THURSDAY, APRIL 6, 1905.

PSYCHOLOGY AND PHYSIOLOGY.

Grundzüge der physiologischen Psychologie. Von Wilhelm Wundt. 5th edition. Vols. ii. and iii. Pp. viii+865, ix+796 and 133; and Gesamtregister. (Leipzig: Engelmann, 1902–3.) Prices 13*s.*, 14*s.*, and 3*s.*

Principles of Physiological Psychology. By Wilhelm Wundt. Translated from the fifth German edition by E. B. Titchener. Pp. xvi+347. (London: Swan Sonnenschein and Co., Ltd., 1904.) Price 12*s.*

WITH these two volumes Prof. Wundt concludes what in all probability is the last edition of this great work prepared by his own hand. The single volume of the first edition of 1874 is now expanded to three large volumes comprising 2168 pages. Founded, as it is, chiefly upon the author's own researches and those of his pupils, the treatise forms a splendid monument to his life-long labours in a field in which he has been for long a pioneer and the most prominent figure.

The main part is an expansion and development of the views expounded in earlier editions in accordance with the data that have accumulated so rapidly in recent years. For, as Wundt points out, psychology has now happily achieved methods of research by which any intelligent and industrious worker may add something, however small, to the mass of empirical data on which the future science is to be built up, and in so doing has assured its place among the progressive sciences. To this edition a final section is added, in which the veteran thinker sets forth his matured conclusions on the general principles of psychology and on its relations to other sciences. To the exposition of one of the most important of these principles this article may profitably be devoted. Not many years ago most writers who discussed the functions of the brain postulated what they called a *sensorium commune*, a central nervous organ or "centre" in which the afferent nerves of all the sense-organs were supposed to come together, and to the substance of which each such nerve was supposed to communicate its specific mode of activity, generally assumed by those writers to be some peculiar form of molecular vibration. It was supposed, therefore, that when two or more sensory nerves of different functions are simultaneously stimulated, this "centre" becomes the seat of a complex resultant physical process, embodying the specific characters of the two or more kinds of neural process. And this hypothetical physical resultant was held to be the immediate correlate or excitant of the complex affection of consciousness. In this way it was sought to explain the unitary character of the state of consciousness resulting from the simultaneous stimulation of different sensory nerves. To every part of the brain that is median and therefore has no symmetrically disposed duplicate, this position of honour has been assigned by one or other writer—to the pineal gland by Descartes, to the pons by Spencer, to the basal ganglia in general by Maudsley and Carpenter, to the *septum lucidum* and to the third ventricle by others, to some undefined region by Herbart and Lotze. Under the powerful impulse of this supposed necessity others, notably G. H. Lewes, E. v. Hartmann and Ed. Montgomery, have made the whole brain the *sensorium commune*, assuming that the specific mode of vibration initiated in each kind of sensory nerve thrills throughout the whole or the greater part of the mass of the brain.

In the *Psycho-physik* (1860) Fechner clearly exposed the untenable character of all such assumptions and showed that "the psychically unitary and simple are resultants from physical manifolds, the physically manifold gives rise to a unitary or simple (psychical) resultant." This principle was accepted by Helmholtz, and by Lotze in his later writings; and the progress of our knowledge of the brain achieved since that time has made patent to all the impossibility of assigning the psycho-physical processes, the processes immediately correlated with psychical processes, to any one part or "centre" of the brain.

Nevertheless, in dealing with concrete instances of unitary psychical resultants from multiple sensory stimulations, as in the case of the compound colour sensations or of the fusion of the effects of stimuli applied simultaneously to corresponding areas of the two retinæ, many, perhaps most, physiologists and psychologists still postulate a fusion of the underlying neural processes to a unitary physical resultant. It is more difficult to refute this view in such special cases than to prove the erroneousness in principle of the conception of a *sensorium commune*, but fortunately Prof. Sherrington's recent research on the functional relations of corresponding retinal points[1] demonstrates in the clearest manner the separateness of the physiological effects in the brain-cortex of stimuli simultaneously applied to corresponding retinal areas, the instance of fusion of effects to which the doctrine of physiological fusion has been most confidently and plausibly applied; and many pathological and experimental observations bear out this view, both in this case and in other similar cases of fusion of effects of sensory stimuli. The principle laid down by Fechner in the words quoted above may therefore be regarded as well established. This principle Wundt adopts, and he extends its application in a thorough-going manner to the relations of neural and psychical processes in general. Assuming that every "psychical element" is related in a constant manner to an accompanying neural process, he asks (vol. iii., p. 775), Is there any corresponding constant relation between the connections (*Verbindungen*) of those elements and the connections of these processes? "It goes without saying that this question must be answered affirmatively in the sense that to all the psychical elements that are comprised in a complex affection of consciousness, the corresponding physical processes must also be given in simultaneous connection." But that is by no means to say that these physical correlates will constitute a unitary resultant, which would correspond to the psychical resultant. "The complex psychical

[1] See *British Journal of Psychology*, part i. 1904.

formations are further removed from their physiological correlates (than the psychical elements), and this removal is greater the more complex the psychical compounds become. And it is just at this point that psychology as an independent science in the proper sense of the word takes up its task." That is to say, it is the task of psycho-physics to discriminate the elements of our psychical processes and to discover their physiological correlates, but it is the task of psychology proper to discover the purely psychical laws of the synthesis of these elements—a task which would remain to be carried out, though the workings of the brain "stood as clearly exposed to our eyes as the mechanism of a watch."

Wundt then formulates four such fundamental psychical laws or principles, of which the first and most important is the "principle of creative resultants," the principle "that the product arising from any number of psychical elements is more than the sum of those elements . . . . it is a new formation incomparable in all its essential attributes with the factors that contribute towards it." So "a clang is more than the sum of its partial tones." "In the same way every spatial percept is a product in which certain elements (the local signs) have yielded up their independence to impart to the product an entirely new property, namely, the spatial ordering of the sensations. In binocular vision the separate images of the two organs of vision disappear, to give rise in the common resultant image to the immediate perception of solidity and depth." On the other hand, the neural correlates of these elements remain a spatially ordered manifold, exhibiting no corresponding fusion or synthesis. The acceptance of this principle is of the first importance for the progress of physiological psychology, but whether it is compatible with adhesion to the doctrine of psycho-physical parallelism, as Wundt maintains, may be seriously questioned, as also whether it can properly be called a principle of psychical causation. It seems clear that if with Wundt we recognise this and the other psychical laws that he formulates, whether or not we admit them as principles of psychical causation, we cannot maintain the principle of psycho-physical parallelism in the rigid form in which it is so widely current at the present time.

It is a pleasure to welcome the appearance of the first part of an English translation of this great work. Prof. Titchener has accomplished this part of his difficult task with all the care and skill which his previous labours in this line have prepared us to expect.

In spite of the title of this work, it is as much a treatise on experimental as on physiological psychology, and in view of the common misconceptions of the relations of experimental to other methods in psychology the following quotation may fitly conclude this brief notice:—"We now understand by 'experimental psychology' not simply those portions of psychology which are directly accessible to experiment, but the whole of individual psychology. For all such psychology employs the experimental method: directly, where its direct use is possible; but in all other cases indirectly, by availing itself of the general results which the direct employment of the method has yielded, and of the refinement of psychological observation which their employment induces."

W. McD.

RADIUM AND RADIO-ACTIVITY.

Radium Explained. By Dr. W. Hampson, M.A. (Jack's Scientific Series.) Pp. x+122. (Edinburgh and London: T. C. and E. C. Jack, 1905.) Price 1*s.* net.

THIS little book, which is sold for the modest price of one shilling, will, we think, serve a useful purpose in giving an elementary acquaintance with the subject of radio-activity, so far as that is accessible to those with little scientific knowledge. The explanations given of the experimental properties of radium are, so far as we have observed, clear and accurate, and the get-up of the book, though not superb, is respectable. Probably one of the most valuable chapters in the book is that on the medical aspects of radium, and its possible uses in the cure of disease, for few writers on radio-activity generally are competent to discuss this part of the subject. Dr. Hampson is of opinion that the medicinal value of mineral waters is connected with their radio-activity. This question, we think, should easily be susceptible of a definite and conclusive answer. There would not be the slightest difficulty in giving baths of weak radium solution more potent by far than the richest mineral waters. Why not test the medicinal value of these? It is really urgent that this experiment should be tried by competent hands.

It is, we think, to be regretted that Dr. Hampson has plunged into an attack on modern views of the constitution of matter, as expounded by Prof. J. J. Thomson, Sir Oliver Lodge, and others. We have read these criticisms with the attention due to a worker like Dr. Hampson, who has done good service in the cause of science, but cannot admit that they possess any validity. To go fully into the questions which he raises would take us beyond the limits of this notice, but we may briefly discuss one or two of the points. At the outset, Dr. Hampson objects to the definition of mass by means of inertia. Mass, he says, is quantity of matter; inertia is dependent on velocity as well as on mass.

It is true, no doubt, that the definition of mass as quantity of matter may be found in some old-fashioned text-books of repute. But such a definition has no value, for how is the quantity of matter to be ascertained? The choice practically lies between defining mass by inertia at a given speed or by gravity. So far as is known, exactly the same ratio between two masses of ordinary matter will result, whichever method of comparison is adopted. As, however, gravity depends on local circumstances, while inertia (at given velocity) does not, the latter property is preferred for the definition of mass, as being more fundamental.

No doubt, before it can be granted that the electron theory fully accounts for the observed properties of matter, it will be necessary to show that it will explain the phenomena of gravitation. This, at present, it

makes no pretence of doing, as, of course, its distinguished authors would at once admit. But mass, as we have seen, is not conventionally defined with reference to gravity, but by means of inertia, or momentum at unit velocity. As a moving electric charge can be shown to possess this momentum, it is a strictly correct use of words to say that the electron theory explains the property of mass.

