THURSDAY, OCTOBER 4, 1906.

THE EVOLUTION OF THE GLOBE.

Geology: Earth History. By Thomas C. Chamberlin and Rollin D. Salisbury. Vol. ii., Genesis, Paleozoic, pp. xxvi+692. Vol. iii., Mesozoic, Cenozoic, pp. xi+624. (London: John Murray, 1906.) Price 21*s.* net each.

THE first volume of this important work, noticed in NATURE of January 19, 1905, and already in its second edition, dealt with geological processes and their results. In the two volumes now before us, which complete the work, geology is treated from the historical side, and we have a comprehensive review of the history of the earth on systematic lines. The treatment of these two formally separable branches of the science is, however, such as to emphasise the essential unity of the whole. As geological processes were discussed with continual reference to the historical application of the principles laid down; so the evolution of the globe, which is the story of these latter volumes, is regarded consistently from the causal point of view. Indeed, some subjects already considered under the head of geological processes, such as the dynamics of deformation, the causes of glaciation, &c., are now more fully discussed in connection with the particular geological periods which most clearly exemplify the phenomena.

The part of the work which will be read with greatest interest is that which falls under the subtitle "Genesis." Considering geology as "the domestic chapter of astronomy," the authors devote much more space than is customary in geological treatises to the problem of the origin and primitive condition of the globe. This is, we think, amply justified by the fundamental place which cosmogony necessarily occupies in the construction of the science. It is evident that opinion concerning such questions as the causes of crust-movements, the essential mechanism of igneous action, the origin of the atmosphere and hydrosphere, the beginning of life, must be controlled by the view adopted, formally or tacitly, of the mode of origin of the earth as a planet. Less obviously, but not less surely, some theory of the earth's initial state is involved in numerous geological doctrines, the dependence of which on such considerations is liable to be overlooked; and the authors do good service in recalling this fact repeatedly in the historical record which follows. The clear recognition of cosmogony as the foundation of geology, by revealing an unsuspected element of hypothesis at various places in the superstructure, offers a warning which is perhaps in some quarters not wholly unnecessary.

The special interest of this part of the book, however, lies in the first complete exposition of the "planetesimal" theory, which the senior author has already propounded elsewhere. That our solar system has in some manner been evolved from a nebula of some kind is an assumption to which few will demur; but the particular theory associated with the name of Laplace, and generally known as the nebular hypothesis, starting from a gaseous nebula of extreme tenuity, has for some time been felt to involve difficulties, which become more serious upon a closer examination. These difficulties are cogently stated by the authors, especial stress being laid on the great discrepancy which Moulton has pointed out from a consideration of the actual distribution of moment of momentum in the solar system. The meteoritic hypothesis, whether in Lockyer's or in Darwin's form, is held by the authors to be open to the same objections as the theory of a gaseous nebula, with which, indeed, it is practically identical as regards its more important consequences. According to the planetesimal hypothesis, the constituents of the system might be molecules or small masses of any kind moving in orbits about a common centre, the essential point being that their behaviour depended, not on mutual collisions (as on the meteoritic hypothesis), but on revolution in independent orbits. On this supposition there was, after the initial nebula was once formed, no fundamental change in the dynamics of the system, but only a progressive aggregation of the infinitesimal planetoids ("planetesimals") to form the planets and their satellites as they now exist.

The original nebula postulated was not a gaseous one, but belonged to the type giving a continuous spectrum, and had, like most of these, the spiral form. There were also, as in such nebulæ in general, knots of denser aggregation which became the nuclei of the several planets, though the greater part of the material outside the central helioid was still widely scattered. The manner in which such a system may have been developed from an ancestral helioid by the near approach of another star is tentatively pictured; but this is no essential part of the hypothesis, which is concerned, not with the whole evolution of the solar system, but with the birth and subsequent history of the planets. Starting with the conception of an infinitude of small masses revolving in different elliptic orbits of considerable eccentricity, with a certain degree of clustering already pronounced, the authors discuss the manner in which these planetesimals became aggregated into planets, moving in orbits of only small eccentricity, and with rotation in the same direction as the orbital revolution.

It is for the mathematician rather than the geologist to pass judgment upon this new treatment of the dynamical problems involved, but the geologist must be vitally interested in the verdict. The earth as built up on the planetesimal hypothesis will be a very different body from the earth as condensed from a gaseous spheroid, and must have passed through very different stages of evolution since it acquired individuality. The first-formed solid nucleus was probably devoid of any atmospheric envelope, its attraction being insufficient to control the rapidly moving molecules of gases. An appreciable atmosphere had probably been gathered when the growing globe had attained one-tenth of its present mass (being then comparable with Mars). The atmosphere would at first be collected from outside, but there was already a large quantity of occluded gases in the material built into the solid globe, which might eventually be

set free by extrusive agency, and continues to be a source of supply to the present time. The nature of the primitive atmosphere may be conjectured from the known occluded gases in crystalline rocks and meteorites, having regard also to a certain selective effect depending on molecular weights. Carbon dioxide was probably abundant and nitrogen only a minor constituent, the latter, in virtue of its chemical inertness, having accumulated progressively throughout subsequent time. It is supposed also that the oxygen in the present atmosphere has mainly been set free by the agency of vegetable life. The initiation of vulcanism is next considered, involving a discussion of the thermal conditions in the growing globe. The heat produced by the infall of the planetesimals was probably important only in the earlier stages of growth, and the chief source of the earth's internal heat is ascribed to the progressive compression of the central parts. It is estimated that this cause alone would suffice to reach the melting temperature of rock when the earth had acquired one-tenth of its present mass. On account of the originally heterogeneous composition of the globe, local spots of fusion would arise, the occluded gases presumably playing a part in the process, and, aided by the varying differential attractions of the sun and moon, the molten matter would gradually work its way outward. This action is supposed to be facilitated by "selective fusion," the more fusible materials encountered being taken up and the more refractory of the old materials deposited. In the general theory of igneous action developed by the authors there is evidently much that is debatable. In particular, the assumption that minerals have their melting points raised without limit by increased pressure, is one to which many physicists will demur. The maximum melting point found by Damien and others for various organic bodies, and considered by Tamman to be a general property, has led Arrhenius to very different conclusions concerning the actual condition of the earth's interior.

Another part of our authors' system which fails to carry complete conviction is the explanation offered for the initiation of the ocean-basins. The cardinal fact to be accounted for is the lower density of the crust in the continental areas as compared with that beneath the ocean floor. The difference is here attributed to the weathering and leaching action on the land, as contrasted with the relative protection of the rocks under the sea. It is supposed that the selective action of degradation and transportation sets up in time an appreciable difference in composition between the average material of the continental and that of the suboceanic tracts, the former becoming more acid and so lighter, and the latter more basic and therefore denser. The effect would be cumulative, and the difference of density established would be permanent, not being obliterated by subsequent metamorphism. In this way there might be evolved, from an originally fortuitous disposition of the growing hydrosphere, a distribution of land and water having a high degree of relative permanence.

We have dwelt on that part of the work which offers most of novelty, but the larger portion of the two volumes deals, on a more familiar model, with the several geological periods in order. The Archæan era is regarded as representing the climax of igneous action (or, as it is confusingly styled, volcanic action), and as being concurrently a time of intense crustal deformation. The Huronian and other pre-Cambrian formations which follow the Archæan are grouped as Proterozoic—an unfortunate choice, since the name has already been used by Lapworth for the Lower Palæozoic. The Lake Superior region is taken as the typical area, and three distinct systems are recognised —Huronian, Animikean, and Keweenawan. The great fossiliferous systems are then dealt with in turn, the chief innovations as regards systematic arrangement being the division of the Carboniferous into two, Mississippian and Pennsylvanian, and the separation of the Lower Cretaceous as a distinct system under the name Comanchean. Under each head the development of the stratified sequence in the North American continent is described and its interpretation discussed, the probable geographical conditions of the North American area at different periods being illustrated by maps. The corresponding strata of other parts of the world are dismissed more summarily. This plan is natural in a work designed primarily for American students, and its inconvenience is felt only in certain cases where the American record is incomplete or inadequate, especially in the Permian and Jurassic periods. We have, however, as a digression, a good account of the widespread glaciation in the southern hemisphere in Permian times, with excellent figures (after Schwarz) of glaciated rock-surfaces and boulder deposits in South Africa. We think that the authors have succeeded in giving a fairly complete and well-proportioned sketch of the earth's history in its successive chapters. The only serious defect which we find is the slight notice accorded to igneous action, and especially the failure (except in the earliest chapters) to recognise this as an essential part of geological history, closely bound up with the tectonic development of the globe.

For reasons connected with the curriculum of American universities, the history of life is treated in great measure apart from the physical history of the earth, a plan not without practical disadvantages. No attempt is made to give a complete "roll-call" of the flora and fauna of each period, but attention is directed especially to the main lines of biological development from the evolutionary standpoint. As regards the evolution of life in general, it is supposed that more than half of the complete history antedates the first fair record, offered by the Cambrian strata, in which we have abundant evidence of a development already far advanced. For this reason the Cambrian faunas are dealt with at some length. Similarly, in the Carboniferous we have for the first time a large mass of material bearing on the evolution of plant life, and this receives due notice, with a digression discussing the origin of coal and the climatic conditions implied in the profusion of vegetable life at that epoch.

The arrangement of the book is in most respects

well adapted to the requirements of students, and the presentation of the subject-matter is always clear. In the biological sections Transatlantic freedom of style is sometimes carried so far as to savour of the evening Press, paragraphs being headed, for example, "New Devices of the Bryozoans" and "The Protozoans make a Record." The abundant figures are well chosen, and, within the limitations of black and white, usually well executed, but the glazed paper, on which the whole is printed, is an offence to the sensitive eye. The work as a whole is one which will find a welcome in England as well as in America. The planetesimal theory, too, whatever its ultimate fate, is at least a spirited protest against any narrow limitation of geological time, and may serve to fortify timid geologists against the thunders of certain mathematicians, too apt to forget the precarious basis upon which their calculations are built. A. H.

THE GENESIS OF THE INVENTOR.

Erfindung und Erfinder. By A. du Bois-Reymond. Pp. vi+284. (Berlin: J. Springer, 1906.) Price 5 marks.

IN his opening chapter, Herr du Bois-Reymond gives an historical survey of the development of the Patent Laws in civilised countries. They date from the Act of Parliament passed in the year 1623, which in its first clause abolished the long-standing grievance known as monopolies, by which favoured individuals had the exclusive right to sell such things as salt and coal; the second clause established a new variety of monopoly, out of which patent rights had their origin. Little has been altered in principle since that date. Even down to the term of fourteen years the system still holds good, rights being granted to "any new manufactures." Other countries, adopting the idea at much later dates, attempted a more formal definition of invention, and legal logic has constantly tried to define the admissible and the inadmissible. Herr du Bois-Reymond shows that in Germany, since the year 1889, the number of patents granted has varied between 29 per cent. and 45 per cent. of the number of applications filed, and, therefore, assuming the quality of the inventions to be on an average the same from year to year, it would seem that the official mind is not yet certain in its workings.

The author's analysis of the nature of invention and inventors leads to the conclusion that neither need, nor chance, nor the lack of necessaries in surrounding life suffices to draw out the inventor. Instead of solving the problem by philosophic deductions from generalities, he descends to the particulars of the Patent Office, and concludes that inventors can be subdivided into three classes:—first, the intuitive genius, or, as Herbert Spencer would have said, the man who can do with little trouble that which cannot be done by the ordinary man with any amount of trouble; secondly, the technical man, well acquainted with his work, who follows in the wake of the intuitive genius, and is largely inspired by him; thirdly, the layman, whose special province seems to be feeding-bottles. We are inclined to think that too much stress can be laid on the existence and qualifications of the first class. A long series of inductive reasonings, followed generally by equally laborious experiment, is the usual course of a successful invention. Helmholtz and Darwin were not inventors, but their methods were the same. Helmholtz said that in his work he could only liken himself to the mountaineer, painfully and slowly climbing, often obliged to turn backwards, lighting later on new traces leading forward, and finally reaching the goal, only to find to his confusion that a plain road led thither, if he had only had the eyes to see. Darwin said he thought he was superior to the common run of men in noticing things which easily escape attention, and in observing them carefully. "My industry has been nearly as great as it could have been in the observation and collection of facts." Herein lies the real spirit of the pioneer. Nothing is more useful than the quality on which Darwin naïvely lays stress, viz. that of noticing things which escape attention; and those who hope to reach the promised land without wandering in the wilderness are probably doomed to disappointment.

Superficially, chance seems to play a large part; but Herr du Bois-Reymond maintains that chance only determines whether this or that individual shall do the deed, and has nothing to do with whether or not the deed shall be done. This is probably true in those cases in which attention is directed to a problem from various sides owing to a main directing cause. Such was the result of Moissan's discovery of the production of calcium carbide in the electric furnace. The acetylene generator seems to follow as a matter of course. Moissan had no heed for the commercial exploitation of such things, and many others, becoming aware of the existence of an obvious need, which appeared to be capable of being dealt with without the aid of the calculus, rushed in, left the relics of their labours in the files of the Patent Office, and discovered later that they were wholly unacquainted with the conditions of the problem. In this case mere inspiration leads nowhere; laborious experiment is much more to the point, and chance only comes in, having regard to the number of men at work on the task, in determining who shall lodge his application first. That cannot properly be called chance which is merely the outcome of some unlooked-for combination or slight variation of procedure; it is precisely for these things that the inventor toils, and when they come within his sight he merely recognises that for which he has patiently hoped.

Herr du Bois-Reymond concludes by considering the reaction on civilised life which is due to the existence of the inventor. The idea of protecting the inventor was only an indirect cause of the Patent Laws in most countries. A more direct impulse was probably given by the view that the prosperity of the State was likely to be increased by such encouragement as could be given to the creation of industries. Still, Faraday's commercial value has been incalculable, but he received little encouragement from Patent Laws, while

Watt was obliged to circumvent them in order to carry on his business. Moreover, the State undoubtedly profits directly. It is asserted by men competent to judge that the amount received in patent fees is greater than all the profits made by inventors. In other words, the average profit made on an invention is not sufficient to cover the charges made by the State. Herr du Bois-Reymond's book may be recommended to those who take an interest in the philosophic analysis of these questions, and they may also hope to find much worldly wisdom scattered throughout its pages, and a wealth of illustration, drawn from the experience of a busy life.

W. H. S.

BIOLOGICAL PHILOSOPHY.

Psychology (pp. 124); *Sociology* (pp. 124); *Ethics* (pp. 118). By Dr. C. W. Saleeby. Three vols. Scientific Series. (Edinburgh and London: T. C. and E. C. Jack.) Price 1*s.* net each.

DR. SALEEBY discusses the problems of philosophy from the Spencerian standpoint in an interesting fashion. Of the three volumes, that on Psychology appears much the best; it is the most serious, and though the author has there one *bête noire* in the person of Dr. Ward, who suffers vicariously for all the sins of "academic psychology," the reader is not wearied, as in the Ethics volume, by incessant declamation against Nietzscheanism, on the one hand, and what is politely called "hell-fire morality" on the other.

On psychology our author has nothing very startling to say. He defines his subject as the science, not of consciousness, but of mind. He favours the Wundtian theory of psychophysical parallelism. He regards mind as a product and phenomenon of evolution; or rather, having boldly stated that life is prior to mind, he closes one of two chapters on the evolution of mind by maintaining that the responsiveness of the leucocyte to irritation points to sentiency on its part, and by withdrawing his bold statement in favour of a bolder, that life and mind are co-equal, co-extensive, and of common origin. That is to say, he levels up the leucocyte to man. In the latter part of his book he dwells much more on the will than on the intellectual functions, as he wishes, not to lead up to a text-book on logic, but to the consideration of conduct. The result is that many questions which one finds discussed in the ordinary handbooks are not even mentioned in this; but, of course, amid the multiplicity of cheap introductory works there is no reason why all should go in the same ruts.

In the volume on Sociology one notes that our author follows the Spencerian line that the State has no consciousness of its own, and therefore the welfare of the State never means anything more or other than the welfare of the citizens. He follows his master, too, very closely in his opposition to free education, which he thinks as bad as free breakfasts for the children. A later chapter is occupied with an indictment of the modern city, and others with a discussion of socialism, conservatism, and liberalism.

The volume on Ethics has some excellences—the discussion of the origin of morality, for example, with what the author regards as the most important proposition he has to offer, viz. that organic evolution, reproductive evolution, and moral evolution are interdependent. Some other things are not quite so convincing—the statement that there has been far more vicious than virtuous obedience in human history, or another that morality is æons of æons older than the oldest creed, the proof offered being that a cat cares for its kittens. Apparently morality began ages before man was ever heard of, though, in a different context, Dr. Saleeby describes a baby as "non-moral, pre-moral, or if you like, immoral."

There is a hard saying on one page to the effect that historians of the (inaccurate and picturesque) school of Carlyle and Froude are no longer in request. This comes with rather a bad grace from one whose merits are probably—*quanto intervallo!*—much like those of the writers named; while his defects include an inadequate apprehension of the real issues involved and a stumbling knowledge of Greek. For *logos* does not mean science, nor is teleology derived from the word meaning "at a distance."

BIOLOGY OF THE FROG.

