarritzensis*, and *Numm. gizehensis*.—Method of ready transformation of the tubercular products of joints and certain other parts of the human body, by M. Lannelongue.—On the determination of the constants and coefficients of elasticity of nickel-steel, by M. E. Mercadier. Experiments have been made to determine the relation $\frac{\lambda}{\mu}$ for solid sonorous bodies, and, therefore, the coefficient of dynamical elasticity, by a method founded on Kirchhoff's theory of vibration of circular disks. From the results obtained it appears that the incorporation of a sufficient quantity of nickel with steel tends to make the alloy isotropic. The mean coefficient of dynamical elasticity for alloys containing about 5 per cent. and 25 per cent. of nickel is 18,600, whereas that of pure steel is 20,700.—Calculation of molecular volume, by M. G. Hinrichs.—On an explosive compound which results from the action of baryta water on chromic acid in the presence of oxygenated water, by M. E. Péchard. By adding baryta water in the presence of an excess of oxygenated water, a precipitate is produced, which, after desiccation, explodes violently by heat or percussion. The compound has the formula $BaO_2 . CrO_3$.—On the detection of small quantities of boric acid, by M. F. Parmentier.—On the structure of the ocellates of *Lithobius forficatus*, by M. Victor Willem.—Comparative study of the development and morphology of the parapodia of Syllidiæ, by M. A. Malaquin.

GÖTTINGEN.

Royal Society of Sciences.—The Proceedings of the Society for February, March, and May 1891 contain the following papers of scientific interest:—

No. 1.—W. Nernst: on Henry's law of chemical equilibrium in solutions.—F. Meyer: on discriminants and resultants of singularity-equations.—O. Venske: contribution to the integration of the equation $\Delta^2 u = 0$ for certain plane figures (the disk, the annulus, the rectilineal angle, the rectilinear strip with parallel sides, the annular sector).

No. 2.—W. Voigt: contributions to hydrodynamics (pulsating sphere or cylinder in an infinite liquid; stationary waves in a stream as an example of Kirchhoff's theory of liquid stream-rays; successive approximation to the irrotational motion of a heavy liquid with free surface; stationary combined motions depending on two co-ordinates in a liquid under a conservative system of forces; non-stationary current-motion, partly rotational, partly irrotational, within an ellipsoidal shell at rest).—O. Venske: integration of a special system of linear homogeneous differential equations, with doubly periodic functions as coefficients.—F. Meyer: on real properties of curves in space.

No. 3.—G. Tammann: on conduction through membrane-like precipitates.—O. Venske: a new apparatus for the determination in absolute measure of the internal thermal conductivity of badly conducting bodies.

STOCKHOLM.

Royal Academy of Sciences, June 10.—On the treatment of cancer through injections, by Prof. Rossander.—Analysis of a pyrite, which seems to contain a new element, by Herr L. J. Igelström.—A letter from Baron Ferd. von Mueller on the Australian contributions towards a South Polar expedition planned in Sweden, communicated by Baron Nordenskiöld.—The intensity of the radiation of gaseous bodies under the influence of an electric discharge, by Dr. K. Ångström.—On derivates of sulphur urates, iii., by Dr. Hector.—A solution of a mechanical problem which leads to the functions of Rosenhain, by Dr. Olsson.—Some experiments on the respiration of the Algæ, by Miss H. Lovén.—The African genera of the Calandrides related to the Oxypisthens, by Prof. Chr. Aurivillius.—A comparison between the methods of Ångström and Neumann for determining the conductibility of heat in bodies, Part iii., by Dr. Hagström.—On 1-6 dibrom-naphthaline, by Herr Forsling.—Triazol combinations produced from aldehydes and dicyan-phenyl-hydrazine, by Herr Holmqvist.—On the ammoniacal combinations of iridium, by Dr. Palmær.—On the formulas for calculating the mortality during the first year of human life, as derived from the statistics of the population, by Dr. G. Eneström.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Among the Butterflies: B. G. Johns (Isbister).—The Business of Travel, W. F. Rae (Cook).—The Melanesians: Dr. R. H. Codrington (Clarendon Press).—Verlags-Catalog von R. Friedländer und Sohn, 1830-90 (Berlin, Friedländer).—The Geology of Nova Scotia, &c., or Acadian Geology, 4th edition: Sir J. W. Dawson (Macmillan and Co.).—British Cage Birds, Part 15: R. L. Wallace (U. Gill).—North Midland School Cookery Book (Raithby).—Der Peloponnes Versuch einer Landeskunde auf Geologischer Grundlage, Abtg. 1: Dr. A. Philoppson (Berlin, Friedländer).—Darkness and Light in the Land of Egypt: Colonel Fraser (Sutton).—Die organischen Elemente und ihre Stellung im System: W. Preyer (Wiesbaden, Bergmann).—Destructive Locusts: C. V. Riley (Washington).—U.S. Department of Agriculture—Reports of Observations and Experiments (Washington).—Insect Life, vol. iii., Nos. 9 and 10 (Washington).—Stonyhurst College Observatory—Results of Meteorological and Magnetical Observations, 1889-90: Rev. W. Sidgreaves (Market Weighton).—Simple Recipes for Sick-Room Cookery: Mrs. Buck (Raithby).—Journal of the Royal Agricultural Society, vol. ii. Part ii. No. 6 (Murray).—Journal of the College of Science, Imperial University of Japan, vol. iv. Part 1 (Tokio).—Mind, July (Williams and Norgate).—The Pedagogical Seminary, vol. i. No. 2 (Worcester, Mass.).—The Economic Journal, No. 2 (Macmillan and Co.).—London and Middlesex Note-Book, No. 2 (E. Stock).

CONTENTS.