Dr. Hampson argues, in the second place, that electricity is a form of energy, and that it cannot therefore be identified with matter.

"When an electrical machine . . . is used to charge a Leyden jar . . . there is no change in the quantity of material substance with which operations were started; it is the mechanical energy driving the machinery that has been converted into electricity" (p. 87).

The misconception here lies in confusing the separation of positive and negative electricity with the creation of either. Take the case of a Leyden jar. The coatings of the jar, according to modern views, initially both contain a number of chemical atoms, all with their normal complement of constituent electrons. The operation of charging consists in the removal of some of these electrons from the outer coating, say, and their transference to the inner one. This leaves the outer coat with a defect of electrons, and therefore positively charged, while the inner one acquires an excess of them, and consequently becomes negatively charged. The transference involves the expenditure of energy on the electrons, but no alteration in their number, and therefore no change in the amount of matter concerned.

We are sorry to have had to dwell principally on the parts of the book with which we disagree, as these are but a small portion of the whole, and do not detract from the usefulness of the rest.

R. J. S.

OIL FUEL.

Oil Fuel: Its Supply, Composition and Application. By S. H. North. Pp. viii+152. (London: Chas. Griffin and Co., Ltd., 1905.) Price 5*s*. net.

MR. SYDNEY H. NORTH has utilised the store of data collected whilst he was editor of the *Petroleum Review* to supply a most valuable addition to Griffin's scientific text-books in his work on "Oil Fuel" and to give his readers a concise and valuable record of the developments in the use of liquid fuel for the generation of power.

In the first chapter of the book he deals with the distribution and sources of supply of petroleum, and points out that the chief sources are now so geographically situated as to place the United Kingdom at a disadvantage in case of war, should the use of liquid fuel be largely adopted in the Naval Service, a fact which accentuates the importance of developing such fields as those of Canada and Burmah, and also of opening up new areas where possible in British Possessions.

In concluding this portion of the work, the author expresses his opinion that recent developments and extensions of oil-bearing areas are now progressing so rapidly that it is quite within the bounds of possibility that the liquid-fuel question may in the near future be placed above the control of price and geographical position.

In dealing with the economic aspect of liquid fuel it is pointed out that although the enormous advantages accruing from its use were early recognised, the prohibitive price prevented any great advance in its use, but that with the increase in output its utilisation now comes within the range of practical possibility, and that the advantages in winning, transporting, and storing and using the oil, especially for marine purposes, are so great that the supply of the liquid fuel is now the only factor checking its universal introduction.

In considering the absolute economy as a fuel, the author very properly leaves out the extravagant claims made by some of the early experimentalists, and only gives the best authenticated values, which vary from 12·5 to 16 lb. of water evaporated per lb. of liquid fuel. Variations in the use of oil as a fuel are of course largely dependent upon the method by which the oil is burnt, and too little stress is put upon the importance of the space factor, which is a most essential one, as, given plenty of combustion space in the boiler, the smokeless burning of liquid fuel is a perfectly simple problem, which, however, increases enormously in difficulty as the available space becomes more and more cramped.

The chapter on the chemical composition of fuel oils gives an excellent summary of analytical results, and this ends with a table showing the composition, calorific value and evaporative power of different descriptions of British coal. This, however, is liable to lead to misconception, as the value expressed in lb. of water evaporated per lb. of fuel is calculated, and not that obtained in practice, so that the reader who finds that by this table 1 lb. of Welsh coal will evaporate 14·98 lb. of water will be a little puzzled to see where the large economy comes in, when 1 lb. of oil only evaporates from 12·5 to 16 lb. of water. As a matter of fact, all recent work points to the relative evaporative results under the best conditions being 9 lb. of water per lb. of coal, or 15 lb. of water per lb. of oil, whilst the theoretical results give 14·98 lb. of water for coal, and 20 to 21 lb. for oil.

The section dealing with the conditions of combustion in oil furnaces is a useful reproduction of the views expressed by Messrs. Ord, Paul, and Lewes, and the author does not venture on any generalisation of his own.

Turning from consideration of the oil itself to the methods of burning it, the author gives a very useful historical summary of the early experiments down to the year 1883, when Mr. James Holden, whose name will always be inseparably connected with the subject of liquid fuel, introduced his method of consuming the oil on the Great Eastern Railway.

A chapter is then devoted to modern burners and methods, and steam, air, and mechanical injectors are discussed. The author very properly concludes that

"for the successful use of liquid fuel it appears to be a *sine qua non* that auxiliary apparatus

and extraneous sources of heat must be avoided, and the furnaces made practically self-contained, if anything approaching perfection is to be attained. It must be upon simplicity, ease of working, and freedom from complicated parts that the progress of liquid fuel must chiefly depend.

"The direct pulverisation of the oil is now coming to be recognised as the proper method ; it is the most efficient and the most economical."

The next two chapters are devoted to discussing the use of oil fuel for marine and naval purposes, but the division into two chapters is hardly needed, as the naval side of the question is scarcely touched upon, the bulk of the matter in that chapter being taken up with the trials of liquid fuel on the s.s. *Mariposa*, and the tests made on land by the American Liquid Fuel Navy Board.

The chapter on oil fuel in locomotives is an excellent summary of the work of Urquhart and Holden, whilst the use of oil fuel for metallurgical and domestic purposes also receives some attention.

The whole work compares very favourably indeed with the far more pretentious treatise on the subject which until now has been the only book of reference, and everyone interested in this important question will welcome Mr. North's excellent text-book.

THE DYNAMICS OF CHEMICAL CHANGE.

Chemical Statics and Dynamics. By J. W. Mellor, D.Sc. (N.Z.), B.Sc. (Vict.). Pp. xiii+538. (London : Longmans, Green, and Co.) Price 7*s.* 6*d.*

FOR some years past a marked increase of attention on the part of English chemists towards the rapidly developing physical chemistry has been observable. Until recently, however, the available English literature on the subject was confined to German translations, a state of things which is now being in a large measure remedied.

The present work forms one of the series of text-books of physical chemistry edited by Sir William Ramsay. According to the table of contents, four chapters are devoted to the consideration of homogeneous reactions, and in succeeding sections the initial periods in chemical change, heterogeneous reactions, equilibrium and dissociation, electrolytic dissociation, catalysis and the theory of chemical change, fermentation, the influence of temperature and pressure in chemical reactions, and finally explosions, are dealt with.

Since the appearance of van 't Hoff's "Etudes de Dynamique Chimique" a vast amount of work has been done in connection with the problems involved here, and the necessity for a summary of newly discovered facts, a criticism of recent theories, and an unbiased statement of our present position in regard to the dynamics of chemical change and allied problems must have been felt by many. Dr. Mellor's work will, therefore, receive an undoubted welcome.

The accumulated evidence on the nature of chemical change resulting from kinetic studies leads the author to favour the view that the "association" or "intermediate compound" theories describe in the most rational manner the mechanism of the majority of reactions. Simple consecutive changes determine the character of many apparently complex reactions.

In connection with the determination of the number of molecules taking part in reactions in gaseous systems the author sounds a very necessary warning note. The rate of decomposition of phosphine or arsine is a frequent text-book illustration of one of the methods employed, and the experimental data fit in with the assumption that the reaction is unimolecular and non-reversible. But there is another side to this and similar problems. It is not improbable that the reaction takes place on the surface of the walls of the containing vessel, and that its rate is conditioned solely by the rate of absorption of the gas by this surface. The course of the reaction will in this case also be that of a unimolecular change.

In the section on the measurement of chemical affinity we meet old and familiar friends in the illustrations of the thermal and density methods of comparing the affinities of two acids. The very moderate accuracy attainable in these methods, which involve the small difference between two experimental quantities, and in which corrections have frequently to be introduced in consequence of secondary changes, is scarcely ever sufficiently emphasised, and attention might have been directed to this point. A method depending upon the measurement of a property possessed by only one component of a system has obvious advantages, even if such methods are of limited application. Whether Thomsen's relative avidities and the relative ionic affinity coefficients are always identical conceptions is left for the reader to infer.

Chapter x., dealing with catalysis and the theory of chemical change, is most attractive reading. Here the processes of slow combustion or autoxidation are discussed in the light of the theories of Brodie, Schönbein, Clausius, van 't Hoff, Traube, Bach, Engler and Wild, and the interesting phenomena included under induced or sympathetic reactions are treated. In the chapter on explosions the account of older work is supplemented by many new and interesting facts.

In the reviewer's opinion Dr. Mellor's work is to be warmly recommended. The fact that it contains three thousand or so references to original papers is in itself evidence of its utility to the teacher, to the advanced student, and to the physical chemist engaged in research. H. M. DAWSON.

RECENT EARTHQUAKES.

A Study of Recent Earthquakes. By Charles Davison, Sc.D., F.G.S. Pp. xii + 355; 80 illustrations. (London : Walter Scott Publishing Co., Ltd.) Price 6*s.*

IN this copiously illustrated volume Dr. Charles Davison, whose seismological investigations, especially those relating to British earthquakes, are so well known, gives a popular account of the results which have been arrived at by modern seismology. The method in which he treats his subject is one that appeals to the general reader. Rather than grouping

seismic phenomena, as we should expect to find them in a text-book, the author has given a concise history of eight disturbances, each of which has a special interest. The Neapolitan earthquake is of interest from an historical point of view, the Ischian earthquakes illustrate the relationship between volcanic and seismic activities, a Japanese earthquake is described on account of the fault line which was produced at the time of its occurrence and the numerous after shocks by which it was followed, whilst a British earthquake illustrates the growth of a fault. From the work of Robert Mallet upon the first of these earthquakes, which in 1857 devastated a district to the south-east of Naples, and when upwards of 9000 people lost their lives, the scientific world learned that out of ruins much might be learned respecting the direction and intensity of the movements which had caused them. Although his methods of investigation, as, for example, those relating to the determination of the depths of seismic foci, may have been modified by new observations, Mallet directed attention to new problems for the solution of which he employed scientific methods.