The Biology of the Frog. By Samuel J. Holmes, Ph.D. Pp. vii+370. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1906.) Price 6*s.* 6*d.* net.

IN the vast literature that treats of the frog there is no comprehensive summary of its biology. Every natural history teacher has realised this want, which has increased in proportion with the great recent extension of instruction in elementary natural phenomena. No animal is more thoroughly known from the anatomical, histological, and embryological aspects, but on the side that appeals to teachers and commencing students, the study of habit and function, existing knowledge of the frog is scattered and often untrustworthy. This gap the author strives to fill, writing primarily for the student. His book is a compilation of what is known of the behaviour of the frog and of its several organs. Unfortunately it is not only this. Dr. Holmes has not freed himself sufficiently from formal and dogmatic zoology. He must have all the nomenclature and the anatomy of the medical school, as though we could never learn or teach zoology without a load of descriptive structural details. The new wine of comparative physiology has been poured into the old vessel and has burst it, leaking out now here now there, so that no good draught is obtainable. The wine, however, is good, and the more pity the framework was not better adapted to hold it and yield it to the thirsty soul.

The frog enters on p. 62, chapter ii. Here "we begin our study." Unfortunately there are two earlier chapters, with which most readers will begin. The first deals with the classification of Amphibia, and ought to have been simplified or postponed. The

second is the main ecological chapter, and involves the use of many anatomical expressions that a young student will not understand until later. The mode of protrusion of the tongue by lymph pressure; the changes in the liver, fat-body, and gonads; the formation of new blood corpuscles and other difficult topics, are referred to before so much as a brief reference to the chief features of the frog itself.

The succeeding chapters are arranged on the stereotyped anatomical plan. In reference to the external features, no remark is made of the prevalence or significance of the dark upper sides and light under sides of animals, or of the meaning of gradational shading. A green pigment is attributed to the frog at the close of the third chapter and denied on p. 192. Descriptions of the internal organs, of development, and of the histology of the different organic systems occupy the rest of the book. We have, however, admirable summaries of physiological action under each histological section, and for these teachers will be thankful. The treatment of the skin and of the blood, of digestion and respiration calls for praise. The seasonal metabolic changes in the tissues of the frog are well described under the various organs that are affected, and the references will enable one to find the original papers with ease.

The book is one that will prove useful to every teacher of elementary biology, and its usefulness would have been enhanced by a thorough-going biological treatment and simplification of the anatomical details. Few biological writers realise what a stimulus to teachers and to taught lies in a new mode of presentation of a well-worn subject. In the writing of a biology of the frog a superb opportunity has presented itself of boldly embarking on the physiological method and of subordinating anatomy to the working out of function and response. Moreover, the biology of the frog is not well worn. It is, in contrast with anatomical knowledge, inaccessible and scattered, and with much labour it has been brought together for the first time. With so much novelty at his disposal one cannot help regretting that the author has adopted an arrangement for his work that puts biology into a subordinate place, with the result that he has made a useful but not an illuminating work.

It is in no carping spirit that we point out a few suggestions and corrections for a second edition. Chiefly we should advise the deletion of the experiments and experimental results dealing with severe lesions. The chapter on the nervous system is one that no sensitive student could read without shuddering, and a recapitulation of the revolting experiments made by certain writers was wholly unnecessary in such a work as this. It is with regret that we notice this serious drawback.

The description of the tadpole, and, indeed, of the life-history generally, while fairly careful in cellular detail, is lacking in any broad suggestiveness that will remain after the anatomical detail has faded from the mind. The mode of hatching, the meaning of food-yolk, the fish-like character of the larva are not touched upon, nor is there given in this or any other chapter of the book an idea of the process of evolution.

Few misprints occur, but "Wiederscheim" for the distinguished anatomist of Freiburg is of irritating frequency. F. W. G.

OUR BOOK SHELF.

Morphologie und Biologie der Algen. By Dr. Friedrich Oltmanns. Zweiter Band, Allgemeiner Theil. Pp. vi+443. (Jena: Gustav Fischer, 1905.) Price 12 marks.

IT is difficult to say of this much-wished-for and long-expected fruit of Dr. Oltmanns's industry more than that it meets all these wishes and hopes. There is one respect in which a fault may be found, the last to be thought of, viz. the arrangement, but it is cured by the provision of an excellent index. Detailed criticism of a work of this size in the pages of NATURE is out of the question, and the present writer confesses that he has attempted such a task several times, but always with the result that his effort not only left no satisfaction to himself, but kept a fear before him that his judgment might easily be misunderstood.

In a word, the book is invaluable to all workers at this subject, and well worthy of the great reputation of Dr. Oltmanns as a researcher and teacher. If any faults were to be found in a detailed criticism they would be, not with Dr. Oltmanns, but with the fate that has prevented his access to our great collections. This short notice of so great a work must not, from its brevity, seem to lack in the heartiness the reviewer wishes to express in his welcome to it. The volume has been long needed by those who are earnestly at work, and no one values it more than the writer of this brief note of thanks for it, and for the industry of the author of it.

GEORGE MURRAY.

Atlas colorié de la Flore alpine. By J. Beauverie and L. Faucheron. Pp. 98. (Paris: J. B. Baillière and Son, 1906.) Price 7.50 francs.

THE recollections of botanising expeditions in the High Alps must ever remain a source of pleasure to those who have had such enjoyable experiences. Not only the botanist, but anyone endowed with a spark of latent appreciation for the beauties of nature cannot fail to be aroused to enthusiasm when for the first time he has the good fortune to behold patches of *Anemone vernalis* in the spring, or to discover clumps of *Ranunculus glacialis* on the snow-line. It is natural, therefore, that there should be a demand for floras of the Alpine regions adapted to amateurs, and also worthy of professed botanists. Such is the nature of this volume, which contains excellent illustrations combined with simple descriptions of the flowers and references to localities where they may be found. To confine the book to reasonable compass, only fairly common Alpine plants are included, and preference is given to the denizens of the higher Alps. So far as the selection is concerned, there is little to note except that the orchids have received rather scant measure, and the thistles are entirely omitted. Some of the plants, *e.g. Douglasia vitaliana* and *Androsace villosa*, are interesting for their association with the French Alps, while, on the other hand, several species are included that are absent from French territory. The compilation reflects credit on the authors for their clear and pithy descriptions, and on the publishers for the manner in which the plates are produced.

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.*]

Measurement of Resemblance.

AT the distance of a few scores of paces the human face appears to be a uniform reddish blur, with no separate features. On a nearer approach specks begin to be seen, corresponding to the eyes and mouth. These gradually increase in distinctness, until at about thirty paces the features become so clear that a hitherto unknown person could thereafter be recognised with some assurance. There is no better opportunity of observing the effects of distance in confounding human faces than by watching soldiers at a review. Their dress is alike, their pose is the same, the light falls upon them from the same direction, and they are often immovable for a considerable time. It is then noticeable how some faces appear indistinguishable at distances where great diversity is apparent in others, and the rudely-defined idea will be justified that the distance at which two faces are just mistakable for one another might serve as a trustworthy basis for the measurement of resemblance. The same may be said of obscurity, of confused refractions, and of turbid media; but in this letter I shall confine myself almost wholly to the effects of distance under the conditions of ample light and a transparent atmosphere. Beyond this I shall say nothing, except in one paragraph almost at the end.

The scale of the features has, of course, to be taken into account. This is of much less importance in living persons than in portraits, because the differences in scale of the adult human face are not very great, whereas those in photographs and paintings—ranging as they do between miniatures and life-sized portraits—are so. It is necessary to adopt a *facial unit*, based on some specified dimension. That which I use is the vertical distance between the middle of the line that joins the pupils and the parting of the lips. It is unaffected by head-dress or by the thickness of the hair on the top of the head, while its lower termination can be located in a bearded face more accurately than the chin. I call this u. If the portraits have different units, they are distinguishable as u and u'. If d and d' be the critical distances at which mistakability first occurs, then u/d and u'/d' are necessarily equal, and either of them would serve as a measure of mistakability; but as u is very much smaller than d, this fraction would always be a decimal preceded by one or two zeros. Therefore I take the index of mistakability, which I will call N, as $=1000\,u/d$. It is, however, convenient to measure u and d by different scales; u in millimetres, distinguishing it as u_m; d in centimetres, distinguishing it as d_c. Then $N=100\,u_m/d_c$.

Of course, N could be expressed by the arc or angle of which u/d is the chord, but it would be a roundabout method, as angles could not be measured directly without special and troublesome apparatus. I find it very convenient for my purposes to employ a nomenclature for chords based on that of the metrical system, d, the distance, being the radius or "rad." So a chord $=1/100$ becomes a "centirad," and that $=1/1000$ a "millerad." A centirad is the chord of 34·4 minutes of a degree, and, therefore, a trifle larger than the apparent diameter of the sun or moon. It is equal to the apparent size of one-tenth of an inch at 10 inches distance from the eye, which is a convenient distance for reading small type. A millerad which subtends between three and four minutes of a degree, and is equivalent to 1/100 of an inch seen at 10 inches, is as small an interval as can usually be detected in photographs without scrutiny, though a normal eye is able to distinguish one-third or even one-fourth of that interval between sharply defined objects.

Mistakability is only an approximate measure of resemblance, for it depends more on the scale of the distinguishing features than on the amount of difference of those features. This peculiarity is well exemplified, though greatly exaggerated, by what is seen in the time-tables hung up by railway stations. From across the road, say, they all appear alike as a shade of uniform grey. On approaching nearer, differences are observed in the headlines; nearer still, varieties in paragraphing come into sight, and at a reading distance the figures are all simultaneously distinguishable. This experience is partly, but only partly, applicable to human faces. Those that are alike are certainly distinguishable at shorter distances than unlike ones, and I notice no excessive clustering of values closely round particular values of N in my results, which there would be if mistakability always occurred near a particular stage, such as that at which the whites of the eyes cease to be visible, or at twice or three times that distance.

A strong likeness in small details may so dominate the perception that a want of likeness in larger features is overlooked. Here the distance of maximum mistakability will be small, the portraits appearing more unlike when removed further off, and the small details cease to be visible. Extreme cases of partial likeness, whether in contour or in detail, would, of course, be noted and allowed for. With these exceptions the index of mistakability appears to be a fair, even, as I think, a close, approximation to an index of resemblance when the quality of the observed likeness is recorded by appropriate letters, as will be described later on.

The observational value of mistakability lies in its asking a simple question which different persons would answer in the same way, when they had become familiar with the method. On the other hand, *likeness* includes mutual *suggestibility*, a highly complex perception dependent on the mind of the observer, and consequently appreciated differently by different observers, as is notoriously the case.

The apparatus I now use with ordinary photographs acts very well, but I wasted much time before I contrived it, and more before sending it to be made in a workmanlike manner. I think it could still be improved, so I will describe, not my own, which was made for me by Baker, 240 High Holborn, but such as I should order if I required another one.

It is a long, thin, light box or framework 6½ feet (2 metres) long, 10 inches (25 centimetres) wide, and 2 inches (5 centimetres) deep, which admits of being divided for sake of portability. It stands on two folding supports 2½ feet apart, which fold back when out of use; when in use they can be clamped to any ordinary table. These raise the long box in a sloping position, the end towards the eye being at the most convenient height for a person seated on a chair, but the further end being lower, because it is easiest to look somewhat downwards. Two rollers, A and B (Figs. 1 and 2), run independently on a horizontal axis at one end of the box, and two corresponding ones, *a* and *b* (Fig. 2) at the other end. A light sledge that slides on the top of the box is harnessed in front to a tape graduated in centimetres, which passes over and round A, back to and around *a*, and thence forwards to the back of the sledge. (By inadvertence the path of the tape between the lower margins of A and *a* has been omitted in Fig. 1. The reader might dot it in pencil.) A similar sledge and tape is adapted to B and *b*. The tapes lie half an inch above the box (Fig. 1), and can be manipulated by the hands severally, so either or both sledges can be easily pulled either backwards or forwards while sitting in the chair, and their distances from the rollers at any moment be read off on the graduated tapes. (A winch and handle are superfluous.) The photos are mounted on two easily detachable standards (Figs. 1, 2), with clips at the bottom to hold them (not shown in the diagram), and standing on circular bases. These fit quite loosely into shallow hollows in the tops of the sledges. The standards can be lifted out, the photographs inserted, and the whole replaced with perfect ease. The circularity of the bases of the standards enables either of them to be set a little askew, which is convenient when the broad, full face of one portrait has to be compared with the narrowed, three-quarter face of another. A board stands vertically across A and B, and above them as a bridge. An eye-slit of half an inch width runs below its upper edge (Figs. 1, 3, 4), through which the photos are viewed, and from which the distances of the sledges are reckoned. A ledge 1 inch below the eye-slit (Fig. 1), with a parapet a little less than 1 inch high, forms a long,

narrow groove into which light rectangular frames of wood, each with a spectacle lens in it, can be slipped and will stand upright (Figs. 1, 4). I chiefly use lenses of 12, 24, and 48 inches; my eye can accommodate its focus to intermediate distances, but I possess others which are sometimes serviceable. Younger persons with normal eyesight would want no lenses at all. The length of the box suffices for cabinet-size photos. An opera-glass reversed enables it to be used with larger ones, the minifying power of the opera-glasses at various short distances having been ascertained.

Mutual mistakability may occur under any one or more of the following conditions, which are to be noted, together with further remarks:—

a a. The portraits are apparently exact copies or reductions on different scales.

a. They appear to be portraits of the same person at about the same age, though differing in pose and dress.

b. They would be mistaken for portraits of the same person, even though they differ in sex and considerably in age, if the hair had been cut and dyed alike, and the dress arranged in the same way.

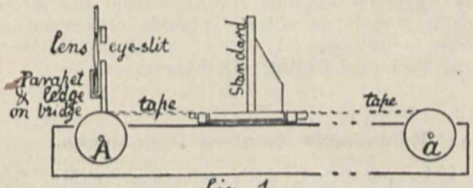


Fig. 1

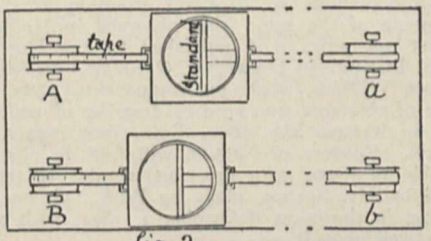


Fig. 2

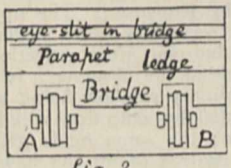


Fig. 3

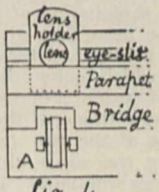


Fig. 4

c. As above, if much disguised, as for theatrical personations.

b–c. Applies to cases intermediate between *b* and *c*.

P. Their resemblance is partial only, being confined to specified features.

The following little table saves trouble in operating; my own is more extended:—

Values of d_c in terms of N and of u_m $\left(d_c = \frac{100\ u_m}{N}\right)$

N	u_m									
	1	2	3	4	5	6	7	8	9	10
5	20	40	60	80	100	120	140	160	180	200
7·5	15	30	45	60	75	90	105	120	135	150
10	10	20	30	40	50	60	70	80	90	100
15	7	15	22	30	37	45	52	60	67	75
20	5	10	15	20	25	30	35	40	45	50
25	4	8	12	16	20	24	28	32	36	40

The procedure adopted after many trials was to measure the u_m of each portrait to the nearest half-millimetre and to write it below. Then to mount the two portraits, each on a separate sledge if their facial units differed, otherwise on the same. When they differed, the facial unit of the one about to be used for d_c was distinguished as u_m, the other was in brackets as (u'_m). Next, after referring to the above table, to send them to their respective d_c for N = 5, to consider them carefully, and to note the result. Then to do the same for N = 10, and so on, until the eye became familiarised with the differences between the portraits. Finally, guided by these provisional attempts, to fix on the suitable index and letter, adding such remarks as may seem wanted.

I became gradually more consistent in judgment, as ascertained by comparing the results on different days, but have felt all along that it would conduce to trustworthiness if two or more companions worked together and criticised one another, and recorded their common verdict.

A very brief example will suffice. Usually an entry consists of more lines followed by general remarks.

Two Sisters, Registers (so and so).
$u_m = 8{\cdot}5$; $(u'_m = 9{\cdot}0)$

N	d_c	Character of likeness
5	170	*b*
10	85	Nearly *b*
After trials	115	Just *b*

Accept N(*b*) $= \frac{850}{115} = 7{\cdot}4$

I will add a few words on dealing with mistakability caused through obscurity or other hindrances to clear vision. I prepared test cards, each containing numerals printed in different types, and, having ascertained by experiment the value of d_c for each kind of type when just able to read it in a clear light, wrote that value boldly by its side. An appropriate test card was put by the side of the portraits, and at the time when the portraits themselves were just mistakable, the written d_c of that row of figures which were just unreadable, was noted. The value of d_c remains constant whatever be the character or amount of the optical hindrance. If the hindrance increases, the portraits and the accompanying test card must be brought nearer to the eye. They will increase simultaneously in legibility. The written d_c will always show what the d_c would be in a clear light.

The applications of the process are numerous, as must always be the case when a hitherto vague perception is brought within the grip of numerical precision. To myself it has the especial interest of enabling the departure of individual features from a standard type to be expressed numerically. The departure may be from a composite of their race, or from a particular individual. The shortcomings of a pedigree animal from a highly distinguished ancestor could be measured in this way. Many other examples might be given.