The Andalusian earthquake in 1884, we are told, is chiefly remarkable from the fact that it was recorded at very distant stations, as, for example, by magnetographs near Paris, at which city the movements of the ground could not be felt. For this disturbance the depth of its origin is determined by means of angles of emergence calculated from the directions of fractures in masonry walls. That the direction of these fractures might be due to the varying steepness of the earth waves which produced the shattering is not considered

The peculiarity of the Charleston earthquake is that it occurred in a region where such disturbances are almost unknown, that it had two foci about thirteen miles apart, and that it illustrated the behaviour of different races when confronted by a terrible disaster. With the negroes there was wild fear, panic, and a "selfish rush for safety." With Europeans in similar circumstances similar conditions prevail, but we are told that with Japanese there is calmness. Our own idea is that Japanese like to save their necks as well as other people. They will bolt at the time of an earthquake, to return, not with hysterical and shattered nerves, but chattering and laughing as if earthquakes were very fine jokes.

A subject attractive to the general reader which is referred to in several chapters is an account of signs which have given warning of a coming earthquake. Underground sounds have been heard, springs have varied in their flow, horses, birds, dogs, and even human beings have been restless for some time before great earthquakes. In his reference to the Riviera earthquake in 1887, Mr. Davison remarks that as premonitions were noted at 130 different places within the central area, "there can be little doubt that they were caused by microseismic movements for the most part insensible to man." In these days of psychical research we think that the author has lost an opportunity for romantic speculation.

Although the book is intended more for the person of ordinary intelligence than for the specialist, here and there we come upon information of an uncommon kind. For example, it is pointed out that the areas over which earthquake sounds are heard is variable in different countries. One reason for this is that the limits of audibility vary with different races. From illustrations given it would appear that for certain sounds the Anglo-Saxon ear is more acute than the Neapolitan, and very much more than that of the Japanese. This relationship between the physiological structure of the human ear and earthquake music is, to say the least, extremely interesting, but while discussing the same the fact must not be overlooked that in the same country districts may be found where seismic sounds are frequent, whilst there are other districts where Pluto shakes the ground but mutterings are never heard.

Dr. Davison's book is well worth reading, whilst the manner in which its contents have been arranged should obtain for it a circulation amongst those who seek for general information.

OUR BOOK SHELF.

A German-English Dictionary of Terms used in Medicine and the Allied Sciences. By Hugo Lang and B. Abrahams. Pp. vi + 598. (London: J. and A. Churchill, 1905.) Price 15*s.* net.

THERE is undoubtedly a vacant place which would be filled by a well-compiled work bearing the above title. The book now under review has a certain claim on our regard in this connection, and in some respects is a useful work. It purports to be, in the first place, a medical dictionary, and, so far as we can judge, fulfils this promise in a satisfactory manner. With a few minor blemishes there is a complete vocabulary of medical terms, and as a rule these are very fairly rendered by their English equivalents. But in the allied sciences, which are also supposed to be included, there are curious lacunæ. Chemistry is pretty well represented—for example, we found most of the technical terms in Biedermann's "Chemiker Kalendar" duly set down—but the pathological vocabulary leaves much to be desired, and apparently physiology is not considered an allied science at all—at any rate, physiological terms are very seldom to be met with.

The authors have generally avoided the pitfalls set for the unwary in works of this kind, and there are few actual mistakes; occasionally it is difficult to ascertain the real meaning of a word without extraneous assistance. For example, the word "typhus" by itself is not correctly translated by "typhus"; it invariably means "enteric" (typhoid), and the English typhus fever is "fleck-typhus," the latter being, however, correctly entered in its place. The medical meaning of "Belastung" is given; the completely different signification when the word is applied to muscle is omitted. But the cardinal fault of the dictionary is the treatment of compound words. These are separately set forth at length instead of being collected under their first components, and this increases the bulk and cost of the work (already too great) without conferring any real ease of reference. The courteous way in which the authors in the preface invite suggestions disarms too caustic comments, and we merely hint gently that in the next edition the space that could be saved by the course indicated could be profitably employed by the

insertion of a few additional pathological and physiological terms, and that it would be unwise to translate these in the fashion adopted at present in such words as "luftweg."

Règles internationales de la Nomenclature zoologique. Pp. 63. (Paris: F. R. de Rudeval, 1905.)

IT has frequently been remarked that it is not of much use making laws and regulations unless you have the power to enforce their observation; and this trite saying applies, in our opinion, very forcibly to this code of regulations for zoological literature, drawn up by an international committee the deliberations of which have extended over some years. The code, which is published in three languages, is admirably drawn up, and for the most part free from ambiguity; but the question is, will naturalists agree to abide by it? In our opinion, a large number will refuse to accept it, since a rigid and slavish adherence to the law of priority is enjoined, and to many this is anathema. The rule that when a genus-name is changed this entails the change of the family title will be generally regarded as satisfactory. As regards emendation in names, this is held to be justifiable only when an error in transcription, a *lapsus calami*, or a misprint is apparent; but in the interpretation of this difficulties may arise, as in the well-known case of Neurogymnurus, which is *believed* to be an error for Necrogymnurus. Differences of opinion, again, are likely to arise with regard to the rejection of names on account of unsuitableness or similarity to others already in use. The retention of such names as Polyodon and Apus when applied to animals which do not properly come under such designation will, no doubt, be generally accepted; but what is to be said when, for instance, an essentially African species is named asiaticus? Such names as Polyodus, Polyodon, Polyodonta, Polyodontus, &c., are held not to come under the category of synonyms, although the converse rule is followed in many systematic works and catalogues, such as Dr. Trouessart's "Catalogus Mammalium."

As a "pious" expression of opinion on the part of the International Committee the "Règles" are, no doubt, valuable; but they would have been much more so had a *plebiscite* of zoologists and palæontologists agreed to accept and abide by the ruling of the committee. R. L.

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.*]

A New Thallium Mineral.

THE element thallium, discovered by Sir W. Crookes in 1861, has up to the present been known as an essential constituent of only two minerals, viz. crookesite, a selenide of copper and thallium, and lorandite, a sulpharsenite of the latter element. To these minerals a third must now be added in hutchinsonite, a new sulpharsenite from the Binnenthal, which also contains thallium as an important constituent. The crystallographic characters of hutchinsonite were described about a year ago by Mr. R. H. Solly, who, of late years, has been particularly successful in discovering new mineral species in the Binnenthal. At the time of its discovery very little in the way of chemical investigation was possible owing to the extreme scarcity of the mineral, but during the past year additional crystals have been acquired for the British Museum, and from these about eighty milligrams of fairly pure material have been obtained for chemical analysis. Thallium is present (up to nearly 20 per cent.), together with lead, silver, and copper, in combination with arsenic and sulphur. A full description of the mineral will appear shortly in the *Mineralogical Magazine*. G. T. PRIOR.

The Legendary Suicide of the Scorpion.

I HAVE recently come across the following passage in the Rev. John Campbell's "Travels in South Africa" (London, 1815), p. 38:—"Having caught a scorpion near our tent, we tried whether naturalists were accurate in relating, that if that animal be surrounded with fire, and sees he cannot escape, he will sting himself to death. However, it died as quietly as any other animal, only darting its sting from it, as if to oppose any ordinary assailant." The experiment was made near Zwellendam, Cape Colony, on February 20, 1813. EDWARD B. POULTON.

Oxford, March 31.

Propagation of Earthquake Waves.

A FEW days ago I read Major C. E. Dutton's book on "Earthquakes in the Light of the New Seismology." While acknowledging the high merits of this book, I take the liberty of pointing out some statements which seem misleading.

I refer to chapter xiii., where the author, quoting the results of the experimental investigations of Mr. Nagaoka, gives the speeds V_1 and V_2 of the normal and transverse waves. Now a glance at the table on pp. 230 and 231 shows that for many rocks the two moduluses E_1 and E_2 perpendicular and parallel to the bedding planes are far from being equal; on the contrary, the quotient E_1/E_2 varies so much as from 1·43/2·49 for rhyolite tuff to 32·1/17·5 for rhyolite. Hence the physical properties of the rocks in question are different in different directions, and the speeds of propagation of waves are also different in different directions, so that the speeds V_1 and V_2 of the table being the same for all directions have no real meaning for many rocks.

Again, in chapter xiii. and in other chapters of the book, the author refers to normal and transverse waves in rocks. It would be better, perhaps, to speak of dilatational and torsional waves; but leaving the question of terminology out of consideration, I observe that it is only for perfectly elastic homogeneous and isotropic bodies that the separation of the dilatational (normal) from the torsional (transverse) wave takes place with certainty. We have no right to extend this property to æolotropic bodies. When the body is æolotropic the deformation of an element on the passage of a wave need not be of a purely dilatational (normal) or of a purely torsional (transverse) character; it is rather of a mixed nature.

I will not say that æolotropic bodies able to propagate purely dilatational and purely torsional waves cannot exist, but I observe that such bodies are to be considered rather as possible exceptions, inasmuch as certain special conditions must be fulfilled in order that the generation of purely dilatational and purely torsional waves should be rendered possible. So, for example, the elastic potential of a perfectly elastic homogeneous uniaxial body implies five independent constants. When we introduce the condition that purely dilatational waves may be propagated apart from torsional ones, we find that two definite relations between the constants must be satisfied so that the number of independent constants is reduced to three. But we have no reason to maintain *a priori* that the conditions in question must be always satisfied.

Of course it is to be understood that a perfectly elastic homogeneous uniaxial body cannot be considered as an exact "model" of stratified rocks; it is only very similar to them; but it is more than highly improbable that the effect of internal friction would neutralise the effect of æolotropism. M. P. RUDZKI.