I must not conclude without expressing gratitude for answers to a request, published by me some time ago in NATURE, for waste photographs from amateurs and professionals. If I be allowed to mention a single name, it would be that of Mr. Norman Campbell, whose photographs have been eminently serviceable.

FRANCIS GALTON.

Models of Atoms.

AN interesting and instructive variant of Prof. Mayer's experiment with floating magnets, which has been used so much to illustrate the structure of atoms, is to do away with the *centripetal* magnetic force and to arrange that its place be taken by forces arising from capillarity. This is managed as follows:—

A small circular dish is filled almost to overflowing with water the surface of which will be convex. A single floating magnet (with its axis vertical) placed on this moves at once to the centre; two or more such magnets placed on it form regular equilibrium figures, as in the usual form of the experiment. The chief interest of the modification arises, however, from the fact that *the figures are not in general the same as in the ordinary arrangement.* This is instructive, because it brings out clearly the necessity of knowing the exact law of force between the parts of an atom before it can be possible to predict its structure.

The experiment is so easily tried by anyone that there is no need to go into great detail here; but it may be mentioned that with the particular dish and magnets used by me it is possible to arrange ten in a single ring without any central nucleus, and that in a larger dish more can, of course, be so arranged. These ten also form stable groups as a ring of nine with one in the middle, or a ring of eight with two in the middle. But a ring of seven with three in the middle is not possible; if temporarily so placed one of the three gradually moves out and joins the seven. The first arrangement in three groups occurs for eighteen magnets in all; these are stable when placed with twelve in an outer ring, five in an intermediate ring, and a single one in the centre. ALFRED W. PORTER.

University College, London, September 17.

Chemical and Electrical Changes induced by Light.

THE issue of NATURE for August 30 (p. 455) contains an abstract of a paper read before Section A of the British Association by Sir Wm. Ramsay and Dr. J. F. Spencer on the chemical and electrical changes induced by ultra-violet light, in which the "fatigue" shown by certain surfaces is discussed. I have for some time been engaged in an investigation of the fatigue shown by metals for the photoelectric effect, and have made a careful examination of the rate at which the photoelectric current decays in the case of a zinc plate, polished or amalgamated. A large Nernst lamp supplied with current from storage cells was used to give a steady source of light. The decay immediately after exposure to the light was very rapid, but after about twenty minutes became much slower. For a change taking place according to the "compound interest law," as in the case of a monomolecular chemical reaction or a single purely surface effect, we know that the curve can be represented by an exponential term involving the time. In the case of zinc, I find that the activity at any instant can be represented with considerable accuracy by the sum of two exponential terms. It is possible to interpret this result somewhat on the lines followed by Rutherford in explaining the decay of the excited activity of radium or thorium, by supposing that a succession of changes takes place.

Similar results have been obtained in the case of aluminium, and also with specimens of coloured fluor-spar. In the latter case the colour is attributed to the presence of particles of reduced metal.

It is interesting to note that the longer waves of light tend to produce a change in the opposite sense, so that the rapid decay at first observed on exposure to light may be followed by a small increase in activity unless the long waves are absorbed by a solution of alum.

These experiments were carried out partly in the laboratory of Lord Blythswood, to whom my thanks are due, and partly in the Wheatstone Laboratory of King's College.

H. S. ALLEN.

King's College, London, September 21.

The Rusting of Iron.

THE experiments made by Mr. J. Newton Friend, and described by him in NATURE of September 27, confirm similar experiments previously made by me, and furnish further evidence that the rusting of iron is primarily a result of acid attack. That cast iron, a very complex material frequently containing a high percentage of sulphur and phosphorus, decomposes hydrogen peroxide "with astonishing rapidity," and that the metal becomes covered with rust in a few minutes, is not, however, to be referred to catalytic action, as Mr. Friend suggests, but is a consequence of the formation of acids by the oxidation of some of the impurities present in the iron, and of the subsequent electrolytic action. As Mr. Friend says, "the purer the iron the less is the action of the peroxide upon it," which is another way of stating that the intensity of action will be determined by the amount of acid formed on the surface of each particular sample of metal when in contact with the peroxide.

Cast iron is known to oxidise in air more readily than wrought iron, and this is probably due to the former containing impurities which on oxidation yield acids. The rust formed on cast iron exposed to air often contains appreciable quantities of combined sulphur.

The fact that cast iron is attacked by water in absence of air, becoming darker in colour, whilst pure iron under identical conditions remains unchanged, may also be referred to the production of a minute quantity of acid. In this case the acid is not formed by oxidation, but it is probably hydrogen sulphide resulting from the interaction of sulphides, such as silicon sulphide, contained in the crude iron, with water. GERALD T. MOODY.

Central Technical College, October 1.

Remarkable Rainbow Phenomena.

MAY I be permitted, with reference to Mr. Spence's observation of a remarkable rainbow, described in your issue of September 20, to direct attention to a number of phenomena of the same kind observed in Holland during the last ten years, and published by the Dutch Meteorological Institute in *Omweders, Optische Verschijnselen enz.* At Fort William, also, on August 16, 1887, a phenomenon of this sort was seen, a drawing of which is to be found in Trans. Roy. Soc. Edin. (vol. xxxiv., p. xvii, Fig. 17). Readers of NATURE will find an observation of a double rainbow, with drawing, similar to the oval described by Mr. Spence, made by Prof. Tait on September 11, 1874, in the issue of October 1, 1874, with a comment by Maxwell upon it.

The explanation of the phenomenon is simple, and seems to have been first given by Rubenson. The upper of the two ordinary and the two secondary bows is generated by rays which enter the raindrops after reflection from a level of water situated behind the observer. It is obvious that the altitude of the ordinary rainbow being $42°-h$, the altitude of the one generated by reflection will be $42°+h$, h being the sun's altitude; the same holds good for the secondary rainbow. The centres of all the bows lying in the same vertical, it is clear that the two ordinary bows and the two secondaries touch each other at the horizon. For further information see my "Meteorologische Optik" (pp. 491 and 555). J. M. PERNTER.

Vienna, September 28.

Fugitive Coloration of Sodalite.

WITH reference to the properties of Indian sodalite shown by Mr. T. H. Holland at the York meeting of the British Association (September 27, p. 550), will you permit me to point out that, although not generally noticed in the text-books, the change of colour referred to is not peculiar to the Rajputana mineral. The first sodalite discovered had the same property, and Giesecké, under date August 28, 1806, records the occurrence of "pfirsichblüthenrothfarbene" sodalite from Kangerdluarsuk, in Greenland, "welche die hohe Farbe auf frischem Bruche sogleich beinahe ganz verliert." The same observation was made independently by Allan (Thomson's "Annals of Philosophy," 1813, vol. i., p. 104); but I am not aware that there is any record of a recovery of the lost colour, which Mr. Holland appears to have observed.

JAS. CURRIE.

Edinburgh, October 1.

THE QUATERCENTENARY CELEBRATIONS OF THE UNIVERSITY OF ABERDEEN.

THE quatercentenary celebrations of the University of Aberdeen, which included the opening of the new buildings at Marischal College by their Majesties the King and Queen, were favoured by a week of uninterrupted sunshine, which quickened everyone's pulse and gave splendour to the proceedings. There were many remarks on the forethought of the University in conferring the honorary degree of Doctor of Laws on the director of the Meteorological Office.

On the morning of Tuesday, September 25, there was a solemn service of commemoration in the chapel at King's College—that priceless heritage founded by Bishop Elphinstone in 1500. In the afternoon there was a remarkable procession through a mile of crowded streets, by a circuitous route from Marischal College to the temporary Strathcona Hall, built for the celebrations by the generous Chancellor. This pageant, almost iridescent with robes of many colours, included the University authorities and staff, the Town Council, the delegates and guests, the honorary graduates, the general council, and students. It was a striking spectacle, greatly appreciated by the keenly interested and courteous crowds, a quaint intertwining of town and gown.

In the Strathcona Hall, the delegates from sister universities and learned institutions all over the world presented congratulatory addresses, and representative men made brief speeches. Thus the Vice-Chancellor of Oxford spoke for Britain, Principal Peterson for dominions beyond the seas, Prof. J. William White for the United States, Prof. Becquerel for France, Prof. Deissmann for Germany, Prof. Höffding for Denmark, Prof. Einthoven for Holland, Prof. Lanciani for Italy, Prof. Scheviakoff—a zoologist—for Russia, and Prof. Matsumura—a botanist—for Japan, and there were many others. The huge audience of 4000 showed enthusiastic interest in the famous men who filed past, especially in those who are familiar to all, such as Sir Oliver Lodge, Sir William Turner, and Sir Archibald Geikie.

The great event of Wednesday was the conferring of honorary degrees on a phalanx of intellectual giants, who came from all quarters of the world to do honour to, and be honoured by, the ancient University of Aberdeen. They included, as the Dean of the Faculty of Laws felicitously expressed it,

"explorers, discoverers, inventors; some who have all but solved the mysteries of the natural universe or of the animal frame, others who have illuminated the even greater depth of mind, others who have successfully grappled with controversies of history or the not less complex problems of national institutions and international relations; men of thought and action, poets, musicians, and philosophers, great administrators, great rulers, and judges."

The list is too long to be quoted *in extenso*, but we may note some of those who are especially concerned with science in the wide sense. It may be noted that a few who were expected were unavoidably absent, such as Signor Marconi, who was referred to by the promoter as "the annihilator of time"; Dr. Dohrn, of the Naples Zoological Station; and Prof. Lombroso. Among those upon whom the degree was conferred were the following:—

Richard Anschutz, professor of chemistry, Bonn; Henri Becquerel, professor of physics, Paris; Sir James Crichton-Browne, Kt., Lord Chancellor's Visitor in Lunacy; Casimir de Candolle, Geneva; Frank Wigglesworth Clarke, chief chemist, U.S. Geological Survey, Washington; Yves Delage, professor of zoology and comparative anatomy, Paris; J. Deniker, librarian of the Museum of Natural History, Paris; W. Einthoven, professor of physiology, Leyden; Herbert Mackay Ellis, Director-General, Naval Medical Service, London; Arthur J. Evans, keeper of the Ashmolean Museum, Oxford; Andrew Russell Forsyth, Sadlerian professor of pure mathematics, Cambridge; Sir Archibald Geikie, secretary to Royal Society; Arnold Hague, U.S. Geological Survey, Washington; H. J. Hamburger, professor of physiology, Groningen; Edward Hjelt, professor of chemistry, Helsingfors; Harald Höffding, professor of philosophy, Copenhagen; Ferdinand Hueppe, professor of hygiene, Prague; Howard A. Kelly, professor of gynæcology, Johns Hopkins University, Baltimore; Surgeon-General Sir Alfred Keogh, K.C.B., Director-General, Army Medical Service; Rudolf E. Kobert, professor of pharmacology, Rostock; Casimir Kostanecki, professor of anatomy, Cracow; Hugo Kronecker, professor of physiology, Bern; Sir Francis H. Laking, Bart., G.C.V.O., physician in ordinary to His Majesty the King and the Prince of Wales; Commandatore Rodolfo Lanciani, professor of ancient topography, University of Rome; Charles Rockwell Lanman, professor of Sanskrit, Harvard University; Gustavus Mittag-Leffler, professor of mathematics, Stockholm; Oscar Liebreich, professor of pharmacology, Berlin; Sir Norman Lockyer, K.C.B., director of Solar Physics Laboratory, South Kensington; Sir Oliver Lodge, Kt., Principal of Birmingham University; Friedrich Loffler, professor of hygiene, Greifswald; Donald Macalister, president, General Medical Council; A. B. Macallum, professor of physiology, Toronto; Sir John Macfadyean, Principal of the Royal Veterinary College, Camden Town, London, N.W.; Lord M'Laren, vice-president, Royal Society of Edinburgh; Jinzo Matsumura, professor of botany, University of Tokyo, Japan; His Serene Highness Albert Honore Charles, Prince of Monaco; Wilhelm Ostwald, professor of chemistry, Leipzig; Edmund Owen, vice-president, Royal College of Surgeons of London; W. M. Flinders Petrie, professor of Egyptology, University College, London; Rev. George E. Post, professor of surgery in Johanite Hospital, Beirut; Sir Richard Douglas Powell, Bart., K.C.V.O., president of the Royal College of Physicians, London; Salomon Reinach, professor of archæology, Paris; Guglielmo Romiti, professor of anatomy, Pisa; Sir Henry E. Roscoe, late professor of chemistry, Owens College, Victoria University; Major Ronald Ross, C.B., Liverpool School of Tropical Medicine; Vladimir Scheviakoff, professor of zoology, St. Petersburg; Jakob Schipper, professor of English philology, Vienna; Dukinfield Henry Scott, hon. keeper, Jodrell Laboratory, Kew Gardens; William Napier Shaw, director of the Meteorological Office, London; Joseph J. Thomson, Cavendish professor of experimental physics, University of Cambridge; Frederick Trendelenburg, professor of surgery, University of Leipzig; Sir William Turner, K.C.B., principal of University of Edinburgh; Giuseppe Veronese, professor of analytical geometry, Padua; Hugo de Vries, professor of physiological botany, Amsterdam; J. William White, professor of surgery, Pennsylvania University; J. W. van Wijhe, professor of anatomy, Groningen, Holland; Sir John Williams, Bart., K.C.V.O., late professor of midwifery, University College, London.

The proceedings concluded with a speech by the Chancellor, who in the course of his address is reported by the *Times* to have said:—

"The presence of so many distinguished men representing universities and learned societies from all parts of the world might suggest, if this were the occasion to deal with it at length, a comparison of the aims and objects which we cherish here and the methods by which we seek their accomplishment with those of similar institutions in other countries. Let me say, to begin with, that Scotland is proud of her universities, their close connection with the national life, their free and open constitution, their services to science and letters, their stimulating influence—especially of late years—on the schools of the country, and the manner in which, in spite of great difficulties, they have kept before them lofty and high standards. All the countries of the world have each their own type of national university. There are, among many others, the

English type, the German type, and the American type. We have no reason to be ashamed of the Scottish type. But while it is legitimate for us, especially at the celebration of our 400th birthday, to plume ourselves on work done and service rendered, we must not forget that others also have been making progress, and are even now passing us in the race of efficiency. Scotland is no longer the only country in the world that can justly boast that its main industry is education; and our universities have still, perhaps, something to learn in the way of relegating a greater proportion of their work to the practical activities of life. I do not speak from a merely utilitarian point of view, and I know that it is the proper function of a university to foster even those studies which may be described as ends in themselves. If it were not for what universities do in cherishing abstract and theoretical learning, some of the practical applications of that learning resulting in the great triumphs of modern scientific activity would never have been made. I know also that the universities, for example, of the New World have something to learn from those of Europe in the direction of more solid attainment and a higher standard, at least in certain departments of study. But speaking for the moment as one who has lived for many years on the American continent and has watched with close attention the growth of one of our greatest universities in Canada, I may be allowed to record my conviction that universities on the other side of the Atlantic enjoy a considerable advantage in the ease and readiness with which, unhampered as they are by any venerable traditions, they can adapt themselves to the practical needs of the various constituencies which they seek to serve. They found out long ago that law and medicine and theology are not the only legitimate points of academic study; and in their faculties of applied science they are training their young men to do work that is most loudly called for. They have never accepted the view that universities must necessarily be institutions cloistered and apart from the main current of public life and service. On the contrary, they make a training for citizenship and for public usefulness the basis and foundation of much of their educational activity. The reward they have is that—fully as much as we do here—they find their *alumni* in every walk of life, not in the 'learned professions' only; and some of the most notable benefactions which the American universities have lately received come from men whose desire it is to connect them still more closely with practical work. As a recent illustration of this spirit, let me refer to the great gift that was made the other day by my friend Sir William Macdonald to McGill University, Montreal. It consists of a college of agriculture situated about ten miles outside the city, and comprises, besides all the necessary buildings erected in palatial style, some six hundred acres of ground. The whole benefaction amounts to some 600,000*l*., and secures to the agricultural interests of the country that they shall be developed hand in hand with those of a university which has already done so much for engineering and other practical sciences."

At the various festive meetings of the crowded four days—the receptions at the two colleges and at the Art Gallery, the Town Council banquet, and Lord Strathcona's gigantic dinner-party of two thousand four hundred guests—there was renewed opportunity to realise the cosmopolitan nature of the concourse and the generosity of the response made to the University's invitation. Among the famous men who were present as delegates we may note the following, taking them in order of the institutions represented:—

FIG. 1.—View of Marischal College. (From over the top of the houses in front.)