K. K. Sternwarte, Krakau (Austria), March 24.

NOTES ON STONEHENGE.[1]

V.—On the Star Observations made in British Stone Circles.[2]

THE work I have tried to do so far on our British stone circles has dealt with the observations of the sun made in connection with them, and the attempt to determine a date has been based upon the slow change in the obliquity of the ecliptic which is continually taking place.

In continuation of my work in Egypt in 1891, and Mr. Penrose's in Greece in 1892, I have recently endeavoured to see whether there are any traces in Britain of the star observations which I found connected with the worship of the sun at certain times of the year. We both discovered that stars, far out of the sun's course, especially in Egypt, were observed in the dawn as heralds of sunrise—"warning-stars"—so that the priests might have time to prepare the sunrise sacrifice. To do this properly the star should rise while the sun is still about 10° below the horizon.

I stated ("Dawn of Astronomy," p. 319) that Spica was the star the heliacal rising of which heralded the sun on May-day 3200 B.C. in the temple of Min at Thebes. Sirius was associated with the summer solstice at about the same time. The equinoxes were provided for in the same way in Lower Egypt, but they do not concern us now.

Mr. Penrose found this May-day worship continued at Athens on foundations built in 1495 B.C. and 2020 B.C., on which the Hecatompedon and older Erechtheum respectively were subsequently built, the warning star being now no longer Spica, but the cluster of the Pleiades.

It is generally known that Stonehenge is associated with the solstitial year, and I have recently suggested that it was originally connected with the May year; but the probable date of its re-dedication, 1680 B.C., was determined by Mr. Penrose and myself by the change of obliquity.

Now if Stonehenge or any other British stone circle could be proved to have used observations of warning stars, the determination of the date when such observations were made would be enormously facilitated. Mr. Penrose and myself were content to think that our date might be within 200 years of the truth, whereas if we could use the rapid movement of stars in declination brought about by the precession of the equinoxes, instead of the slow change of the sun's declination brought about by the change of the value of the obliquity, a possible error of 200 years would be reduced to one of 10 years.

In spite of this enormous advantage, so far as I know no one has yet made any inquiry to connect star observations with any of the British circles.

I have recently obtained clear evidence that some circles in different parts of Britain were related to the May year, a vegetation year, which we know was general over the whole of Europe in early times, and which still determines the quarter-days in Scotland.

If the Egyptian and Greek practice were continued here, we should expect to find some indications of the star observations utilised at the temple of Min and at the Hecatompedon for the beginning or the other chief months of the May year.

Following the clue given me in the case of the Egyptian temples, such as Luxor, by successive small changes of the axis necessitated by the change in a star's place due to precession, I have looked out for this peculiarity in an examination of many maps and plans of circles.

I have already come across two examples in which the sight line has been changed in the Egyptian manner. The first is the three circles of the Hurlers, near Liskeard, a plan of which is given in "Prehistoric Stone Monuments of the British Isles: Cornwall," by H. C. Lukis, published by the Society of Antiquaries, who were so good as to furnish me with a copy, and also some *unfolded* plans on which sight lines could be accurately drawn and their azimuths determined. I am anxious to express my obligations to the council and officers of the society for the help thus afforded me.

The second is at Stanton Drew, in Somerset, consisting of three circles, two avenues, and at least one outstanding stone. These were most carefully surveyed by Mr. C. E. Dymond some years ago, and he was good enough to send me copies of his plans and levelling sections.

How can such plans help us? The easiest way for the astronomer-priests to conduct such observations in a stone circle would be to erect a stone or barrow indicating the direction of the place on the horizon at which the star would rise. If the dawn the star was to herald occurred in the summer, the stone or barrow itself might be visible if not too far away, but there was a reason why the stone or barrow should not be too close; in a solemn ceremonial the less seen of the machinery the better.

Doubtless such outstanding stones and barrows would be rendered obvious by a light placed on or near them. Cups which could hold oil or grease are known in connection with such stones, and a light thus fed would suffice in the open if there were no wind; but in windy weather a cromlech or some similar shelter must have been provided for it.

Now if these standing stones or barrows were ever erected and still remain, accurate plans—not the slovenly plans with which Ferguson and too many others have provided us, giving us either no indication of the north or any other point, or else a rough compass bearing without taking the trouble to state the variation at the time and place—will help us in this way.

The work of Stockwell in America, Danckworth in Germany, and Dr. W. J. S. Lockyer in England has provided us with tables of the changing declinations of stars throughout past time, or enough of it for our purpose.

An accurate determination of either the *azimuth* (angular distance from the N. or S. points) or *amplitude* (angular distance from the E. or W. points) of the stone or barrow as seen from the centre of the stone circle will enable us to determine this declination.

This, of course, only gives us a first approximation. The angular height of the point on the horizon to which the alignment or sight-line is directed by the stone or barrow from the centre of the circle must be most accurately determined, otherwise the declinations may be one or two degrees out.

To come back to the two cases to which I have referred, the Hurlers and Stanton Drew. I will begin with a reference to the available descriptions of the circles.

The three circles of the Hurlers, some five miles to the north of Liskeard, are thus referred to by Lukis in the valuable monograph which I have already mentioned.

"On the moor, about a mile to the south of the singular pile of granite slabs, which rest upon and overlap each other, and is vulgarly called the Cheesewring, there are three large circles of granite stones placed in a nearly straight line in a north-north-east, and south-south-west direction, of which the middle one is the largest, being 135 feet in diameter, the north 110 feet, and the south 105 feet.

"The north Circle is 98 feet, and the south 82 feet

[1] Continued from p. 393.

[2] This article is generally based upon a note communicated to the Royal Society on March 15.

from the central one. If a line be drawn uniting the centres of the extreme Circles, the centre of the middle ring is found to be 12 feet 6 inches to the west of it.

"These Circles have been greatly injured. The largest consists of 9 erect and 5 prostrate stones; the north Circle has 6 erect and 6 prostrate, and a fragment of a seventh; and the south has 3 erect and 8 prostrate. In Dr. Borlase's time they were in a slightly better condition. A pen-and-ink sketch made by him, which is extant in one of Dr. Stukeley's volumes of original drawings, represents the middle Circle as consisting of 7 erect and 10 prostrate stones; the north of 10 erect and 6 prostrate; and the south of 3 erect and 9 prostrate. The stone to the east of that marked C in the plan of the middle Circle is the highest, and is 5 feet 8 inches out of the ground, and appears to have been wantonly mutilated recently. Two of the prostrate stones of the north Circle are 6 feet 6 inches in length.

"About 17 feet south from the centre of the middle Circle there is a prostrate stone 4 feet long and 15 inches wide at one end. It may possibly have been of larger dimensions formerly, and been erected on the spot where it now lies, but as Dr. Borlase has omitted it in his sketch it is probably a displaced stone of the ring.

"If we allow, as before, an average interval of 12 feet between the stones, there will have been about 28 pillars in the north, 26 in the south, and 33 in the middle Circle.

"At a distance of 409 feet westwards from K in the middle Circle there are 2 stones, 7 feet apart, both inclined northwards. One is 4 feet 11 inches in height out of the ground, and overhangs its base 2 feet 7 inches; the other is 5 feet 4 inches high, and overhangs 18 inches."[1]

I next come to Stanton Drew.

I will begin by giving a short account of the stones which remain, abridged from the convenient pamphlet prepared for the British Association meeting at Bristol in 1898 by Prof. Lloyd Morgan.

The circles at Stanton Drew, though far less imposing than those of Avebury and Stonehenge, are thought to be more ancient than are the latter, for the rough-hewn uprights and plinths of Stonehenge bear the marks of a higher and presumably later stage of mechanical development. Taken as a group, the Somersetshire circles are in some respects more complex than their better known rivals in Wiltshire. There are three circles, from two of which "avenues" proceed for a short distance in a more or less easterly direction; there is a shattered but large dolmen—if we may so regard the set of stones called "the cove"; and there are outlying stones—the "quoit," and those in Middle Ham—which bear such relations to the circles as to suggest that they too formed parts of some general scheme of construction.

The "quoit," lying in an orchard by the roadside, has nothing very impressive about its appearance—a recumbent mass of greyish sandstone; but it seems to be a brick in the Stanton Drew building. By some regarded as a sarsen block from Wiltshire, it is more probably derived from the Old Red Sandstone of Mendip. In any case it is not, geologically speaking, *in situ*; nor has it reached its present position by natural agency.

With regard to two of the megalithic circles, at first sight the constituent stones seem irregularly dotted

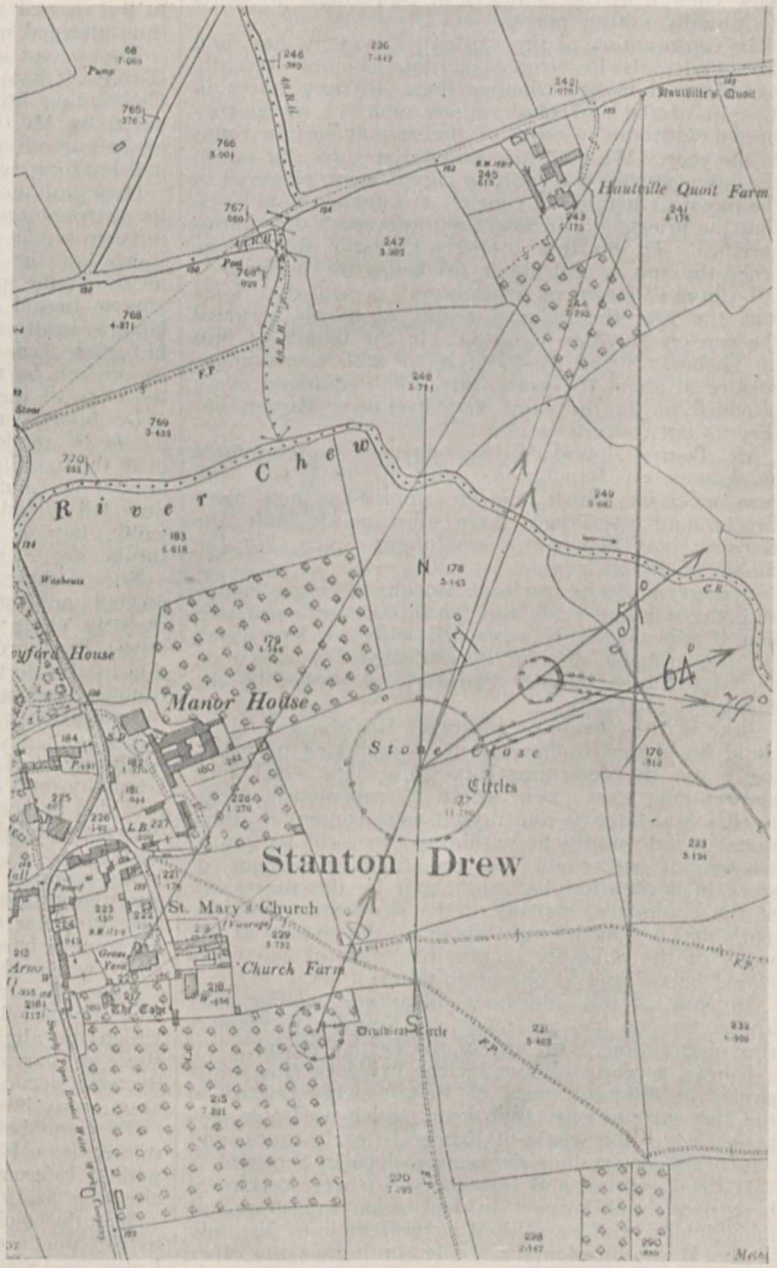

FIG. 13.—The Circles and Avenues at Stanton Drew. Photograph of 25-inch Ordnance Map, giving approximate azimuths of sight-lines.

[1] "The Prehistoric Stone Monuments of the British Isles: Cornwall." By William Collings Lukis, M.A., F.S.A., Rector of Wath, Yorkshire. P. 4.

about the field; but as we approach them the unevenly spaced stones group themselves.

The material of which the greater number of the rude blocks is composed is peculiar and worthy of careful examination. It is a much altered rock consisting, in most of the stones, of an extremely hard silicious breccia with angular fragments embedded in a red or deep brown matrix, and with numerous cavities which give it a rough slaggy appearance. Many of these hollows are coated internally with a jasper-like material, the central cavity being lined with gleaming quartz-crystals.

The majority of the stones were probably brought from Harptree Ridge on Mendip, distant some six miles. Weathered blocks of Triassic breccia, showing various stages of silicification, there lie on the surface; and there probably lay the weathered monoliths which have been transported to Stanton Drew. It is important to note that they were erected unhewn and untouched by the tool. A few stones are of other material —sandstone, like the "quoit," or oolite from Dundry.

In the great circle, of the visible stones some retain their erect position, others are recumbent, several are partially covered by accumulation of grass-grown soil. Others are completely buried, their position being revealed in dry seasons by the withering of the grass above them.

To the east of this circle a short avenue leads out, there being three visible stones and one buried block on the one hand, and two visible stones on the other. But one's attention is apt to be diverted from these to the very large and massive megaliths of the small N.E. circle. This is composed of eight weathered masses, one of which (if indeed it do not represent more than one), Prof. Lloyd Morgan tells us, is recumbent and shattered. From this circle, all the stones of which are of the silicious breccia, a short avenue of small stones also opens out eastwards.

The third or S.W. circle lies at some little distance from the others. The average size of the stones is smaller than in either of the other circles, and not all are composed of the same material.

"The Cove," which has been variously regarded as a dolmen, a druidical chair of state, and a shelter for sacrificial fire, is close to the church.

The dimensions and number of stones are as follow:—

Great Circle, diameter 368 feet, 30 stones.					
N.E.	,,	,,	97	,, 8	,,
S.W.	,,	,,	145	,, 12	,,

We now pass from general descriptions of the circles to the azimuths of the sight lines already referred to, so far as they can be determined from the published Ordnance maps.

To investigate them as completely as possible without local observations in the first instance, I begged Colonel Johnston, R.E., C.B., the Director-General of the Ordnance Survey, to send me the 25-inch maps of the sites giving the exact azimuth of the side lines. This he obligingly did, and I have to express my great indebtedness to him.

Of the various sight lines found, those to which I wish to direct attention in the first instance, and which led me to the others, are approximately, reading the azimuths to the nearest degree,

Hurlers Lat. 50° 31′ N.	Az.	Stanton Drew Lat. 51° 10′ N.	Az.
S. circle to central circle	N. 12° E.	Great circle to Quoit S.W. circle to great circle	N. 17° E. N. 20° E.
Central to N. circle	N. 15° E.		
N. circle to tumulus	N. 19° E.		

For the purposes of a preliminary inquiry in anticipation of the necessary local observations with a theodolite, for which I am making arrangements; assuming hills half a degree high, which roughly compensate the refraction correction so that we may use sea-horizon values, we have the following declinations approximately:—

The Hurlers. Lat. 50° 31′	Stanton Drew. Lat. 51° 10′
Dec. N. 38½°	Dec. N. 37°
,, 38°	,, 36½°
,, 37°	

Here, then, we have declinations to work on, but declinations of what star? To endeavour to answer this question I prepared a diagram showing the declination of the three brightest stars in the northern heavens, having approximately the declinations in question for the period 0 to 2500 B.C. The calculations for 0 to 2000 B.C. are taken from the tables published by the Astronomisches Gesellschaft,[1] and have been completed from 2000 to 2500 B.C. by Dr. Lockyer.

Vega is ruled out as its declination is too high. The remaining stars Capella and Arcturus may have been observed so far as the declinations go. For time limits we have:—

Dec. N.	Capella.	Arcturus.
38½°	500 B.C.	1550 B.C.
36°	1050 ,,	1150 ,,

The interesting fact must be pointed out that about 1000 B.C. the declination of the two stars was very nearly the same.

Now there is no question as to which of these two stars we have to deal with, for I find by the use of a precessional globe that for about 1400 B.C. and 800 B.C. the warning stars were as follows for the critical times of the year, *i.e.* May, August, November, February.

	1400 B.C.	Az.	800 B.C.	Az.
May	Pleiades rising		Pleiades rising	
Aug.	Arcturus rising	N. 14° E.	Sirius rising	
Nov.	Capella setting		Betelgeuse rising	
Feb.	Capella rising	N. 29° E.	Capella rising	N. 21° E.
		Dec. 34° N.		Dec. 37° N.

It is quite clear, then, that we have to deal with Arcturus, and this being so, the approximate dates of the use of the three circles at the Hurlers can be derived. They are:—

	B.C.
Southern circle aligning Arcturus over centre of central circle	1600
Central ,, ,, ,, N. circle	1500
Northern ,, ,, ,, tumulus	1300

I have already pointed out that Mr. Penrose found the warning star for May morning at the date of foundation of the Hecatompedon, 1495 B.C., to be the group of the Pleiades. As the foundations of the Hecatompedon were only built some few years before the stones of the central circle of the Hurlers were used, we ought to find traces of the observations of the same May morning stars. We do; there is a stone with amplitude E. 15° N., which, when aligned from the S. circle, would have pointed out the rising place of the Pleiades in 1300 B.C., that is, the date we have already found from the observations of Arcturus. I regard this as an important confirmation of the time of the use of the temple, all the more as the high situation of the circles, not generally dominated by higher levels for some miles, renders it probable that large corrections for hills will not be required to be made.

There are alignments in connection with the N. circle which indicate the introduction of the solstitial year, but these and some others may wait until local observations have been made before more is said about them.

With regard to Stanton Drew, it is clear that we are there also dealing with Arcturus. Mr. Dymond's

[1] Dr. O. Danckworth, *Vierteljahrschrift der Astronomischen Gesellschaft*, 16 Jahrgang 1881, p. 9.

levels give an idea of the height of the hills, so with the Ordnance map azimuths, read to 1°, the dates of the use of the great and S.W. circles are approximately as under:—

	B.C.
Great Circle	1260
S.W. Circle	1075

We seem, then, to have made a step in advance. More accurate readings of the Ordnance maps and accurate determination of the heights of hills may vary the above values slightly. But that is an unimportant detail if it can be shown that we have a new method of dating what went on in prehistoric Britain at the time when the Athenians were building the Hecatompedon.

A great amount of local theodolite work has to be done, for while Mr. Lukis only referred to two outstanding stones at the Hurlers, there are many more marked on the Ordnance map; there are also others besides the "quoit" at Stanton Drew.

I am more rejoiced than I can say to know that this local work has already been begun under the best possible conditions. As it was impossible for me to leave London when the significance of the alignments was made out, I appealed to the authorities of University College, Bristol, and of the Royal Cornwall Polytechnic Society for aid. The principal of the college, Prof. Lloyd Morgan, together with Prof. Morrow and his engineering class, have already made observations at Stanton Drew, and Captain J. S. Henderson, of Falmouth, an accomplished surveyor, sent me last week from the Hurlers the angular heights along some of the alignments, the means of eight readings obtained with a 6-inch theodolite, both verniers and reversed telescopes being employed. Other students of science besides myself will, I am sure, feel their indebtedness for such opportune help. NORMAN LOCKYER.

BRITISH ASSOCIATION GEOLOGICAL PHOTOGRAPHS.

THE geological photographs committee of the British Association and its indefatigable secretary, Prof. W. W. Watts, are to be congratulated on the third issue, which completes the first series, of their admirable photographs. There are twenty-four photographs in this issue, all of great interest, showing much skill in technique, and considerable artistic power in the choice of the point of view from which the objects were taken. They treat of a variety of subjects, chiefly the action of wind and rain, frost and ice, and sea-waves, igneous intrusion, the character of sedimentary rocks, and structures due to faulting and folding.