(1) Great Britain and Ireland:—Universities: Oxford, Prof. Henry Goudy, Prof. Arthur Thomson; Cambridge, Prof. Henry Jackson, Dr. James Adam, Dr. William L. Mollison; Durham, Rev. Dr. Henry Gee (Master of University College, Durham); Edinburgh, Prof. Alex. Crum Brown, Prof. George Chrystal, Prof. James Cossar Ewart, Sir Thomas Richard Fraser, Dr. Thomas Smith Clouston; Glasgow, Sir T. McCall Anderson, Prof. Archd. Barr, Prof. John Cleland, Prof. John Ferguson, Prof. Samson

Gemmell, Emeritus Prof. John G. McKendrick; Leeds, Dr. Nathan Bodington (Vice-Chancellor); Liverpool, Mr. Alfred W. Winterslow Dale (Vice-Chancellor); London, Dr. Augustus Desiré Waller; Manchester, the Victoria University, Dr. Alfred Hopkinson (Vice-Chancellor); St. Andrews, Lord Balfour of Burleigh (Chancellor), Dr. Andrew Carnegie (Rector), Principal James Donaldson, Very Rev. Principal Alexander Stewart, Principal John Yule Mackay (Dundee), Prof. James Musgrove, Prof. John E. A. Steggall (Dundee); Wales, Mr. Henry Rudolf Reichel (Vice-Chancellor). Colleges and Learned Societies:—Bangor, University College of North Wales, Prof. Philip J. White; Bristol, University College, Principal C. Lloyd Morgan; Dublin, Royal College of Physicians, President Sir William J. Smyly; Royal College of Surgeons, President Henry Rosborough Swanzy; Edinburgh, Royal College of Surgeons, President Charles Watson MacGillivray; Glasgow, West of Scotland Agricultural College, Principal Robert Patrick Wright; London, British Academy, Prof. Henry Francis Pelham, President of Trinity College, Oxford; British Medical Association, Mr. George Cooper Franklin (President); Charing Cross Hospital Medical College, Dr. William Hunter; Guy's Hospital Medical College, Dr. Frederick Taylor; Inner Temple, Hon. Mr. Justice Grantham; King's College, Rev. Principal Arthur Cayley Headlam; London Hospital Medical College, Dr. Wm. Bulloch; Middlesex Hospital Medical College, Mr. Andrew Clark; Pharmaceutical Society of Great Britain, Mr. Alderman R. A. Robinson (President); Royal Academy of Arts, Mr. John Macallan Swan, R.A.; Royal College of Physicians, Sir Richard Douglas Powell, Bart. (President); Royal College of Science, Prof. W. Gowland; Royal College of Surgeons, Mr. Edmund Owen (Vice-President); St. Bartholomew's Hospital Medical College, Sir Dyce Duckworth; University College, Principal T. Gregory Foster.

(2) British Dominions beyond the Seas:—Canada: Dalhousie University, Halifax, N.S., Prof. Jas. G. MacGregor; University of Toronto, Prof. A. B. Macallum. Africa: South African College, Prof. P. Daniel Hahn. Australia and New Zealand: University of Tasmania, Prof. John Walter Gregory. India: Calcutta, Asiatic Society of Bengal, Colonel Alf. Wm. Alcock.

(3) Other countries:—America (South): University of Ecuador, General Don Emilio M. Teran. Austria-Hungary: University of Vienna and Imperial Academy of Sciences, Vienna, Prof. Jakob Schipper; University of Buda Pesth, Prof. Ignacz Goldziher; Bohemian University of Prague, Prof. Vaclav E. Mourek; German University of Prague, Prof. Ferdinand Hueppe. Belgium: University of Brussels, Prof. Count Eugene Goblet D'Alviella. France: Institut de France, Prof. Emile Boutroux, Prof. Salomon Reinach. Germany: University of Berlin, Prof. Hans Dellbrück; University of Greifswald, Prof. Friedrich Löffler. Italy: University of Padua, Prof. Giuseppe Veronese. Norway: University of Christiania, Prof. A. Taranger. Russia: St. Petersburg, Imperial Academy of Military Medicine, Prof. Henry Turner. Sweden: University of Upsala, Prof. Henrick Schück (Rector); Stockholm, Royal Swedish Academy of Sciences, Prof. Einar Lönnberg. Switzerland: University of Geneva, Prof. Charles Borgeaud; University of Bern, Prof. Hugo Kronecker; University of Zürich, Prof. Theodor Vetter.

Among the guests of the University other than delegates there were many illustrious men of science, such as

(1) England:—Dr. T. Clifford Allbutt, regius professor of physic, University of Cambridge; Dr. Henry E. Armstrong, professor of chemistry, Central Technical College, London; the Right Hon. Lord Avebury, F.R.S.; Sir Robert S. Ball, professor of astronomy and geometry, Observatory, Cambridge; Colonel David Bruce, C.B.; Dr. Wm. Burnside, professor of mathematics, Royal Naval College, Greenwich; the Lord Archbishop of Canterbury; Prof. W. Watson Cheyne, professor of surgery, King's College, London; Sir William Crookes; Sir Edward Elgar; Dr. Herbert MacKay Ellis, Director-General, Naval Medical Service; Dr. Arthur J. Evans, keeper of the Ashmolean Museum, Oxford; Sir John Evans, K.C.B.; Prof. A. R. Forsyth, Sadlerian professor of pure mathematics, Trinity College, Cambridge; Right Hon. Sir Edward Fry, F.R.S.; Dr. Richard Tetley Glazebrook, director of the National Physical Laboratory, Bushy House, Teddington; Dr. A. S. F. Grünbaum, professor of pathology, University of Leeds; A. D. Hall, director, Rothamsted Agricultural Experiment Station, Harpenden, Herts; Prof. Joseph Larmor, secretary of the Royal Society; Sir Norman Lockyer, K.C.B.; Dr. Alexander Macalister, professor of anatomy, University of Cambridge; Dr. Donald Macalister, president, General Medical Council; Major Percy Alex. MacMahon, secretary, British Association; Prof. Raphael Meldola, president of the Chemical Society; J. E. Quibell, Bedrashein, Egypt; Sir Wm. Ramsay, K.C.B., professor

FIG. 2.—Front of Marischal College Buildings, looking southward.

of chemistry, University College, London; Sir Henry E. Roscoe, late professor of chemistry, Victoria University; Major Ronald Ross, C.B., Liverpool School of Tropical Medicine; Rev. Archibald H. Sayce, professor of Assyriology, University of Oxford; Dr. George D. Thane, professor of anatomy, University College, London; Dr. Thomas E. Thorpe, C.B., director of Government Laboratories, London; Dr. J. A. Voelcker, chemist to Royal Agricultural Society of England.

(2) Scotland:—William S. Bruce, leader of the Scottish Antarctic Expedition (1902–4), Edinburgh; Sir Henry Craik, K.C.B.; the Right Hon. the Earl of Elgin, K.G., G.C.S.I., LL.D., D.C.L.; Right Hon. Richard Burdon

Haldane, M.P., Secretary of State for War; Sir John Murray, K.C.B.; Sir J. A. Russell, inspector of anatomy for Scotland.

(3) Ireland:—Dr. Jas. Little, professor of physic, University of Dublin; Prof. John Pentland Mahaffy, senior fellow, Trinity College, Dublin, late professor of ancient history.

(4) Other Countries:—Yacoub Artin Pasha, Under-Secretary of State for Education, and president of the Institute of Egypt, Cairo; Dr. G. Stanley Hall, professor of psychology, Clark University, Worcester, Mass., America; Prof. H. J. Hamburger, professor of physiology, Groningen; Prof. O. Kellner, K. S. Landwirthschaftliche Versuchsstation, Möckern, Leipzig; Prof. Oscar Liebreich, professor of pharmacology, University of Berlin; Prof. Friedrich Trendelenburg, professor of surgery, University of Leipzig.

The great event of Thursday was the opening of the new buildings at Marischal College by the King and Queen. The whole of the large quadrangle was filled with a sea of faces, and Dr. Marshall Mackenzie's "granite miracle" was the subject of universal admiration. The Principal read an address from the University, and His Majesty in a strong voice declared the buildings open. The Rector asked leave to present the following gentlemen:—

Mr. Alexander M. Gordon, Mr. Alexander Wilson, Dr. William Dey, Dr. Angus Fraser, Dr. David Littlejohn, Dr. Albert Westland, Prof. Matthew Hay, Prof. John Harrower, Prof. Neil J. D. Kennedy, Prof. Robert W. Reid, Prof. James W. H. Trail, Prof. Henry Cowan, Prof. James B. Baillie, Prof. Stephenson, Prof. Charles Niven, Prof. David J. Hamilton, Prof. Alexander Ogston, Prof. William M. Ramsay, Mr. Patrick Cooper, Mr. Theodore Crombie, Dr. John Fleming, Mr. Alexander O. Gill, Mr. David M. M. Milligan, Mr. James Murray, M.P., Mr. Andrew R. Williamson, Mr. A. Marshall Mackenzie, A.R.S.A., the architect, and Mr. W. Wilfred Campbell.

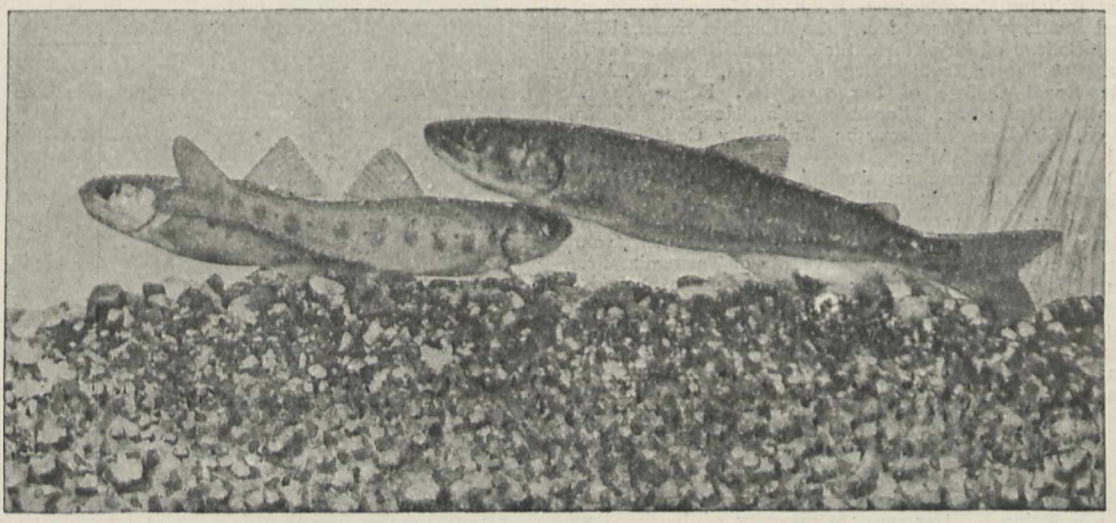
Their Majesties afterwards visited the parts of the new buildings devoted to agriculture and modern languages, and showed great interest in their equipment.

The success of the University celebrations surpassed even the most sanguine expectations, and was attributable to a combination of factors. The weather, though technically autumnal, was better than the best Aberdonian summer. The solemn commemoration of a past four hundred years happily coincided with entering into the possession of a new legacy which makes the University's outlook on the future hopeful. The response to the University's invitation on the part of sister institutions and her own sons and daughters was exceedingly hearty. What began as a primarily academic ceremony broadened out into a civic festival, partly through the kindness of their Majesties, partly through Lord Strathcona's princely generosity, and partly because of the cordiality of the relations between town and gown. But there can be no overlooking the fact that the success of the celebrations was the natural reward of most thoughtful and detailed organisation, of putting brains as well as goodwill into an arduous task. *Vivat, crescat, floreat Universitas Aberdonensis.*

TWO BOOKS ON ANGLING.[1]

IN "Salmon Fishing" Mr. Hodgson deals with the spirit, rather than the technique, of the sport. The first half-dozen chapters of the book are a series of essays on different aspects of fishing, and they are written in a most attractive manner and provide excellent reading. In the chapter on the "Elusive quarry," for instance, the instincts, or rather whims, of the salmon are written about very pleasantly. Mr. Hodgson discusses the old question as to whether or not the salmon feeds in fresh water, and is inclined to think that when the fish rises to a fly it does so with the intention of eating. Evidence against this contention was collected a few years ago by the Scottish Fishery Board, and it was shown that the epithelium of the stomachs of salmon in fresh water was in a catarrhal condition that made digestion impossible. It is, on the whole, the simplest solution of this question that the salmon, when it rises to a fly, does so urged by some kind of sporting instinct.

Mr. Hodgson's book is, however, very practical as well as entertaining. Three chapters are devoted to an account of the salmon rivers of the United Kingdom, and in one very useful chapter there is an excellent account of salmon passes and some useful



Non-migratory Danube salmon, and British fish, in the Thames. The small fish, natives in British waters, are four times the age of the less small—an alien from the Danube. From "Salmon Fishing," by W. Earl Hodgson.

[1] "Salmon Fishing." By W. Earl Hodgson. Pp. xi+314. (London: A. and C. Black, 1906.) Price 7s. 6d. net.
"The Science of Dry Fly Fishing." By Fred. G. Shaw. Pp. xii+142. (London: Bradbury, Agnew and Co., Ltd., 1906.) Price 3s. 6d. net.

suggestions as to their improvement. The account of the British and Irish rivers is rather depressing reading. Almost everywhere, save in a few favoured counties, there is the tale of pollution. We agree with Mr. Hodgson that this is preventable. The crude by-products of various manufactures need never be turned into fishing rivers—such a thing, for instance, as the reckless discharge of sawdust into a stream, and the consequent destruction of hosts of trout, ought certainly not to be permitted. With modern methods of septic purification it is a scandal that salmon rivers and streams should still be the repositories of crude sewage; but local sanitary authorities are difficult to move, and so far as the prevention of the pollution of rivers is concerned the law "is a hass."

The book is excellently printed and illustrated. Particular praise should be given to the series of seven plates at the beginning of the volume illustrating eighty typical salmon flies. The colouring and printing of these plates leave nothing to be desired. Altogether Mr. Hodgson's book should be a very welcome addition to the sportsman's library.

In "Dry Fly Fishing" Mr. F. G. Shaw makes a creditable attempt to make clear that which he terms the "science" of trout fishing. Chapters i. and ii. give directions how, when, and where to cast a trout fly. Chapter iii. deals with the selection of the fly, and includes a discussion of the range of vision of the fish. Chapter iv. gives a useful account of some aspects of pisciculture, and chapter v., "The necessities of the trout fisherman," is devoted to a consideration of the "gear" necessary for the craft. The book is abundantly illustrated. If the niceties of trout fishing can be taught by means of diagrams and practical directions, then Mr. Shaw's book ought to be very useful; but, as he says himself, "It is of no use to read books in order to determine your actions when actually fishing. Common sense is the most valuable guide." Nevertheless, the experience of others is always interesting, and no doubt the tyro, and even those of greater knowledge, will learn much from this work. J. J.

PROF. LUDWIG BOLTZMANN.

ONLY two years ago Dr. Ludwig Boltzmann, professor of physics in the University of Vienna, celebrated his sixtieth birthday. On that occasion a "Festschrift" was presented to him containing papers by about 125 physicists from all parts of the world. The announcement of Prof. Boltzmann's death, which was reported in the London papers of September 8, will be received with regret, not only by physicists of repute, but by every student who has attempted to gain an insight into the mysteries of molecular physics.

Ludwig Boltzmann was born on February 20, 1844. Before he was twenty-two years old, on February 8, 1866, he read a paper before the Academy of Sciences of Vienna entitled "Ueber die mechanische Bedeutung des zweiten Hauptsatzes der Wärmetheorie." The opening sentences of the paper may be freely translated as follows:—

"The identity of the First Law of Thermodynamics with the principle of *vis viva* has long been known, on the other hand the Second Law occupies a peculiarly exceptional position, and its proof is based on methods which are not only uncertain here and there, but are in no case obvious. The object of this paper is to furnish a purely analytical and perfectly general proof of the Second Law of Thermodynamics, as well as to investigate the corresponding principle in Mechanics."

Little did the young Boltzmann imagine that the task he had thus set before himself would occupy his whole lifetime.

A year later, after having obtained the doctorate, and having been appointed assistant in the physical institute at Vienna, we find him writing on the number of atoms in a gas molecule and the internal work of gases.

In 1868 he published his first important paper on the law of partition of energy under the title of "Studien über das Gleichgewicht der lebendigen Kraft zwischen bewegten materiellen Punkte." The problem had been previously attacked by Maxwell, but Boltzmann soon found difficulties and objections arising out of Maxwell's treatment, and it was one of the objects of the paper to place the theory on a more satisfactory basis. A second paper on the same subject ("Weitere Studien") was published in 1872, and in it the important theorem now known as Boltzmann's "minimum theorem" or the "H-theorem" first saw the light. That this theorem is not independent of assumed hypotheses has been amply shown by discussions in NATURE and elsewhere in which Watson, Burbury, and other physicists took part early in the 'nineties; but, granting these premises, it is proved that in a system of molecules a tendency exists to assume an equilibrium distribution of energy analogous to the tendency to heat equilibrium in a material gas. It was not until 1892 that Boltzmann published a third part to his "Studien." In it he deals with difficulties that had been raised in the discussion referred to in connection with the assumption that the kinetic energy of the system could be reduced to a sum of squares, and he also examines certain test cases of the kinetic theory proposed by Lord Kelvin.

In 1875 Boltzmann, then a corresponding member of the Vienna Academy of Sciences, treated the problem for the case of a system of molecules in a field of external force.

From Vienna Boltzmann went to Graz, where he was appointed professor in the university. After going there he wrote, in 1876, a paper on the integration of the equations of molecular motion, and several other minor papers on the kinetic theory. A fresh line was started in 1877, although the underlying idea had been suggested by Boltzmann in 1871, and employed by Dr. Oskar Emil Meyer in his book of 1877. This was the application of the theory of probability to the problem of energy-partition. The method of treatment adopted is highly instructive; Boltzmann starts with considering a system of molecules the energy of each of which can only have one or other of a series of discrete values—a series of counters marked 1, 2, 3 . . . might be used in illustration—and he investigates the most probable distribution of energy for a number of them drawn at random. From this simple case he is led by gradual stages to the more complicated case of a gas the molecular state of which is specified by generalised coordinates.

In 1880 to 1882 Boltzmann published long and important papers on viscosity and diffusion of gases, in which the consequences of Maxwell's assumption of the "inverse fifth" law of intermolecular force were fully discussed. In 1884 he was evidently attracted by Helmholtz's work on monocyclic systems, and lost no time in applying the method to the kinetic theory. In this connection the possibility of building up statistically monocyclic systems was considered. But a further application suggested itself in the possibility of representing thermodynamic and other phenomena by means of mechanical models. In his "Vorlesungen über Maxwell's Theorie," pub-

lished in 1891, Boltzmann makes use, not only of monocycles, but also of what he calls "bicycles," illustrating the phenomena of mutual induction of electric currents.

In 1885 Boltzmann was raised from "corresponding" to ordinary member of the Vienna Academy. He remained at Graz until about 1891, when he was called to Munich. A year or two later he visited England and called on the present writer at Cambridge, and thus a personal friendship sprang up. In 1894 the British Association meeting at Oxford, with its memorable field-day on the kinetic theory, came simultaneously with Lord Rayleigh and Sir William Ramsay's announcement of the discovery of argon. The part which Prof. Boltzmann took in these discussions will long be remembered. He received an honorary degree, and expressed some amusement at being made a Doctor of Laws. "It were better they made me Doctor of Science," he remarked. It was, however, pointed out that as an authority on the laws of thermodynamics the title was a fitting one.

In 1895 Boltzmann was transferred from Munich to Vienna, where he resided until his death, with one exception. In 1904 he was called to the University of Leipzig, and actually went there for a short time, but the change did not suit him, and he was back again in Vienna almost immediately.

In 1899 he was elected corresponding fellow of our Royal Society, and allusion has already been made to the universal and widespread enthusiasm shown over his diamond jubilee five years later.

Those who knew Boltzmann will remember the pair of heavy, highly-powerful spectacles resting on a deep groove in his nose. For many years his eyesight had been failing, and he found it increasingly difficult to complete the many researches which were on his mind. He appears to have ended his life during a summer holiday at or near Abbazia, a neighbourhood which he frequently visited with his wife and family.

We have alluded to some of Boltzmann's earlier writings more or less in chronological order. One of his most important later works is his book "Vorlesungen über Gastheorie" (Leipzig: Barth), the first volume of which bears the date 1895 and the second 1898. It fills an important gap in the literature of the kinetic theory, and renders much of Boltzmann's own work more accessible to general readers than it would be if his separate papers had to be consulted. While Boltzmann's chief energies were concentrated on the difficult problems of the kinetic theory, other branches of physics were by no means neglected. In evidence we have his book of lectures on Maxwell's theory, papers on Hertz's experiments, and an address on the methods of theoretical physics. Artificial flight also interested the Vienna physicist, who some years back gave a discourse on the subject, illustrated by models. Among his recreations allusion may be made to music. His thick fingers descending on the keys of the piano well knew how to produce those variations in timbre which are understood in Germany, but the want of which makes English people often say that the piano is devoid of soul. He would often play in trios with his son and eldest daughter.

It may be that the kinetic theory of gases is even now regarded as being less complete and perfect in itself than many other physical theories, such as the electromagnetic theory of light. But the study of irreversible phenomena stands on a far higher order of difficulty than that of purely reversible effects. If it has been impossible to build up a statistically irreversible system out of reversible elements without making *some* assumptions, we are, at all events, in possession of theories of molecular phenomena in which the assumption in question is of the simplest and most self-evident character, and the agreement with experiment as close as could be expected. These theories are in a very large measure results of the labours of Ludwig Boltzmann.

G. H. BRYAN.

NOTES.

THE results of the Gordon-Bennett balloon race, as announced in the daily papers, show that the sixteen competitors who started from Paris on Sunday afternoon all landed within a belt comprised between the meridians of 1° east and 1° west of Greenwich. The longest and most northerly journeys were those of Lieut. Lahm (U.S.A.), who landed near Whitby—about 400 miles from Paris—after a journey of 23½ hours; Signor Vonwiller (Italy), near Hull; Comte de la Vaulx (France), near Walsingham, four miles from the Norfolk coast; and the Hon. C. S. Rolls, near Sandringham. A second group landed in the south of England, this group comprising M. J. Balsan (France), at Singleton, near Chichester; Prof. Huntington (Great Britain), at Sittingbourne, Kent; and Captain Kindelan (Spain), near Chichester. The next group were carried from Paris in directions between west and north-west, and landed on or near a strip of the French coast extending from Dieppe to near Caen. These were Herr Scherle (Germany), near Dieppe; Mr. F. H. Butler (England), Comte de Castillon (France), and Señor Salamanca (Spain), all three at Blonville, near Trouville; Baron von Hewald (Germany), at Coudé, near the mouth of the Seine; Captain von Abercron (Germany), at Villers-sur-Mer; and Lieut. Herrera (Spain), at Cabourg. A little south of this group, M. Santos Dumont landed at Broglie, after having met with an accident to his arm. A different course was followed by the Belgian competitor, M. van den Driesche, who landed at Bretigny, a place 19½ miles south of Paris, soon after midnight.

SIMULTANEOUSLY with this competition, another of the same character, in which seven balloons took part, started from Milan. This was one of a number of aëronautical competitions organised during the month of September in connection with the exhibitions, other contests being arranged for aëroplanes, machines, and models, both with and without motive power. Whether owing to this clashing or to other causes, the aëronautical pavilion at the Milan Exhibition shows a remarkable dearth of exhibits, the only really successful attempt at a complete and well-organised exhibit being that of the Prussian Aëronautical Observatory in Lindenburg. These exhibits mostly illustrated apparatus for the meteorological study of the upper layers of the atmosphere, and their systematic display under the charge of Prussian officials in their smart military uniforms only made the absence of other important exhibits the more conspicuous.

THE second International Conference on Wireless Telegraphy, which is now sitting in Berlin, is likely to prove of great interest and importance from both the national and commercial points of view. Delegates from nearly all countries have accepted the German Government's invitation, and are now in Berlin. The preliminary conference of 1903, which was also convoked by the German Government with the hope of securing general support for its contention—that intercommunication between ships fitted

with wireless telegraphy apparatus and shore stations should be made compulsory without regard to the system employed—ended in a protocol embodying the German view being signed by all the delegates attending the conference except those of Great Britain and Italy. The basis of the discussions at the present conference will be the protocol above mentioned, though further proposals arising out of the recommendations contained therein have been put forward. At first sight the proposition of universal intercommunication seems to have considerable attractions, but many difficulties will have to be overcome before it can be carried out. The present conference may, therefore, have greater issues and unforeseen results than are expected, and the scientific world will be especially interested, as should the proposed treaty be entered into by our delegates—who are drawn from the Post Office officials, the Army, and the Navy—future improvements in wireless telegraphy would be more or less confined to a specified basis. As to which is the best system of wireless telegraphy of the many now at work, the question is one that may well puzzle the delegates, and may take many years of practical working of wireless telegraphy before it can be satisfactorily answered.

A SHORT description of a new method of colour photography, described by Prof. Lippmann before the Paris Academy on July 30, was given in NATURE of August 30 (p. 459). Mr. F. Cheshire, writing from the Birkbeck College, London, states that Mr. Julius Rheinberg suggested in the *British Journal of Photography* of January 1, 1904, "a method which is, I think, identical for all practical purposes with that now proposed by M. Lippmann." We have referred Mr. Cheshire's letter to Prof. Lippmann, who, in the reply with which he has favoured us, expresses regret that he overlooked Mr. Rheinberg's article, and agrees that the method proposed in it is the same in principle as that described by him. Prof. Lippmann adds that about three years ago he obtained successful results by this method, using very imperfect apparatus, still in his laboratory, and a grating roughly made by hand. In July last he obtained a more suitable grating, and the results of his experiments with it were described in his recent paper.

THE fifteenth International Geodetic Congress was held at Budapest last week. Sir George Darwin invited the congress to meet at Cambridge in 1909.

ON September 27 a series of severe earthquakes was felt at San Juan de Puertorico, and a sharp and prolonged earthquake shock occurred at St. Thomas, Danish West Indies.

THE Vienna correspondent of the *Daily Chronicle* announces that Herculaneum is to be excavated by the united action of England, France, Germany, Italy, the United States, and other countries.

To honour Prof. Ronald Ross, Prof. Boyce, and Dr. J. L. Todd, and in recognition of the decoration recently conferred on them by the King of the Belgians for services in research into tropical diseases at the Liverpool School of Tropical Medicine, the Lord Mayor of Liverpool gave a luncheon at the Town Hall on Monday. Sir Alfred Jones announced that the King of the Belgians has just subscribed the sum of 1000*l.* to the Liverpool School.

THE first International Congress for Cancer Research met last week at Frankfurt-on-Main under the presidency of Profs. von Leyden, Czerny, and Ehrlich. All those invited to take part in the work of the congress are actively engaged in cancer research, and a number of important papers were contributed, so many, in fact, that discussion had to be restricted; and the clinical, experimental, and statistical branches of the cancer problem were fully represented. Their Royal Highnesses the Grand Duke and Grand Duchess of Baden were present at the opening ceremony.

THE council of the Institution of Civil Engineers has, in addition to the medals and prizes given for communications discussed at the meetings of the institution in the last session, made the following awards in respect of other papers dealt with in 1905–6:—a Telford gold medal to Mr. G. A. Denny; a George Stephenson gold medal to Prof. W. E. Dalby; Telford premiums to Messrs. W. R. Baldwin-Wiseman, G. N. Abernethy, H. R. C. Blagden, M. R. Collins, and James Kelly; a Crampton prize to Mr. P. T. Gask. For students' papers the awards are:—Miller prizes to Messrs. Ralph Freeman, A. F. Harrison, A. J. Grindling, T. R. Grigson, J. W. D. Ball, and A. Morris. Mr. A. F. Harrison also gained the James Prescott Joule medal. The awards will be presented on Tuesday, November 6, when an inaugural address will be delivered by the president, Sir Alexander B. W. Kennedy, F.R.S.

THE authorities of the Clifton Zoological Gardens, Bristol, have recently made considerable improvements designed for the increased comfort and display of their collections. Two years ago a new lion house was built, having the cages within communicating with four open-air ones iron barred on three sides. The animals placed in these cages showed so distinct a preference for the open air, and improved so materially, that the older range of houses has been entirely reconstructed, and was thrown open to the public on Saturday, September 22, for the first time. As now reconstructed, seven open-air cages are placed along the front of the old house, and communicate with the dens within. The cages are lofty, being between 10 feet and 12 feet in height, about 12 feet wide, and 14 feet long. They are supported upon a brickwork base 4 feet in height, and separated from the public by a stout iron rail, placed 3 feet away from the cage fronts. It is noteworthy that a Rhesus monkey was formerly kept in an outer cage in the gardens for quite a number of years, winter and summer alike, and fared well even in hard frost and snow. When taken into the monkey house, however, it quickly sickened and died.

THE news of the death of Monsignor Molloy, Vice-Chancellor of the Royal University of Ireland and Rector of the Catholic University, Dublin, will be received with deep regret by all who knew him in Dublin and elsewhere. Mgr. Molloy was one of the delegates to the Aberdeen University celebrations, and died suddenly at the house of his host in Aberdeen on Monday morning. Dr. Molloy was born at Mount Tallant House, near Dublin, on September 10, 1834, so that he was in his seventy-third year. From 1874–1887 he was professor of natural philosophy in the Roman Catholic University College, Dublin. From an obituary notice in the *Times* we learn that toward the close of 1883 the bishops, who were the governing body of the University, transformed the old buildings in Stephen's Green to the Jesuit Order, and the Rev. W. Delany became president under the new *régime*. Dr. Molloy remained in residence in the college, and, putting his talents as a teacher at the disposal of the new administration, he succeeded Dean Neville, of Cork, as Rector of

the University in the same year. During the last quarter of a century Dr. Molloy took an important part in the administration of Irish education. He acted on the Commission on Manual Training in Primary Schools, and filled the post of assistant commissioner under the Education Endowments Act. He was at the time of his death a member of the Intermediate Education Board. As a popular lecturer on scientific subjects Dr. Molloy had few equals in Ireland, and he was a frequent speaker at the lectures of the Royal Dublin Society, of the council of which he was a member. He was the author of several scientific and literary works, including "Geology and Revelation," published in 1870, and "Gleanings in Science," in 1888.

A DEVASTATING West India hurricane has quickly followed the China Sea typhoons noted in last week's issue. The permanent Atlantic anticyclone has recently occupied a position more over the south-western quarter of the ocean, while it has been flanked on its north-eastern side by the extensive and stationary high-pressure system which has remained centred over the British Isles for several days past. In these circumstances a disturbance developing anywhere in the neighbourhood of the West Indies would be unable to take the usual sweep round by the great American bight and Bermuda for the Banks of Newfoundland. Instead, an almost direct westerly course would have to be followed into the Gulf of Mexico. This is what appears to have been the case on September 26 and 27, when a violent hurricane, centred on the eastern side of the Gulf, ravaged the Southern States, the coastal regions in particular suffering severely. The tempest raised the waters of the Gulf so high that not only were the low-lying lands inundated, but the streets of Mobile, Pensacola, New Orleans, and other large towns were several feet under water. Numbers of lives were lost, and thousands of families rendered homeless. It is stated that at Pensacola every house along the water front for a distance of ten miles was wrecked, and Fort McCrae, a military station, was completely destroyed, nearly every soul perishing. In the various towns factories and warehouses were demolished, and their contents carried out to sea. There were hundreds of maritime casualties, many of them total losses. One navy vessel was carried 200 yards inland, and a large iron steamer forced through buildings to a distance of a block from the wharf. Inland there was great destruction amongst the cotton, sugar-cane, and other crops, while very considerable structural damage was occasioned by the violence of the wind. The storm is said to be the worst since the one which destroyed Galveston.

MR. J. A. REID, Bedford, has just published a reprint, price twopence, of Huxley's essay "Time and Life: Darwin's 'Origin of Species,'" which originally appeared in *Macmillan's Magazine* for 1859.

IT is announced in the September number that the *Museum Gazette* will for some time to come take more notice of the "humanities," while attention will also be directed to some of the aspects of botanical studies. Articles on fish as food, a seaside museum, mushroom-eating, the potato-disease, and pea-pods, are included in the contents of the number before us.

WITH praiseworthy assiduity, Dr. W. L. Abbott, the well-known amateur collector, continues his zoological exploration of the Malay islands. One of the latest areas explored is the cluster of small islands lying between the Malay Peninsula and Sumatra, and collectively known as the Rhino-Linga Archipelago. The large series of mammal skins collected there is described by Mr. G. S. Miller in No. 1485 of the Proceedings of the U.S. National Museum, with the usual liberal allowance of nominal new species, based, in most cases at any rate, on what are nothing more than local phases. No. 1483 of the same serial is devoted to a review, by Mr. P. Bartsch, of the long-spired "urocoptid" land-shells from the American mainland in the collection of the museum, with the description of a number of new forms.

ALTHOUGH Japanese waters, according to Messrs. Jordan and Starks, in a paper published in the Proceedings of the U.S. National Museum (No. 1484), abound in flat-fishes, the most esteemed British representatives of that group, namely, the turbot and the sole, are unfortunately wanting in the far eastern islands, where, indeed, the genera Rhombus and Solea, as restricted by the authors, are absent. The authors make no mention of the respective values as food-fishes of any of the numerous species recorded. They regard the theory that the flounders are related to the Zeidæ, and that both groups trace their ancestry to the extinct Amphistiidæ, as an ingenious guess for which there is no positive warranty. In No. 1486 of the same publication Messrs. Jordan and Snyder discuss the Japanese killifishes (Pœciliidæ), of which only two species are at present known.

ACCORDING to a writer in the September number of the *Zoologist*, hybrids between blackcock (or grey-hen) and the pheasant are by no means uncommon in England; in Scotland they are more rare, and on the Continent appear to be very unusual. In addition to a portion of Messrs. Clark and Rodd's notes on the birds of the Scilly Islands, the same issue contains a notice of a specimen of the pelagic fish *Scomber thunnina* taken off Yarmouth, being apparently the first of its kind recorded from British waters. There is also a notice of a "sea-monster" seen off the Irish coast. Judging from the sketch sent by one observer, it seems probable that the creature was a basking-shark (*Selache maxima*), unless, indeed, it could have been a straggler of the Indian basking-shark (*Rhinodon typicus*), which attains dimensions more nearly in accord with those estimated by one of the observers for the Irish monster.