There are two good pictures of the remarkable rain-eroded pillars of Old Red Conglomerate which occur at Allt Dearg, on the Spey, Morayshire, and remind us of the similar forms which may be seen in much younger deposits on the right side of the Brenner as we travel towards Italy. They were first figured by Sir Archibald Geikie, who provides a description to the photographs, in which he directs attention to the comparative rapidity of their formation, as shown by the fact that "some of these isolated stacks of conglomerate are capped by boulder clay, and their capitals may here and there be seen to have retained their covering of thick peaty soil."

The photograph of the tower of Eccles Church, an object made so familiar by Lyell's "Principles," is the last that was taken (in 1886), and the last that will be taken, for the tower itself was destroyed in 1895. Prof. Reynolds's photograph of the great Axmouth landslip gives a good view of the "mighty chasm which separated the foundering mass from the land." The original describers of this were Buckland and Conybeare, and a water-colour copy by Ruskin of Mrs. Buckland's drawing still hangs in the University Museum at Oxford. Of queer forms the "Rock and Spindle," St. Andrews, Fifeshire, photographed by Mr. G. Bingley and described by Prof. Bonney, and "Lot's Wife," Marsden, Durham, a "breccia gash" transformed into a sea-stack, described by Prof. Lebour, are

FIG. 1.—Keuper marl resting on terraced granite surface; Mountsorrel Quarry, Leicestershire. Photographed by Prof. H. E. Armstrong, F.R.S.

among the quaintest; they would be good puzzles to set a student in examination. The most novel subject is the wind-worn surface of granite disclosed beneath the Keuper marl in the Mountsorrel quarry, one of the several proofs discovered by Prof. Watts of the desert conditions which prevailed in these islands and elsewhere during a part of the Trias period. We have selected this for reproduction.

As this is the last issue of the first series it is usefully accompanied by some introductory letterpress, which includes the names of the committee, a preface, table of contents, and other information. We learn from the preface that the idea of forming a systematic collection of geological photographs originated with Mr. Osmond W. Jeffs in 1889; to carry it out a committee of the British Association was appointed in 1890, and Mr. Jeffs acted as secretary until 1896, by which time 1412 photographs had been contributed. In 1895 Prof. W. W. Watts became secretary, and by 1903 the collection had grown to the magnificent total of 3754. It is housed in the Museum of Practical Geology, 28 Jermyn-street, S.W. The series issued to subscribers and just completed consists of a selected number (72) of these photographs, taken from negatives generously lent by their owners, and furnished with descriptions by many of the leading geologists of the day.

The success of the scheme is shown by the fact that it has resulted in a considerable profit; of this one half has been returned to the subscribers in the form of additional whole-plate photographs, and the other half will provide funds for carrying on the work of the committee for at least four years. In a strictly business undertaking it is to be presumed that a good slice of the profits would disappear in "wages of superintendence," and subscribers may therefore regard their additional photographs as a gift from Prof. Watts.

THE SOCIETY OF ARTS AND THE LONDON INSTITUTION.

ON Wednesday next a special meeting of proprietors of the London Institution will be held to consider a scheme for its amalgamation with the Society of Arts. Founded in 1805 by merchants and bankers of the City of London, given a charter two years later, and housed in its present imposing, if rather sombre, premises in 1819, the London Institution has done good work in its day. The object of its founders was to maintain, in what was then a central position, an extensive general library of reference, comprising works of intrinsic value and utility in all languages; to provide reading rooms for periodical publications and interesting contemporaneous pamphlets; and to promote the diffusion of knowledge by lectures and *conversazioni*. But since the foundation of the institution circumstances have greatly changed, and not to the advantage of the institution. In 1817, and for many years afterwards, the City contained a large residential population, which for a long time past has been gradually disappearing, until now the number of proprietors who use the institution as a centre of intellectual culture is comparatively small, and is more likely to grow smaller than to increase. In these circumstances the board of management has recognised that if the institution is to live and thrive some scheme must be devised for increasing its usefulness, and the proposal to amalgamate with the Society of Arts is the outcome of prolonged consideration of a difficult problem.

The Society of Arts carries on to a large extent work of the same nature as that for which the London Institution was founded, but whereas the institution has suffered from residential changes, the society was never more prosperous. But it, too, has had its ups and downs. In the early 'forties of the last century it began to show signs of decrepitude, and in 1841 a committee was appointed to examine its position and make recommendations. But little seems to have been done until measures were taken for obtaining a Royal Charter of Incorporation, which was granted in 1847. Then it was proposed to hold an exhibition of English industry. Prizes for modern industrial art were offered, and eagerly competed for, and by 1850 the membership had risen again to 1500. An exhibition of ancient and mediæval art was held which was very successful, and a proposal to hold an international exhibition culminated in the Great Exhibition of 1851. Since then the Society of Arts has done much good work in promoting industrial art and encouraging inventive genius. The prosperity of the 'fifties was followed by some lean years, but for a generation past it has been highly prosperous, largely owing to the sagacious guidance of its present secretary. Sir Henry Wood has always attached great importance to the constitution of the council of the society. He has not only sought for and found eminent men, he has got those who were willing to give time and attention to the affairs of the society, men like Sir Frederick Bramwell, Sir F. Abel, Sir W. Siemens, Sir Douglas Galton, Lord Alverstone, Sir J. W. Barry, Sir W. Preece, the Duke of Abercorn, and Sir W. Abney. All these gentlemen have served as chairmen of the council, and the society owes them much.

Both institutions are financially strong. The London Institution possesses a site which is worth at least 150,000*l*., besides a fund invested in consols of the present value of 31,000*l*. Its income in 1903 was 3583*l*., and its expenditure was 3616*l*. The Society of Arts has an annual income which last year exceeded 11,000*l*., a capital fund of about 20,000*l*., which has accumulated from surplus income during the last twenty years, and trust funds amounting to nearly 15,000*l*. What, then, are the inducements to the one institution and the other to consent to an amalgamation? It is not proposed that either should absorb the other. The suggestion is amalgamation into a single body for the promotion of science, art, and literature, and their practical applications, the members of each corporation preserving all their present rights, and sharing in the government of the new institution and in the direction of its future action.

The determining consideration with the Society of Arts is that the amalgamation would give it a permanent local building. The society does not own its premises. They were built for it by the Brothers Adam in 1774, but the lease has run out, and it is now practically a tenancy at will. Moreover, the building is inadequate for the growing needs of the society, and the funds at its disposal are not sufficient to enable it to build for itself, whereas by amalgamation with the London Institution, which would sell its Finsbury premises, ample funds would be available. It is believed that the accommodation required could be got for a sum of 100,000*l*., and a suitable site found "east of Charing Cross and west of Chancery Lane." If it were decided to erect a building of sufficient size there are several other societies who would probably be prepared to join in the scheme, separate and distinct accommodation being provided for each, much as Burlington House now accommodates a number of independent institutions.

The amalgamation would give the London Institution a large accession of annual income, and the revenues of the new institution would justify the extinction in perpetuity of the annual payment of two guineas now required from the proprietors of the London Institution, while leaving them a permanent property in their shares disposable by will, or otherwise, as heretofore, the Society of Arts having approved of this as one of the terms of amalgamation. It would be part of the arrangement that any proprietor preferring to withdraw from the scheme and to surrender his share would be enabled to do so, and be paid 25*l*. in discharge of his rights and interests in such share. Those who remained would be members of an institution of very great importance and influence, well endowed, and in a position to carry into effect many objects of the highest public, scientific, and economic importance.

It is not to be supposed that the proposed amalgamation will be carried through without encountering opposition, but it will probably be found that a very large majority of both institutions is prepared to accept it. In the opinion of eminent counsel, the effect of its charter is to constitute the London Institution in a legal sense a charity, with the result that its property and funds are impressed with a charitable trust, and cannot be divided or applied to any other purpose than that prescribed by the charter. Consequently, the property could not be divided up without serious risk. If the amalgamation is to be carried through, the most convenient and least costly way of carrying it into effect would be to promote an Act of Parliament for the purpose, and, granted the authorisation of general meetings, this will be done. But an Act cannot be got

until next year, and a site for the new building can hardly be secured before the Act is got, so that if all goes smoothly, a year or two must elapse before the united societies, to be known as "The Society of Arts and the London Institute," can receive their friends under the altered conditions, and in their new premises.

The idea of thus combining into a single body two scientific institutions, each of considerable importance, is a bold and novel one, and it is to be hoped that it may not fail of success. It would be a pity if any narrow views or selfish considerations hindered the carrying out of a very interesting experiment. Each of the two corporations can supply much of what the other lacks. The constitution of the London Institution is unfortunate. It consists of a body of shareholders, the descendants or heirs of the original founders, many of whom are naturally out of sympathy with the objects of the institution, and no means exist of introducing fresh blood or attracting to its membership the men who would most fitly carry on its proper work. Very early in its career the kindred Royal Institution altered its constitution, disendowed its proprietors, and adopted a more popular and democratic organisation. Its unfailing success ever since has proved the wisdom of the change. But the Finsbury institution possesses considerable property. It has a magnificent library. Its list of members is still a showy one. It only requires the infusion of fresh blood; it wants new life and vigour. The Society of Arts is a very popular and vigorous body, full of life and energy. It does much really useful public work. Its examinations, for instance, attract more candidates than that of any other private body in the kingdom. Its Cantor lectures (which are always freely open to London students) are a valuable educational agency. But it is hampered by want of larger offices, its library is far from being a credit to it, and it might well devote more attention and more funds to purposes of research and investigation.