WE have received a copy of No. 45 of the Journal of the Straits Branch of the Royal Asiatic Society (June), which contains a number of articles on subjects connected with zoology, botany, folk-lore, native manufactures, and such like. Mr. C. B. Kloss communicates notes on the Sumatran pig recently described as *Sus oi*, in the course of which he points out that the species does not occur on the mainland of the Malay Peninsula, but only on the adjacent island of Pulo Battam, the fauna of which is essentially of a Sumatran type. The longest article in the issue is one by Dr. H. N. Ridley, giving an account of a recent expedition undertaken by himself to Christmas Island (Indian Ocean). The author was enabled to make considerable additions to the list of indigenous plants, and communicates some interesting observations on the changes which are taking place in the coast fauna and flora as the result of colonisation. Mr. R. Shelford continues his list of Bornean butterflies, while Mr. Kloss records a 30-feet python from Johore.

WE have received the report on the Scientific Investigations of the Northumberland Sea-fisheries Committee for the year 1905. The delay in publication is due to an

attempt to induce the Board of Agriculture and Fisheries to undertake the issue of the report. Although the attempt was unsuccessful, it is hoped that in the near future the Board will become more closely associated with fishery researches throughout the country. As the result of fourteen years' trawling experiments, correlated with Government statistics, and a review of the history of the local fisheries, the present report contains a much fuller account of the "white-fisheries" of Northumberland than has previously been possible. The experiments indicate that the stations are subject to gain and loss from the areas immediately outside, and that the inward movements include a certain number of deep-sea fish, especially plaice. When reduced to a common standard, the results demonstrate that while there was a steady improvement in the fish-population from 1892 to 1903, a decline has set in since the latter date. Recently the fish captured have been found to feed chiefly on sand-eels, in place of molluscs and crustaceans, due, apparently, to the scarcity of the two latter. The improvement in the flat-fishes of the district is attributed to protection, and it is considered that protection will likewise lead to a noticeable increase of crabs and lobsters. Important statistics are furnished with regard to the rate of growth and the migrations of flat-fish.

PROF. R. DE C. WARD contributes a valuable paper on the classification of climates to the July and August numbers of the Bulletin of the American Geographical Society. The chief systems of classification described are those of Supan, Köppen, Hult, and Ravenstein, and Prof. Ward comes to the satisfactory conclusion that the first of these is the best for general purposes. Teachers of geography will find this paper extremely useful.

THE present stage of development and the prospects of the magnesite mines of South Africa are described in the *Engineer* (vol. cii., No. 2646). They are situated between Kaapmuiden and Melelana, eighty-seven miles from Delagoa Bay and 300 miles from Johannesburg. The magnesite occurs in nearly vertical beds associated with serpentine in schists, and is worked in open cuttings. The magnesite is of good quality, and the mines have opened out an industry that is likely to be of considerable future importance.

IN the *Engineering Magazine* for September there are eight articles by prominent American engineers, the most striking being a warning by Dr. Louis Bell on the subject of over-specialisation in manufacturing methods. Standardisation, however desirable from a pecuniary standpoint, in the last resort means the cessation of active improvement. Labour-saving machinery, interchangeable parts, and systematised production have their due place to fill in the world's economy. But they need not become, as they are becoming at the present time, an excuse for stagnation; and, above all, they should not be allowed to check the development of the craftsman, who is necessary to the perpetuation of industry. The greatest industrial problem to-day is to maintain the supply of intelligent American labour in spite of the American industrial system.

THE Records of the Mysore Geological Department (vol. v.) contain the general report of the work of the department for the year 1903–4, by Dr. W. F. Smeeth, the State geologist. The work is of a very varied character, and comprises, in addition to geological inquiries, inspection of mines and explosives, prospecting, lectures, and the management of the library, laboratory, and museum. The same volume contains special reports on the Chitaldrug and Tumkur districts, by Mr. E. W. Wetherell; on the Shimoga and Kadur districts, by Mr. H. K. Slater; and on economic minerals, by Mr. V. S. Sambasiva Iyer. In the last report the occurrence of deposits of asbestos, mica, gold, pyrites, magnesite, chromite, garnet, staurolite, and apatite is recorded. In the Memoirs of the Mysore Geological Department (vol. iii., part i.) Mr. E. W. Wetherell gives a general account of laterite, and a description of the more important exposures in the districts of Bangalore and Kolar. The origin and nature of laterite have always been such controversial questions that the author's conclusions are of special interest. He shows that the Bangalore-Kolar laterite is detrital and of lacustrine origin, and that there is no geological relation whatever between the horizontal laterite proper and the clayey lithomargic beds below. The apparent gradation from these beds into laterite is due to the fact that the laterite was lain down in water on the decomposed surface of the preexisting rocks, and subsequently the chemical changes caused by percolating water have acted both upon the laterite itself and upon the decomposed material below it.

THE excellent work that is being done by the South African Philosophical Society is well shown by the varied contents of the Transactions (vol. xvi., part iii.). Dr. R. Broom describes and illustrates *Hortalotarsus skirtopodus*, the South African dinosaur described by Seeley in 1894. Dr. R. Marloth gives some notes on *Aloe succotrina*, which he has found growing at a spot on Table Mountain, and Mr. T. R. Sim summarises the recent information concerning South African ferns and their distribution. The list he gives shows a total of 212 species. Mr. J. R. Sutton discusses the climate of East London, Cape Colony, giving a summary of meteorological observations made during the twenty-one years 1884–1904. Mr. D. E. Hutchins reviews the cycle year 1905, an important one to those interested in long-period weather forecasts, and concludes that farmers may expect general good seasons for the next two or three years, and that after 1908 there will be six years of drought. Mr. A. L. du Toit points out the considerable influence of the geological formation on the storage of underground water, and considers the potentialities of such a supply in south-eastern Bechuanaland. Dr. Thomas Muir makes known a solution to a set of linear equations connected with homofocal surfaces. Mr. W. L. Sclater gives an account of two recently discovered inscribed stones bearing on the history of Cape Colony. One is a boundary stone erected by the governor Joachim van Plettenberg at Colesburg in 1778 to mark the extreme north-eastern boundary of the colony, and the other is a stone in the castle wall with inscriptions by John Roberts, commander of the *Lesser James*, 1622, and by James Burgess, master of the *Abigail*, 1622.

THE last issue of the Journal of the Institution of Electrical Engineers contains an interesting paper on long-flame arc lamps, by Mr. L. Andrews. The paper is of especial interest at the present time, owing to the recent development of the long-flame arc, which is largely due to the enterprise and competition of the gas companies during the last two years. With the perfection of high-pressure gas the electric arc was seriously threatened, as gas lighting, without a doubt, was driving out the arc lamp from both the cost and candle-power points of view. This competition, however, has had a beneficial result, in that the long-flame arc lamp has been developed and can now more than hold its own with high-pressure gas lamps, as is proved by the fact that, after a practical trial of both systems which lasted over some time, the South-Eastern Railway Company has decided to adopt oriflame arc lamps

at the renovated Charing Cross Station, as they found by test that, on the price for price basis, the oriflame lamps gave a much better light than the high-pressure gas lamps. Mr. Andrews's paper chiefly deals with one particular kind of flame arc lamp, namely, the Carbone lamp. The paper led, however, to a discussion which opened up the question in its more general form. It is to be hoped, therefore, that the question of long-flame arcs will not be allowed to drop until a much greater development has taken place, as much is needed before we can say that it is perfect, as the efficiency of flame arc lamps still leaves much to be desired.

THE August issue of the *Psychological Bulletin* is a pathological number. In addition to an article on the relation of emotional and intellectual functions in paranoia and in obsessions (by Dr. Adolf Meyer, the editor of this number), it contains a discussion by Dr. J. W. Baird of the contraction of the colour zones in hysteria and in neurasthenia. The conclusions to which Dr. Baird's observations lead are (1) that the colour zones of the abnormal subjects examined are, on the whole, of smaller area than those of the normal subjects, and (2) wherever a contraction of the colour zones occurs a definite order is observed —the red and green zones narrow together and the blue and yellow zones together, and there is a greater degree of contraction in the red-green zone than in the blue-yellow zone.

ALTHOUGH it is well established that selenium and tellurium are isomorphous in their compounds, it is still a question of controversy whether the isomorphism extends to the substances in the elementary state. Drs. G. Pellini and G. Vio show in the *Atti dei Lincei* (vol. xxv., ii., p. 46) that the solidifying points of mixtures of these substances are proportional to the percentage compositions, and that the elements are therefore isomorphous. The hexagonal mineral tellurium from Honduras, which contains about 29 per cent. of selenium, would thus appear to be an isomorphous mixture.

A METHOD of isolating radio-thorium from thorium salts is described by Messrs. G. A. Blanc and O. Angelucci in the *Atti dei Lincei* (vol. xxv., ii., p. 90). When sulphuric acid is added to a solution of thorium nitrate containing barium chloride no precipitate is formed in the cold solution, but on warming, part of the barium is precipitated as sulphate, the precipitate carrying down some of the radio-thorium. The sulphate is converted into carbonate by fusion with sodium carbonate, and the product, after thorough washing, is dissolved in acid; on adding ammonia a slight precipitate of radio-thorium is obtained which has an activity about 5000 times as great as thorium hydroxide in a state of radio-active equilibrium.

THE use by the Königliche Porzellan Manufactur of fused magnesium oxide in the construction of tubes and crucibles has led Messrs. H. M. Goodwin and R. D. Mailey to publish the results they have obtained in an investigation of the physical properties of fused magnesium oxide (*Physical Review*, vol. xxiii., No. 1). The fused substance is a white, very hard crystalline substance, the size of the crystals depending on the rate of cooling. The melting point of the material is 1910°, the coefficient of expansion being very nearly the same as that of platinum, a fact which will prove of value in its application. The results recorded for the electrical conductivity show that up to 1150° C. fused magnesia is a better insulator than porcelain. Fused salts, as a rule, have very little action on the material, and it is attacked only slowly by cold, dilute mineral acids.

IN an article in No. 8 of *Le Radium* Mr. A. S. Eve describes a method of estimating the proportion of radium or thorium in a mineral by means of the γ rays which it emits. Incidentally, it is pointed out that solutions of radium bromide which are intended to serve as standards of radio-activity are liable, unless acidified, to become inexact owing to the deposition of radium on the glass of the vessels containing them. It appears advisable always to control such solutions by reference to a standard of solid radium bromide. Dr. M. Levin contributes an article on the absorption of the α rays of polonium to the same number of *Le Radium*, Mr. H. L. Bronson deals with the transformation periods of radium A, B, and C, and Mr. W. H. Bragg describes investigations of the α particles of uranium and thorium.

BOTH theoretically and practically the formation of "basic" salts has long been a difficulty to chemists. In the case of the carbonates, for example, no good reason has been given why the carbonates of the metals of the alkaline earths alone should be definite compounds. The current number of the Journal of the Society of Chemical Industry contains an interesting study of the basic carbonates of magnesium, by Mr. W. A. Davis, which throws a good deal of light on these very obscure compounds. The starting point of the work is magnesium bicarbonate. It has been shown by Treadwell and Reuter that whilst a solution of calcium bicarbonate is stable at the ordinary temperature, a solution of the corresponding magnesium compound is only stable in the presence of carbon dioxide. It is known that when the pressure of the carbon dioxide above this solution is removed crystals are deposited of the composition $MgCO_3.3H_2O$, and these have been regarded as hydrated magnesium carbonate. In the present paper the author shows that this substance is really a hydroxy-carbonate,

$$Mg(OH)(CO_3H)2H_2O,$$

since only two-thirds of the water can be driven off at 100° C., or by boiling with xylene. Photomicrographs of both these salts are given. The decomposition products of this hydroxy-carbonate are then studied, and the results applied to the softening of magnesian waters, the Solvay method of manufacturing potassium carbonate with the aid of magnesia, and the formation of mixed carbonates of magnesium and the alkalis. The author claims that various observations which were formerly inexplicable may be interpreted without difficulty in the light of the explanation which has been given of the manner in which basic carbonates are formed.

PROF. STRASBURGER'S interesting book on botanical and other natural characteristics of the Riviera, a review of which appeared in NATURE of June 22, 1905 (vol. lxxii., p. 171), has been translated into English by O. and B. Comerford Casey, and is published, with the coloured illustrations, by Mr. T. Fisher Unwin. The English version of this charming book will delight visitors to the Riviera who are unfamiliar with the German language.

A SERIES of instructive experiments in practical photography is described by Mr. T. T. Baker in a booklet entitled "Simple Photographic Experiments," just published by Messrs. Percival Marshall and Co.

MESSRS. CONSTABLE AND CO., LTD., have just published the third edition of Mr. H. H. Cunynghame's work "On the Theory and Practice of Art-enamelling upon Metals." A short description of a new furnace invented by the author has been added to the volume.

OUR ASTRONOMICAL COLUMN.

COMET 1906e (KOPFF).—Circular No. 91 from the Kiel Centralstelle contains a set of elements for comet 1906e, calculated by Herr M. Ebell from positions observed on August 23 and 31 and September 12.

These elements give the time of perihelion as May 3·09, 1906, and from them Herr Ebell has calculated an ephemeris from which the following is taken :—

Ephemeris 12h. (M.T. Berlin).

1906	α (true) h. m.	δ (true) ° ′	1906	α (true) h. m.	δ (true) ° ′
Oct. 2	22 27	+6 30	Oct. 18	22 28	+4 58
6	22 26	+6 4	22	22 29	+4 41
10	22 26	+5 40	26	22 31	+4 26
14	22 27	+5 18			

At present the diminishing brightness of the comet is about half what it was on August 23, when its magnitude was about 11·5.

From the ephemeris it may be seen that this object is still in the constellation Pegasus, about half-way between ζ and 34 Pegasi, and is observable throughout the evening.

Observing at Rome on September 12, Prof. Millosevich found it to be a faint object having a coma which was not symmetrical about the thirteenth-magnitude nucleus.

FINLAY'S COMET, 1906*d*.—M. Léopold Schulhof continues his ephemeris for Finlay's comet in No. 4122 of the *Astronomische Nachrichten*, from whence the following abstract is taken :—

Ephemeris 12h. (M.T. Paris).

1906	α (app.) h. m.	δ (app.) ° ′	1906	α (app.) h. m.	δ (app.) ° ′
Oct. 4	7 37	+20 33	Oct. 16	8 2	+20 49
8	7 46	+20 39	20	8 8	+20 54
12	7 54	+20 44	24	8 14	+20 59

The comet, according to this ephemeris, is now in the constellation Gemini, travelling directly eastwards towards Cancer, and rises at about 11.30 p.m. It will be about one degree south of μ Cancri on October 16.

Two photographs of this comet are reproduced in the September number of the *Bulletin de la Société astronomique de France*. They were taken at the Juvisy Observatory on August 21 and 22 respectively by M. Quénisset, and show a well-marked nucleus; a rudimentary tail is also seen on the original negative. During the exposure on August 21 the comet passed over a tenth-magnitude star, the light of which was not perceptibly diminished by the interposition of the coma.

A NEW FORM OF WEDGE PHOTOMETER.—In No. 4120 of the *Astronomische Nachrichten* Herr H. Rosenberg describes, and gives a drawing of, a new form of wedge photometer which he has designed. In the ordinary photometer of the "wedge" type the observer is unable to eliminate the influence of the variation in the brightness of the general background of sky, and the eye, becoming fatigued, is unable to determine exactly the point of extinction.

In Herr Rosenberg's apparatus, however, the image of an artificial star, formed by a *constant* light source, is projected alongside the image of the natural star, and the wedge adjusted until the two images are equally bright. By adjusting the brightness of the artificial star, so that it is less than that of the faintest object which is to be examined, and determining its value in magnitudes, one may thus measure the brightness of any stars within the limits of about eight magnitudes. The error caused by the uncertainty as to the exact point of extinction is thus eliminated.

A postscript to Herr Rosenberg's description states that he finds the principle of a similar contrivance was described by Herr Müller in No. 3693 of the *Astronomische Nachrichten*, and an instrument was constructed at the Potsdam Observatory.

OCCULTATION OF A STAR BY VENUS.—In a communication to the British Astronomical Association, published in No. 9, vol. xvi., of the Journal, Dr. Downing directs the attention of amateur astronomers in Australasia to the fact that on December 9 Venus will occult the third-magnitude star β Scorpii. As it is such a rare occurrence for a planet to occult so bright a star, he gives the particulars of the occultation for Sydney, Brisbane, and Wellington in the hope that use may be made of them by observers suitably located.

RESULTS OF THE INTERNATIONAL LATITUDE SERVICE, 1902–1906.—In No. 4121 of the *Astronomische Nachrichten* Prof. Th. Albrecht discusses the results obtained by the six international latitude stations during the period 1902·0–1906·0. The variation of the position of the apparent pole is shown on a diagram, which includes the tenths of each year from 1900·0 to the beginning of the present year. The values given for the period 1902·0–1905·0 are final, but those for 1905·1–1906·0 are only provisory, although Prof. Albrecht states that they are probably correct to one two-hundredth of a second.

THE AMANA METEORITE.—An interesting description of the various meteoritic objects which fell at Amana, Iowa, U.S.A., in 1875, is given by Dr. G. D. Hinrichs in *Das Weltall* for September 15. Two plates accompanying the description show photographic reproductions of the meteorites, together with the names of the museums wherein they are now to be found. Other illustrations give charts of the locality in which these objects were discovered.

BOTANY AT THE BRITISH ASSOCIATION.

THE work of Section K was not characterised by the announcement of any discovery of very exceptional interest, nor by any sensational feature. As has been usual in recent years, an effort was made to group the papers presented so that those dealing with allied topics were taken at the same session. The whole number of papers read was not large, and no less than three morning sessions were devoted to discussion of definite topics, the proceedings being opened in each case by one or more papers giving an account of the present position of the subject to be discussed, or presenting facts and conclusions likely to lead to debate. These discussions were to some extent organised beforehand; that is to say, the members most likely to contribute usefully to the discussion of a given topic were informed of the intention to hold the discussion some time before the meeting, and were invited to contribute, abstracts of the opening papers being distributed to them as early as possible, so that they were in possession of the lines to be taken before the meeting. Such of these members as were present and had signified their willingness to speak were called upon in succession by the chairman as soon as the papers were over, the discussion being afterwards open to any member of the section. Although it is true that very good discussions often arise quite spontaneously after papers which are not expected to provoke debate, it is believed that on the whole the best results are obtained by the method of semi-organised discussion described, though it is neither possible nor desirable to limit the sectional meetings entirely to proceedings of this type.

The success of such discussions depends very largely on the selection of topics of suitable scope. On the whole the tendency is to take too wide a subject, with the result that the different speakers are apt to deal with quite distinct aspects of it, and unless the opener has the exceptional power of drawing all the threads together in his reply the impression left on hearers is liable to be somewhat inconclusive and chaotic. On the other hand, if the subject chosen is too narrow, its treatment is apt to become excessively technical, the discussion is of limited interest, and may even languish owing to a lack of sufficiently instructed specialists.

Of the three discussions at the York meeting, the first was taken on Friday morning, August 3, and was really divided into two parts. Dr. D. H. Scott opened the session. Though his title was a wide one—"Some Aspects of the Present Position of Palæozoic Botany"—considerations of time compelled Dr. Scott to limit himself to "the difficult question of the position of the ferns in the Palæozoic flora," "the difficulty arising from the accumulation of evidence showing that most of the so-called

Palæozoic ferns were in reality seed-plants." Dr. Scott showed, in his luminous address, that "a large body of true ferns of a simple type—the Primofilices of Mr. Arber—existed in Carboniferous times," while it is probable that true Marattiaceous ferns also existed side by side with these.

The second part of the discussion, dealing with the formation of the well-known calcareous nodules found in the coal seams of the Lower Coal-measures, though it might be thought to be of purely technical and specialist interest, is in reality of great importance to everyone concerned with Palæozoic botany, because the nodules in question contain the greater part of the plant remains showing histological structure that are known to us from Palæozoic rocks, and their mode of formation is of the first importance as throwing light on the question of how these plants grew. Several geologists specially conversant with the occurrence of Coal-measure fossils had been particularly invited to take part in the discussion, which was an excellent instance of the fruitful concentration of two branches of science upon a special problem. Prof. Weiss opened the discussion with a short general paper stating the problems, and was followed by Miss Stopes, who gave an account of her recent work, which went to show that the nodules were formed *in situ*, the calcareous material being derived by solution and re-segregation from marine shells the remains of which are found in the roof of the same seam. A possible chemical process by which such a solution and re-deposition could be effected was indicated. The most clinching proof of this method of formation was shown in the case of two gigantic nodules lying side by side, in which the petrified remains of plants are found to be continuous from one to the other. It is clear that in such cases at least the plant must have been petrified where it was found. Mr. Lomax brought forward evidence which seemed to him to support the rival hypothesis, that these nodules were often carried by water transport to the situations in which they were found. Mr. Watson, who has worked with Miss Stopes, attacked the views of Mr. Lomax, while Mr. Bolton, of Bristol, Prof. Hull, and other geologists, including Dr. Teall, took part in the discussion.

The second discussion took place in joint session with Section D on Monday morning, August 6, and dealt with the nature of fertilisation. The opening paper was given by Mr. V. H. Blackman. This discussion is dealt with in the account of the proceedings of Section D (NATURE, September 27, p. 551). Here it need only be said that the danger already referred to, that of choosing too wide a subject for discussion, was to some extent apparent. The work bearing on fertilisation is now so varied in kind and occupies so many classes of workers, both zoological and botanical, that it is difficult to focus the interest in a single discussion.

The third discussion was on the phylogenetic value of the vascular structure of seedlings. Papers were read by Mr. Tansley and Miss Thomas, by Mr. T. G. Hill, and by Mr. A. W. Hill. Miss Sargant, Dr. Scott, and Prof. Jeffrey took part in the discussion. The work of Mr. Tansley and Miss Thomas and of Mr. T. G. Hill to some extent covered the same ground. In both cases the comparative anatomy of the vascular system of the hypocotyl in Gymnosperms and Dicotyledons was the subject of investigation. Mr. Tansley and Miss Thomas found that the type of symmetry of this structure had considerable phylogenetic value, thus confirming and extending Miss Sargant's conclusion relating to Monocotyledons, published some years ago. Without going into technical details, it may be stated that nearly all the cases met with fall naturally into a series, and the conclusion is reached that the more complex type, met with among the older Gymnosperms, and also among some Dicotyledons, is phylogenetically the older, while the simpler type, very widely prevalent among Dicotyledons, is derived by reduction, through various transitions, from this older type. Mr. T. G. Hill, while bringing to light many of the same facts, was not in agreement with this view, basing his opinion on the apparently primitive diarchy of the ferns. Mr. Hill showed that the anatomical evidence pointed to the cotyledons of the "polycotyledonous" conifers being derived by splitting, in some cases at least, from a primitive "dicotyledonous" type, a conclusion with which the joint authors of the other paper concurred.

Mr. A. W. Hill sought to show, by a consideration of the seedlings of bulbous and rhizomatous species of Peperomia and Cyclamen, that clues may be obtained to the mode of evolution of the true Monocotyledons, the two cotyledons assuming different functions. Thus in his view the single cotyledon of the Monocotyledon represents only one of the two cotyledons of the typical Dicotyledon, the other being represented by the first foliage leaf. Miss Sargant found herself unable to accept Mr. Hill's suggestions.

Several interesting papers on the vegetation of different parts of the world were read. Mr. Seward communicated a paper by Prof. H. H. W. Pearson, of Cape Town, who is doing excellent work on the natural history of the indigenous Cycads. Mr. Hugh Richardson gave an outline account of the vegetation of Teneriffe, laying stress on its zonal distribution. Mr. C. E. Moss gave a general paper on the succession of plant formations in Britain, in which he dealt with succession from sand dunes, from salt marshes, in lowland and upland peat formations, and in certain types of forest, in all cases from his own observation. He used the term "formation" to mean "an historical series of plant associations," beginning as an "open" and ending as a "closed" association. All these papers were illustrated by lantern-slides.

Palæontological papers of some importance were read by Prof. Jeffrey, of Harvard, and by Prof. Weiss. Prof. Jeffrey dealt with the structure and wound-reactions of the Mesozoic genus Brachyphyllum, a genus of hitherto doubtful affinity, which was now shown to be an undoubted member of the Araucarineæ, mainly from the evidence of recently discovered material with the anatomical structure preserved. One of the most interesting points in the paper was the use the author made of the "traumatic" resin-canals found in Brachyphyllum. It appears that this plant produced definite resin-canals in its wound callus like the modern Abietineæ, and unlike the ancient or modern Araucarineæ. Largely, though not wholly, on this account Prof. Jeffrey concludes that this old genus connects the Araucarineæ with the Abietineæ, removing the former from their somewhat isolated position, and showing them as undoubtedly coniferous. Mr. Seward, in the discussion, while recognising the validity of Prof. Jeffrey's demonstration that Brachyphyllum was a member of the Araucarineæ, found himself unable to accept the evidence of Abietinean affinity, and particularly that based on the occurrence of the traumatic resin-canals. Dr. Scott, on the other hand, saw no reason why such evidence should not be valid.

Prof. Weiss described an interesting new Stigmaria possessing a considerable amount of centripetal primary wood, so that at first sight it has the appearance of a stem of Lepidodendron, though its characteristic periderm with the remains of rootlet cushions attached show that it is undoubtedly of stigmarian nature.

Dr. A. F. Blakeslee described some new results he had obtained in connection with the "physiological sex" which he discovered some time ago in the Mucorineæ. In *Phycomyces nitens*, in addition to the heterothallic spores, homothallic mycelia may be obtained by special methods, but the sexual character of these is unstable, and no fixation of the homothallic character takes place. Dr. Blakeslee's paper was illustrated by a series of beautiful preparations showing the homothallic and heterothallic character respectively of various mycelia. The author also contributed a general paper on differentiation of sex in gametophyte and sporophyte. For the former he uses the terms *homothallic* and *heterothallic*, for the latter *homophytic* and *heterophytic*. Investigations are now proceeding as to the sexual differentiation in the sporophyte of the Bryophytes. The evidence shows that both "male" and "female" spores exist in the sporogonium of *Marchantia polymorpha*, and attempts are being made to determine at what point the segregation of sex occurs. Dr. Lang, Mr. V. H. Blackman, and Mr. R. P. Gregory took part in the discussion on these papers.

Of purely physiological papers, Prof. W. B. Bottomley contributed a very interesting account of his successful

attempt to inoculate papilionaceous plants with the root-nodule organisms belonging to non-papilionaceous Leguminosæ and to plants of quite different families, those of Acacia (Mimoseæ) and of Elæagnus and Alnus being chosen. In another paper Prof. Bottomley showed that the long-known effect of sprinkling urine on the floors of greenhouses in order to cause a more luxuriant growth of orchids is due to the presence of both nitrite and nitrate bacteria in the cells of the velamen, which are thus able to utilise the ammonia arising by decomposition of the urine and absorbed along with the water vapour normally condensed by the velamen.

Miss C. B. Sanders, of Oxford, described some experiments carried out in Prof. Gotch's laboratory on the local production of heat connected with the disappearance of starch in the spadices of various Araceæ. Remarks on this paper were made by Dr. F. F. Blackman.

Dr. Ellis, of Glasgow, described experiments to show that ciliation cannot be used as a taxonomic character among bacteria—as has recently been done by Migula—because under appropriate conditions all the members of such groups as Coccaceæ, Bacteriaceæ, and Spirillaceæ, in which this character has been used, can be made to acquire cilia.

The semi-popular lecture was delivered by Prof. Yapp, who took his hearers for a most pleasant excursion through some of the principal regions of South Africa, introducing them to the various types of vegetation met with by means of a series of beautiful lantern-slides from his own photographs.

The section met on Thursday afternoon, August 2, and for a short time on Monday afternoon, August 6. The other afternoons were left free for excursions, of which several were arranged by the local secretary, Dr. Burtt, of the British Botanical Association, and by other local botanists. Those to Askham Bog and to Skipwith Common may be specially mentioned as of great botanical interest.

THE ARCHÆOLOGICAL CONGRESS AT VANNES.

THE second congress of the Prehistoric Society of France was held from August 21–26 in the capital of the department of Morbihan, the classic land of Megalithic monuments, at any rate so far as France is concerned. The attendance exceeded that of the very successful first congress held at Périgueux last year.

The inaugural meeting at 10 a.m. on Tuesday, August 21, was graced by the presence of prominent citizens. Speeches were made by the Mayor of Vannes, Senator Riou, Prof. Adrien de Mortillet, president of the congress, and by Dr. Marcel Baudouin, the secretary, who insisted on the need of providing a special building to house the rich collections of the Société polymathique, and on the desirability of creating a national Megalithic park comparable to the Yellowstone National Park of the United States.

The president of the local committee, M. Morio, welcomed the congress in the name of the Société polymathique, the museum of which was much admired by the parties which visited it in the afternoon. It includes collections from the principal tumuli of the neighbourhood, excavated by the society during its many years of existence; there are, for example, the splendid necklaces of callaïs beads, a fine series of fibrolite axes, curious stone discs, scarcely found outside this area, and huge polished celts. In the evening M. Riou gave a reception at the Mairie, and various toasts were proposed.

The numerous papers and the lively discussions attest the success of the congress. M. Rutot, the curator of the Royal Museum of Brussels, led off with a consideration of the question of the Palæolithic bed of Havre; he maintained that there was no question of displacement; what had taken place was a falling in of the superincumbent earth and erosion of the cliff. Dr. Joussel then described a new prehistoric bed discovered at La Longère, near Nogent-le-Notrou (Eure-et-Loire), where objects of varying appearance and discutable age have been found, assigned by the author to the Flénusien age of Rutot. M. Hue brought forward a new method of measuring the skulls of Canidæ, which M. Baudouin urged all archæologists to apply to the measurement of other animals. Dr. Guébhard appealed to the archæologists of the world to bring into existence a map of prehistoric monuments, the preliminary steps towards which have been made by the Société préhistorique de Paris.

Two long sittings were held on the morning and evening of the second day. The first subject was the Palæolithic age of Brittany, introduced by M. Sageret, of Carnac, who was followed by MM. de Mortillet, Rutot, and Baudouin, who showed why beds of this epoch are rare: the Neolithic period has attracted more attention in Brittany (Mortillet); Brittany is only the central area of Quaternary Brittany, which was united to the British Isles until the Magdalenian period (Rutot), and to a south-western continent which survives in Belle-Ile, Quiberon, Houat, &c. (Baudouin). Some stones of this period were exhibited by M. Landren, of St. Nazaire, under the name of eoliths; the Rennes flints of M. Pavot were not regarded as of prehistoric character. Dordogne, the scene of the last congress, next claimed the attention of the meeting. M. l'Abbé Chastaing offered some remarks on the hammers for use with bones discovered in the cave of Le Moustier, and M. de Ricard directed attention to the new Magdalenian station of Rocheyral, Drôme Valley. Finally, M. de Mortillet brought into prominence the Placard cave (Charente), and the various industries there practised; in this connection there arose a discussion on the pre-Solutrian age of M. l'Abbé Breuil, for which M. Rutot and M. l'Abbé Chastaing took up the cudgels.

M. Rutot spoke on the question of the Micoque beds, on the Vézère, after dealing with the Strépyien of France. He showed that the Chelles-Moustérien of Micoque was in reality Strépyien, and that this stage fell between the Chelléen and the Mesvinien, and not between the Chelléen and the Moustérien. M. Feuvrier (of Dôle) directed attention to a Magdalenian cave in the Jura, and M. J. Dharvent exhibited a sculptured flint of the Moustérien age.

On Wednesday evening Neolithic problems were approached; among the papers were those of Dr. Martin, on the false tumulus of La Motte Beudron (Deux-Sèvres); M. Goby, on the tumuli of the districts of St. Vallier de Thiay, St. Cézaire, and Grasse (Alpes Maritimes); and M. Roerich, of St. Petersburg, on sculptured Neolithic flints. M. Rutot then turned to the Flénusien, or lower Neolithic, in France, and showed that traces could be found from one end of France to the other. Dr. Montelius then gave a summary exposition of the Stockholm collections from the Robenhausen and other periods.

On the morning of Thursday the pottery of the dolmens came up for discussion; M. Fourdrignier, of Paris, showed that the study of finger-prints might be of value, but it was pointed out that the information could throw little light on questions of race. Other papers were those of M. Goby, on the dolmen pottery of the Grasse district, and the micaceous pottery of Camp du Bois-du-Rouret (Alpes Maritimes).

After a remarkable paper by Dr. Stjerna on the Scandinavian origin of the Burgundians came papers on Megalithic monuments, among them those of Dr. Jousset, on the Carnacean age of Perche; Dr. Coutil, on Megalithic monuments in Normandy; M. José Fortès, on Megalithic sculptures in Portugal; M. Tavarès de Proença, on the classification of Portuguese dolmens; M. Coutil, on his exploration and restoration of the tumulus of Fontenay-le-Marmion (Calvados) in 1904 and 1906. Important communications were read by Dr. Waldemar Schmidt, on Megalithic monuments in Denmark; by Dr. Montelius, on the same in Sweden; by Dr. Baudouin, on five years' excavations and restorations of the megaliths of Vendée. A popular evening lecture on the dolmens of Brittany, illustrated by lantern-slides, had already been given in the theatre on the previous evening.

On Thursday evening the subject of prehistoric gold in Brittany and Vendée was treated by Count Costa de Beauregard and Dr. Baudouin, and much was said on the significance of menhirs and of the alignments. For M. de Paniagua they are evidence of a phallic cult, for M. Rutot they are sign-posts, for M. Montelius and for Dr. Baudouin tombstones, and the last view finds support in the results of the excavations of Dr. Baudouin

and M. Hue. The views on the alignments were varied; they were *ex-votos*, and they were connected with the Trojan war; but the majority hesitated to express an opinion. M. le Rouzic, Dr. Baudouin and others, subject to more extensive researches in Brittany and elsewhere, were disposed to connect them with a solar cult. Among other papers, Dr. Atgier discussed the Megalithic enclosures, and M. de Clérambant galgals, or cairns, in Indre-et-Loire.

M. de Villemereuil proposed a motion on the State protection of megaliths. Speaking generally, it may be said that both the discussions and the numerous papers were of much interest, and the meetings were attended by more than a hundred members.