A new institution such as should be formed ought to possess the good points of both its parents, while avoiding the weaknesses of either. It might also form a nucleus round which might gather many of the smaller societies, now often inadequately housed. In a suitable building accommodation might well be provided for many other societies, scientific, literary, and artistic, which are now scattered about in various quarters of London.

Even a larger scheme is conceivable. Burlington House can find room for but a small proportion of the scientific bodies of London. Why should not this proposed amalgamation lead to the erection of a second Burlington House, of which those of our larger and richer societies who are not satisfied with their premises should erect each their own part, independent certainly of one another, and yet combined under a common roof?

NOTES.

LORD KELVIN, who has been out of health for some time, underwent a serious operation on March 29. He passed a restless night on March 30, but has much improved since then, and appears to be making satisfactory progress toward recovery. The King and the Prince and Princess of Wales have made special inquiries as to his condition; and there have been numerous callers.

SIR WILLIAM RAMSAY, K.C.B., F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

IT is reported by the Exchange Telegraph Company that a violent earthquake occurred at Lahore on Tuesday, April 4, causing serious loss of life and great damage to public buildings and other property.

A GRANT of 30,000*l.* has been authorised by the Carnegie Institution, *Science* states, for the solar observatory on Mt. Wilson. It is expected that the first equipment will cost about twice this sum.

WE learn with sincere regret that Prof. Pietro Tacchini, formerly director for many years of the astronomical observatory of the Collegio Romano, and of the Central Office for Meteorology and Geodynamics at Rome, died on March 24 at sixty-seven years of age.

THE *Times* states that the Chartley herd of white cattle has just been purchased by Mr. J. R. B. Masefield, of Cheadle, Staffordshire, on behalf of the Duke of Bedford, who has come forward and saved the herd from leaving the country or falling into the hands of the taxidermist.

AN agricultural education and forestry exhibition will be held in connection with the show of the Royal Agricultural Society at Park Royal on June 27–30. Any offers of exhibits, or inquiries, should be addressed to the secretary of the society, at 13 Hanover Square, London, W.

THE Easter excursion of the Geologists' Association will be to mid-Lincolnshire. The party will leave London for Grantham on Thursday, April 20, and after visiting several places of geological interest will leave Lincoln for London on Wednesday, April 26. The excursion secretary is Mr. W. P. D. Stebbing, 8 Playfair Mansions, Queen's Club Gardens, London, W.

A GREAT historical pageant is in active preparation at Sherborne, Dorsetshire, to commemorate the 1200th anniversary of the founding of the town, bishopric, and school by St. Ealdhelm, A.D. 705. The pageant, which will be presented in the ruins of Sherborne Castle on June 12–15, will take the form of a folk-play written by Mr. Louis N. Parker and dealing with the chief historical events of the town.

THE death of Dr. L. Bleekrode, of the Hague, is announced in the *Chemical News*. Dr. Bleekrode's work was principally connected with electrical matters, his first paper, in 1867, being on the influence of heat on electromotive force. In 1870 he wrote a paper on a curious property of gun-cotton; other papers dealt with electrical conductivity and electrolysis in chemical compounds, observations on the microphone, &c.

WE regret to see the announcement of the death, on March 25, of the eminent German metallurgist, Prof. Bruno Kerl, at the age of eighty-one. He was professor of metallurgy at the Clausthal School of Mines, and subsequently at the Berlin School of Mines, and was the author of a number of metallurgical works. His first book, on the smelting processes of the Upper Hartz, was published in 1852. His important treatise on metallurgy was translated into English by Sir W. Crookes and E. Röhrig in 1868. His books on assaying were also translated.

THE importance of the application of mathematics to engineering problems has frequently been insisted upon in these columns. Another instance of the close connection between pure and applied science is afforded by an investigation of some disregarded points in the stability of masonry dams, by Prof. Karl Pearson and Mr. L. W. Atcherley, referred to by Sir William Garstin in connection with the scheme for raising the Nile dam, in a recent

report to the Egyptian Council of Ministers. It appears that the theory of stresses upon masonry dams requires important modifications, which will have to be taken into consideration in all future designs for such works. We understand that much experimental work on the subject is at present in progress, and that results of great interest to hydraulic engineers may be expected.

THE anniversary dinner of the Chemical Society was held at the Whitehall Rooms, Hôtel Métropole, on March 29, when the president, Prof. W. A. Tilden, was in the chair, and many leading representatives of the physical sciences were present. Sir William Church, in giving the toast of "Prosperity to the Chemical Society," spoke of the advances which chemical science has made, and declared that the advantages which have accrued to the United Kingdom, as a result of the work of chemists, cannot be over-estimated. Prof. Meldola submitted the toast of "Scientific Institutions," which was responded to by Prof. J. Larmor and Dr. R. T. Glazebrook. Sir William Ramsay proposed the toast of "The Guests," and in replying Mr. Haldane said that as science never stood still, but progressed continually, so the Government of this country must, if the nation is to hold its own, make an increasing use of science in all departments of the State service. He expressed the belief that in the course of the next few years the position of science in the Government of the country will be much more prominent, and that scientific methods will become much more general. Prof. Perry also spoke.

A MEETING of the Institution of Naval Architects will be held at the Society of Arts, John Street, Adelphi, on April 12–14. Lord Glasgow, president of the institution, who will occupy the chair, will deliver his address on April 12; and Mr. W. E. Smith, C.B., Colonel N. Soliani, and Mr. Herbert Rowell will submit papers for discussion. On April 13 Prof. J. H. Biles will read a paper on the strength of ships, with special reference to experiments and calculations made upon His Majesty's ship *Wolf*, and other papers will be submitted by Mr. F. H. Alexander, Mr. J. Bruhn, Mr. R. E. Froude, Mr. C. E. Stromeyer, Mr. A. W. Johns, and Herr S. Popper. Among the papers to be read on April 14 is one on the Admiralty course of study for the training of naval architects by Mr. E. L. Attwood, and another on submarine signalling by means of sound by Mr. J. B. Millet, of Boston, U.S.A.

THE Royal medals of the Royal Geographical Society for this year have been awarded to Sir Martin Conway (founder's medal) for his explorations of various mountain regions of the world, and his work among the islands of Spitsbergen; and to Captain C. H. D. Ryder, R.E. (patron's medal), for the important and extensive work which he accomplished while acting as principal survey officer on the recent Tibet Mission. The Victoria research medal, for distinguished service to the cause of geographical research, as distinguished from exploration, has been awarded to Mr. J. G. Bartholomew. The Murchison grant goes to Mr. William Wallace, C.M.G., Deputy High Commissioner of the Northern Nigerian Protectorate. Colonel F. R. Maunsell, R.A., has been awarded the Gill memorial for his explorations during many years' residence in Asia Minor; Mr. F. J. Lewis the Cuthbert Peek grant for contributions to the knowledge of botanical distribution by his researches into the geographical distribution of vegetation in the north of England; and Captain Philip Maud, R.E., the Back grant for survey work in 1903 along the southern border of Abyssinia.

THE concluding issue of the *Proceedings* of the Philadelphia Academy for 1904 contains the reports of the secretaries and curators for that year, from which it appears that the society continues to be in a flourishing condition, both as regards its publications and its museum.

IN an article published in *Naturen* for March, Mr. J. Rekstad shows the value of photography to illustrate the secular variation in glacier terminations, the respective differences between two glaciers in August, 1899, and September, 1903, being admirably exhibited. In both instances, it may be remarked, there has been very decided shrinkage in the length of the glacier. The value of photographs of this nature as a basis of comparison in the years to come will be very great.

WE have been favoured with a copy of No. 17 of the *Boletin* of the Institute of Mining Engineers of Peru, which contains an account of certain annelid remains and ammonites in the Salto del Fraile and Morro Solar districts by Mr. C. I. Lisson. Both formations appear to be of Neocomian age, the higher beds of Salto del Fraile being remarkable for the number of borings of annelids of the genus Tigillites they contain, while the lower Morro Solar stratum is noteworthy for its ammonites of the group Sonneratia.

IN the *Report and Transactions* of the East Kent Scientific and Natural History Society for the past year, the secretary takes occasion to direct attention to the general apathy towards matters scientific prevailing in that portion of the county he represents. Owing to this cause, the season's excursions were practically a failure, and there may be some connection between this apathy and the fact that it has hitherto been found impracticable properly to arrange and display the natural history collections in the Royal Museum.

THE *Zoologist* for March opens with an article by Mr. Lydekker on the small Asiatic mountain antelopes known as gorals. The main object of the article was to describe the Burmese species; but in the course of his investigation the author was led to believe in the existence of two Himalayan representatives of this group, one of which he names *Urotragus bedfordi*, on account of the type specimen having lived in the park at Woburn. In the penultimate line on p. 84 we notice that the word "eastern" should be "western." The second article, by Mr. John Gurney, is devoted to Norfolk bird-life in 1904, and it is interesting to note that in the spring of that year the author had the good fortune to see two avocets and seven spoonbills on Breydon Broad.

FROM the fisheries branch of the Department of Agriculture and Technical Instruction for Ireland we have received a copy of No. 4 of *Scientific Investigations*, containing an account by Messrs. Holt and Tattersall of schizopod crustaceans from the north-east Atlantic slope, and a note on one genus of the same group by Dr. Calman. In proposing several new generic types, the authors of the first paper suggest that these may prove of only temporary value, and add the remark that these, if not forgotten, "will, at least, cease to be harmful whenever the fashion of reviving deservedly forgotten names has run its due course." Dr. Calman proposes the name Nematobrachion to replace his Nematodactylus of 1896, which he regards as preoccupied by Richardson's Nemadactylus. Evidently neither of the three authors are in sympathy with the rules for nomenclature in zoology drawn up by the Paris committee.