The following three days were taken up with excellently organised excursions; weather, vehicles, meals, and speeches, all were of the best, and more than a hundred took part in each excursion. The first day was consecrated to the Gulf of Morbihan, and among the objects visited were the cromlechs of Kergonan, the tumulus of Gavr'inis, and the magnificent dolmens of Locmariaquer, including the largest known menhir. On the second day visits were paid to the little-known alignments of St. Pierre, in Quiberon, and of Erdeven, and to the dolmens of Roch-en-Aud, Crocuno, Rondossec, &c.

The third day was reserved for Carnac and its marvellous alignments Menec, Kermario, and Kerlescant.

Worthy of special mention were the visits to the tumulus of Moustoir-Carnac, and to the Miln Museum, where the secretary of the congress paid a well-deserved tribute to the brilliant efforts of the regretted founder and his enthusiastic and devoted pupil, M. le Rouzic. Finally, a visit was rendered to the splendid tumulus of St. Michel-Carnac, so well cared for by M. d'Ault du Mesnil, president of the Megalithic Monuments Commission, who himself acted as guide.

In the course of the three days numerous speeches were made by foreign members, who were roused to enthusiasm alike by the monuments and by the organisation of the gathering. Mention must be made of the utterances of M. Rutot, on the Gulf of Morbihan; of Dr. Baudouin, on submerged megaliths in Brittany and Vendée, and on the technique of restorations; and of the erudition of M. de Mortillet, as well as of the demonstrations of MM. d'Ault du Mesnil and le Rouzic; the latter also spoke in the Miln Museum on the alignments of Carnac, and on his researches on the spot.

As the scene of the next congress in 1907 Abbeville was suggested by more than one speaker. Before the congress separated, the healths of M. de Mortillet, Dr. Baudouin, and M. Giraux were proposed in eulogistic terms. As M. Rutot said, a society that has been able to accomplish so much in its infancy will do much more in its maturer years, and this was equally the opinion of the foreign savants who attended the meeting.

A NEW SPECIMEN OF THE OKAPI.

IN a letter from the Congo Free State, published in the *Times* of September 26, Major P. H. G. Powell-Cotton states that he has succeeded in obtaining the skeleton and skin of a fine male okapi. This animal was killed at Makala, in the Ituri forest, by the native hunter Agukki, who shot the two specimens taken to Europe by Dr. David. After careful inquiry, Major Powell-Cotton is unable to satisfy himself that any European has hitherto killed an okapi. A Swiss official named Jeannet, in the employ of the Congo Government, was, however, in 1905 shown one of these animals by a native as it stood in thick covert, where it was shot by the latter. This the writer believes to be the first living okapi (or "kangi," as it is called by the Makala natives) seen by a European.

According to information furnished by the Mambutti (pigmies), the okapi is generally a solitary animal, the two members of a pair invariably feeding apart, although, together with their single calf, they may frequent the same section of the forest. The calf, which is born in May, is left hidden in covert by the female, who returns to it at intervals for feeding purposes. Hearing and smell are very acute in the okapi, so that the sound of an axe or the faintest scent of man drives it from its feeding grounds into the depths of the forest. Even when feeding it is restless, and it seldom reposes long in the same lair. In the Ituri forest these animals avoid swampy ground, and always drink from clear running streams. During rain they seek shelter in the densest thickets or even under an abandoned roof, and it is at such times that they are most usually seen by the natives.

In the Ituri forest the okapi does not eat the giant leaves of *Sarcophrynium arnoldianum*, which Major Powell-Cotton believes to be the plant alluded to by Captain Boyd-Alexander in his account of the animal in the Welle district. Specimens of four different kinds of leaves which form the food of the Ituri forest okapi are being brought home for identification.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE honorary degree of LL.D. has been conferred upon Sir Thomas Barlow and Prof. C. S. Sherrington, F.R.S., by Harvard University.

AT a Convocation of the University of Durham, held on September 29, the honorary degree of D.Sc. was conferred upon Sir William White, K.C.B., and Prof. Lebour.

PROF. WIEN, who occupies the chair of physics at Würzburg, informs us that he has declined the invitation to succeed the late Prof. Drude as professor of physics in the University of Berlin, because the Prussian Government is unable to undertake the erection of a modern physical laboratory there.

PROF. E. A. MINCHIN, F.R.S., the recently appointed professor of protozoology in the University of London, will deliver his inaugural lecture on "The Scope and Problems of Protozoology" on November 15. The University library, in which is included the Goldsmiths' Company's library of economic literature, will be opened by the Chancellor on the afternoon of Friday, October 26.

THE new calendar of University College, London, contains an interesting outline of the history of the college by Dr. G. Carey Foster, F.R.S. The contribution deals with the growth and development of the University of London as a teaching university, and the part played by University College in that development. Particulars are given of the post-graduate courses offered this session in all faculties, and of the original work produced in the college during last session. The number of research and post-graduate students last year was 134, as against 119 in the previous session.

THE first volume of the report for 1904 of the Commissioner of the United States Bureau of Education has at last been issued. A gratifying feature noted in the reports of the agricultural and mechanical colleges is the largely increased aid granted them by the several States and Territories. This aid amounted for the year to about 1,131,000*l.*, an increase of more than 200,000*l.* over the amount for the preceding year. A chapter of more than a hundred pages is devoted to the regulations relating to pensions and insurance in all German universities. The data were collected by Prof. Julius Hatscheck, of Heidelberg, for Dr. Theodore Marburg, trustee of Johns Hopkins University, and by the latter presented to the U.S. Commissioner of Education. It appears that in Germany membership in any teaching body means, *nolens volens*, the payment of regular contributions to the pension fund of that body, except in elementary schools, where the State assumes the entire burden of pension payment. Dr. John W. Hoyt contributes a detailed account of the University of Paris during the Middle Ages. Among other chapters of interest in the report, which runs to 1176 pages, may be mentioned two on education at the St. Louis Exposition and one on higher education in England as affected by the Act of 1902, in which prominence is given to Prof. Sadler's reports to various county councils.

AT the University of Leeds on Monday, the inaugural address of the new session was delivered by Sir James Crichton-Browne upon the subject of "Universities and Medical Education." In the course of his remarks, he

said that centuries ago gifts were given for the promotion of objects equivalent to those which modern universities hold in view, which, considering the pecuniary resources of those who gave them, should put our most open-handed modern millionaires to shame. England has been remiss of late in perceiving and promoting those interests that hinge on scientific and medical research. In this direction Germany has stolen a march upon us, for the various Governments in that Empire have unstintedly provided their universities with fully-equipped research laboratories, organised and conducted by professorial directors. A university is something more than a medical school, a workshop of research, or a home of science. It must have loftier aims than material advancement or commercial prosperity. It must provide for culture in its widest sense, afford intellectual guidance, encourage individuality, take cognisance of the theoretical problems that arise in the progress of civilisation, be a storehouse of knowledge, and a gymnasium for the exercise of all the powers of the mind; and to be truly a university it must be an organism, and not a mere conglomeration of parts. The one great objection to the multiplication of universities is that they may tend to become local seminaries, somewhat parochial in spirit, and fed exclusively from one district, for it would be a misfortune to a boy to pass from a secondary school to a university in the next street, where he would meet as his fellow-students only his old schoolfellows, and where, however amply fed with knowledge, he would still be surrounded by the same traditions and associations and shop amongst which he had been brought up. A provincial university is a contradiction in terms. What is wanted is a group of territorial universities, each with distinctive features of its own, specially adapting it to its environment, but all affording the most liberal instruction, the finest culture, the best intellectual discipline of the day, and collectively meeting the higher educational needs of the whole country.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 28.—"Regeneration of Nerves." By Dr. F. W. **Mott**, F.R.S., Prof. W. D. **Halliburton**, F.R.S., and Arthur **Edmunds**.

Five sets of experiments are recorded as a contribution to the discussion as to whether the regeneration of nerve-fibres is autogenetic or not. The experimental methods approach the subject in different ways, and in no case was any evidence forthcoming of auto-regeneration.

The facts recorded, taken in conjunction with those published by such observers as Cajal and Langley and Anderson, form, on the other hand, strong pieces of evidence in favour of the Wallerian doctrine that new nerve-fibres are growths from the central ends of divided nerve trunks. The experimental facts recorded by those who, like Bethe and Kennedy, hold the opposite view, are susceptible of easy explanation, mainly on the lines emphasised by Langley and Anderson, of accidental and unnoticed connection of the peripheral segments with the central nervous system by means of other nerves cut through in the operation. If such connection is effectually prevented, real regeneration of structure and restoration of function never occur.

Moreover, the regenerated fibres always degenerate in a peripheral direction, and in a peripheral direction only, when the link that binds them to the central nervous system is again severed. Perhaps the most striking of the facts brought out in the present paper is in reference to the development of the medullary sheath; this appendage of the axis cylinder appears earliest at situations near the point where the ends of a nerve have been joined together, and reaches the distal portions later.

What takes place in the peripheral segment of a divided nerve is a multiplication, elongation, and union into long chains of the neurilemmal cells. The same change is even more vigorous at the central termination of the cut nerve; and the view of the phagocytic and nutritive function attributed to this sheath has been supported independently by some striking observations of Graham Kerr which are referred to. At the central end this nutritive function is effective, and provides for the nourishment of the actively lengthening axis cylinders. At the peripheral end, unless the axons reach it, it is ineffective in so far as any real new formation of nerve-fibres is concerned. If, however, the axons reach the peripheral segment, the work of the neurilemmal cells has not been useless, for they provide the supporting and nutritive elements necessary for their continued and successful growth. The neurilemmal activity appears to be essential, for without it, as in the central nervous system, regeneration does not take place.

According to Graham Kerr, the formation of neuro-fibrillæ may possibly take place in the protoplasmic residue of the degenerated axis cylinder; according to Marinesco, this property is assigned to the neurilemmal elements themselves, a proposition which is extremely improbable, seeing that these elements are mesoblastic. In either case these two observers consider that the neuro-fibrillæ, however formed, are ineffective until they are activated by union with those of the central axons. The present observations do not entirely exclude this view, but, on the other hand, they lend it no support. The facts are readily explicable, however, on the theory that the nerve-fibres are growths from the central ends of divided nerves.

"The Ionisation produced by Hot Platinum in Different Gases." By Prof. O. W. **Richardson**. Communicated by Prof. J. J. Thomson, F.R.S.

The present paper forms an account of an experimental investigation of the steady positive ionisation produced by hot bodies, platinum being assumed to be typical.

The following are the chief results:—

The positive ionisation, *i.e.* the number of positive ions produced by 1 sq. cm. of platinum surface per second, possesses a minimum value, which depends on temperature and pressure, in most gases. The positive ionisation in oxygen at a low pressure (less than 1 mm.) is much greater than in the other gases tried. In oxygen at low pressures, and temperatures below 1000° C., the ionisation varies as the square root of the pressure; at higher temperatures and low pressures it varies nearly directly as the pressure; whilst at higher pressures at all temperatures the variation with pressure is slower, so that at pressures approaching atmospheric the ionisation becomes practically independent of the pressure.

The variation with pressure in air is similar to that in oxygen. In nitrogen and hydrogen the ionisation appeared to increase more rapidly with the pressure at high pressures than in oxygen. In very pure helium at low pressures there was a positive ionisation which was a function of the pressure.

The experiments on ionisation by collisions indicate that the positive ions liberated by hot platinum in oxygen are of the same order of magnitude as those set free by the collisions.

The positive leak in oxygen always oscillated around a certain value under specified conditions. It was, therefore, never steady, so the minimum values were taken. This variability was much less marked in the other gases.

The minimum value of the positive ionisation was found to remain practically constant with a wire heated during three months at various times (for 150 hours altogether) in oxygen at 900°–1000° C. Moreover, four different wires of different dimensions after continued heating in oxygen gave nearly the same value for the ionisation at the same temperatures and pressures.

The positive ionisation in air at constant temperature is smaller than that which would be obtained if the nitrogen were withdrawn, so as to leave only oxygen at a low pressure. The nitrogen, therefore, exerts an inhibiting effect on the oxygen.

The minimum value of the positive ionisation at a definite pressure in all gases appears to be connected with the temperature by the relation first deduced by the author for the negative ionisation. This relation may be written $i = A\theta^{\frac{1}{2}}e^{-Q/2\theta}$, where i is the ionisation, θ is the absolute temperature, and A and Q are constants. The value of the constant Q, which is a measure of the energy associated with the liberation of an ion, is in most cases smaller for the positive than for the negative ionisation.

These results refer to wires which have been heated in

a vacuum, and subsequently in the gas considered, for a long time. New wires exhibit peculiar properties, especially in regard to their behaviour under different electromotive forces. Old wires also exhibit hysteretic effects with change of pressure.

The view is developed that the positive ionisation is caused by the gas adsorbed by the metal and the consequence examined of supposing the ionisation to be proportional to the amount of the adsorbed gas present. In the case of oxygen, by making the assumption that the rate of increase of the amount of the adsorbed gas is proportional jointly to the concentration of the external dissociated oxygen and to the area of "unoccupied" platinum surface, whilst the rate of breaking up is proportional to the amount present, a formula is obtained which agrees with the experimental results. This formula is that the ionisation $i=Ap/(B+p)$, where $p=(kP+\frac{1}{4}k^2)^{\frac{1}{2}}-\frac{1}{2}k$, P being the external pressure and k the dissociation constant of oxygen; A, B, and k are constants depending on the temperature, and are of the general form $a\theta^{\frac{1}{2}}e^{-b/\theta}$. Thus this view accounts for both the temperature and pressure variation.

The positive ionisation from the outer surface of a hot platinum tube in air is increased when hydrogen is allowed to diffuse through from inside the apparatus. The increase in the ionisation is proportional at constant temperature to the quantity of hydrogen escaping from the surface in unit time.

The negative ionisation from hot platinum in air is unaltered when hydrogen is allowed to diffuse out through the platinum.

These results show that neither the negative nor the positive ionisations usually observed with hot platinum heated in air or oxygen are due to residual traces of absorbed hydrogen.

A wire which has been heated in hydrogen furnishes a negative ionisation which is very big compared with that from a wire heated in oxygen at the same temperature. If the hydrogen is at a pressure of the order of 1 mm. the negative ionisation can be rapidly reduced to a much smaller value by applying a high negative potential to the wire. The wire subsequently recovers its ionising power if the potential is reduced again. Under these conditions the ionisation varies in an interesting way with the time. The reduction in the ionising power of the wire appears to be caused by the bombardment of the surface by positive ions produced by collisions.

When a platinum wire, which has previously been allowed to absorb hydrogen, is heated for a long time in a good vacuum so as to expel the gas, its ionising power does not appear to be reduced. The ionisation apparently is not a definite function of the quantity of gas absorbed by the wire.

PARIS.

Academy of Sciences, September 24.—M. A. Chauveau in the chair.—The colour and spectra of solar prominences: M. **Ricco**. Direct observation of the eastern group of protuberances during the total eclipse of 1905 showed that the colour was different in different parts, and especially at the edges, the latter showing a play of colours. The body of the protuberance was purple-red, the outside was violet-blue, the summit was pure violet, nearly white, and exceedingly brilliant. Two photographs of the spectrum were taken, enlarged reproductions of which are given.—The application of M. E. Borel's method of summation to generalised trigonometrical series: A. **Buhl**.—The amplification of sounds: M. **Dussaud**. The vibrations from any source of sound are received on a membrane, and this, either directly, or through a solid, acts on a jet of compressed air. The sound is in this way faithfully reproduced by the jet of air, the amount of amplification depending only on the power of the motor used in the compression.—The recent scientific cruise of the *Otaria*: Teisserenc **de Bort**.

NEW SOUTH WALES.

Linnean Society, August 1.—Prof. T. P. Anderson Stuart, president, in the chair.—The Australian Melaleucas and their essential oils, part i.: R. T. **Baker** and H. G. **Smith**. In this series of papers on the Melaleucas and their essential oils, of which this is the first, it is the authors' intention to follow out this research on the same lines as those adopted in the work on Eucalypts and their essential oils. Bulk material was employed in obtaining the results given in the paper. The Melaleucas are commonly known as "tea trees," and are distributed throughout the whole continent of Australia, and so are familiar plants in the bush. Two species form the subject of this paper, viz. *M. thymifolia*, Sm., and *M. linariifolia*, Sm.—*Vitis opaca*, F.v.M., and its enlarged rootstock: R. T. **Baker** and H. G. **Smith**. The occurrence of these enlarged rootstocks, weighing from 20 lb. to 25 lb., in the Australian species of Vitis, has been recorded by Baron Mueller, Thozet, Roth, and others, but no chemical investigation of their composition appears to have been made. Such an investigation forms the basis of this paper. From the results a close affinity between the carbohydrates of this "tuber" and those belonging to the true gums is shown, and the alteration products are more in the direction of the sugars than the starches.—Investigation of the disease in cattle known as "rickets," or "wobbles," and examination of the poisonous principle of the Zamia palm (*Macrozamia Fraseri*): E. A. **Mann** and T. I. **Wallas**. The authors for some time have been carrying on investigations on the above subject, as the result of which they have come to the conclusion that the effects upon cattle induced by eating the *Macrozamia Fraseri* are caused by the presence in the plant of acid potassium oxalate (salts of sorrel). This is a confirmation of the results of an analysis made by a Mr. Norrie prior to 1876, and reported to the Royal Society of New South Wales by Dr. F. Milford (Journal of the Society, vol. x., p. 295).

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