DR. T. H. MONTGOMERY, in the *Proceedings* of the American Philosophical Society for the last quarter of 1904, runs a tilt at the generally accepted view as to the morphological superiority of the male sex in animals. Among invertebrates, he urges, it is always the male which is of inferior size and development, while as regards vertebrates, although the males have in many cases secured superiority in the matter of bodily size and secondary sexual characters, yet, as regards the generative organs (notably the suppression in certain instances of one ovary), the advantage, from the point of view of specialisation and development, is largely on the side of the female. While admitting that different morphologists might estimate the value of these characters differently, the author is inclined to give the greatest morphological value to the higher development of the reproductive organs.

IN discussing in the same issue the origin of the markings of organisms, the late Prof. Packard arrived at the conclusion that these are dependent on the physical rather than on the biological environment. The alleged instances of "Müllerian" mimicry he explained, for example, by convergence due to the action of similar physical and climatic causes, since he regarded the attacks of birds as a negligible factor. Again, the frequent instances of colour and pattern resemblance between different animals he attributed to pigmentation caused by exposure to sunlight and shade, due to the repetition of fundamental colours. "To claim that Müllerian mimicry," he added, "is due to the attacks of birds, is to overlook the fact of the existence of stripes, bars, and spots on the wings of palæozoic insects which flourished before the appearance of birds, and even of modern types of lizards."

THE *Report* on the third outbreak of plague at Sydney in 1903 by Dr. Ashburton Thompson is interesting as showing how an epizootic of plague among the rats preceded the two cases of human plague. From July 15, 1902, to April 30, 1903, 31,075 rats were caught, of which 17,160 were examined and found to be free from plague. On May 12 a rat was found on certain premises which on examination proved to be infected with plague, and up to August 15 14,671 rats and mice were caught, of which 111 rats and 50 mice were ascertained to be infected with plague. From then until December, 1903, 13,389 rats and mice were captured of which none was infected. The two human cases occurred on June 20 and July 4, *i.e.* during the period when the epizootic existed among the rodents.

THE February number of *Indian Public Health* (i., No. 7) contains several papers of interest, notably one criticising the plague policy of the Indian Government, in which it is concluded that the only way to grapple with the plague problem is the formation of a properly organised and equipped *permanent* public health service for the country.

IN the course of a report on the characters and analyses of sweet potatoes cultivated in Jamaica, Mr. H. H. Cousins, writing in the *West Indian Bulletin* (vol. v., No. 3), records the fact that the process of cooking increases the sugar content of sweet potatoes very considerably. Further experiments are being undertaken to ascertain the exact chemical nature of the change. A comparison of tubers freshly dug with others that had been stored for some weeks indicated that during storage there is also a development of sugars at the expense of other substances in the tubers.

VARIOUS kinds of citrus fruits, including oranges, pomeloes, grapefruit, and more particularly lemons and limes, are liable to suffer from the ravages of a parasitic fungus, *Colletotrichum gloeosporioides*, which attacks the leaves, causes spot or canker on the fruit, or brings about abscission of the inflorescence. The fungus has been reported from various orange-growing countries, and on account of its partiality for limes, planters in the West Indies will do well to consult the account by Mr. P. H. Rolfs which is published in the *Bulletin*, vol. iii., part ii., of the Department of Agriculture, Jamaica.

THE publication of pamphlets dealing with the cultivation, varieties, and market requirements of well known commercial plant products, as instituted by the director of the Royal Botanic Gardens, Ceylon, is a practical and important phase in the development of economic botany. In vol. ii., Nos. 23 and 25, of the *Circulars* of the gardens, Mr. H. Wright takes up the subjects of ground nuts and castor oil plants. The best quality of ground nuts, and these can be grown in Ceylon, are bought for eating, but the demand is limited; on the other hand, the requirement of the nuts for oil-crushing, although the price is less remunerative, is practically unlimited, and the cake furnishes an excellent cattle food. In the castor seed trade it does not appear that Ceylon will become a formidable rival to India.

THE Cerro de Pasco silver mines are the most remarkable in Peru, having been worked since the year 1630. At the present day operations are chiefly confined to the reworking of old slags and waste heaps. On March 21, 1902, a Government Commission was appointed to make a survey of these mines, and the report of the commission has now been published in the form of a *Boletin* issued by the Peruvian Corps of Mining Engineers. Illustrations and descriptions of the smelting works are given, and it is noted that the output in 1903 amounted to 7213 tons of matte containing 4071 tons of copper. It is curious that these ancient silver mines should develop as copper mines in depth.

A NOTE in NATURE for January 26 (p. 305) referred to Adelaide, in South Australia, and Coolgardie, Western Australia, as the places having the highest maximum temperatures recorded in the British Empire. Mr. W. E. Cooke, Government astronomer of Western Australia, writes to say that Marble Bar, in the north-west division of that State, is very much hotter than Coolgardie. The *mean* of the daily maximum temperatures for January, 1905, was 109°·8, and the highest reading 120°·5. He adds that at Jacobabad, in India, the *average* daily maximum temperature is 111°·6 in May, 112°·7 in June, and 107°·8 in July, and at Duem, in the Egyptian Soudan, the mean maximum for March, 1902, was 114°·4, and the absolute maximum 127°·4.

WE have received from Mr. J. van Breda de Haan a copy of a valuable series of meteorological observations made during the year 1901 at the State Botanical Gardens at Buitenzorg, Java. The observations are made with the view of explaining certain problems connected with vegetable physiology, and consequently special attention is given to air and underground temperature, humidity and sunshine, and more particularly to the intensity of rainfall showers. Observations and monthly means are given for several hours of each day, in addition to daily means.

THE *Quarterly Journal* of the Royal Meteorological Society for January last contains an interesting paper on the decrease of fog in London during recent years. The results are given for months and for seasons for each of

the thirty-three years 1871 to 1903, based upon the observations for London (Brixton) published in the daily weather report of the Meteorological Office. The mean annual number of foggy days is 55, of which 45 occurred in the winter half of the year. Dividing the thirty-three years into three equal periods, the result is, for the first period, a mean of 55, for the second 69, for the third only 41. Since the year 1888 a steady and uninterrupted decrease is shown in the mean annual number of fogs. Among the principal agencies which may have conduced to this desirable result must be mentioned the efforts of the Coal Smoke Abatement Society and the London County Council, also the use of incandescent gas light and electricity; but, as pointed out by Captain A. Carpenter and Mr. C. Harding, the increase of wind in recent winters is probably chiefly responsible for the decrease of fog. As we have remarked before, the geographical situation of London is, from a purely meteorological point of view, eminently favourable to the development of fog, and the only permanent improvement we can hope for is an abatement of its more injurious effects caused by the imperfect consumption of coal and gas.

WE have received a copy of part i. of the "Katalog der Bibliothek der Naturforschenden Gesellschaft in Danzig," published at Danzig in 1904. Although the list of books included is not completely representative, this publication, containing the sections mathematics and astronomy, may be found useful to those desiring to refer to the works of certain authors on these two subjects. The range of subjects is a wide one, and the books are entered under the names of the authors.

HAVING occasion recently to devise a short-focus spectrograph, Prof. Wood, of the Johns Hopkins University, found it necessary to make a study of the distribution of light (monochromatic) in the different orders of a typical grating. His method, a beautifully simple one, is described and illustrated in No. 2, vol. xxi., of the *Astrophysical Journal*. The result showed that, in the typical grating experimented with, half the reflected light was concentrated in one spectrum, and as the grating reflected about 76 per cent. of the total incident light, this means that about one-third of this total was found in the one spectrum, which was one of the two first orders. It was also found that the ruling makes little or no difference to the total reflecting power of the speculum. Two flint prisms of 60° would give about the same average dispersion as that produced, and, according to Pickering's table in Kayser's "Handbuch," they would transmit a little more than twice the light reflected, in the first order of the grating used.

THE *Psychological Bulletin*, ii., 2, contains reports of the proceedings of the thirteenth annual meeting of the American Psychological Association and of the fourth annual meeting of the American Philosophical Association, which were both held at Philadelphia on December 28–30. Abstracts of the papers are given. Invitations on behalf of Harvard University to hold the next annual meeting in Cambridge, Mass., to signalise the opening of the Emerson Hall of Philosophy were accepted by both associations, and it is proposed that the Western Philosophical Association and the Southern Society for Philosophy and Psychology shall also meet at the same time and place.

A COLOURED plate of a new species belonging to a new genus of Hydrachnidæ is given in the *Rendiconti* of the Lombardy Institution, xxxviii., 3, in illustration of a note by Mr. R. Monti on the new "find." This water mite was obtained in cold springs on the right bank of the Anza, near Ceppomorelli, and has been named *Polyxo placophora*. The same writer in another number of the same journal discusses the horizontal migrations of lacustrine plankton, and finds in mountain lakes that, in addition to the known vertical movements, there are well-marked diurnal migrations of the small crustacea to different parts of the lake depending on sunshine and shade.

IN the March number of the *American Journal of Science* Mr. Charles S. Hastings utilises some observations of the power of accommodation of the eye for light of different wave-lengths to make a complete determination of the optical constants of the eye for all conditions of accommodation and for all colours. The results are given in two tables, by the use of which all problems connected with the purely optical properties of the schematic eye may be solved.

IN the course of an investigation of radio-active muds which is published by Prof. G. Vicentini in the *Atti* of the Royal Venetian Institute (vol. lxiv., ii., 535), the connection existing between the ionisation produced by the mud and the quantity of material used is experimentally ascertained. When the mud is spread uniformly over a definite area, the intensity of the radiation increases as the thickness of the layer is increased, but a direct proportionality does not exist between them. After a certain point, moreover, the radio-activity is not increased by adding fresh material. Mr. H. S. Allen, in a paper read before the Royal Philosophical Society of Glasgow on January 25, also deals with radio-active water and mud, the material in this case being derived from the springs of Bath and Buxton. An interesting point which is established incidentally is that the fluorescence excited in a sensitive plate by the radium rays plays only a very minor part in the production by these rays of a photographic effect.

AN interesting investigation of the secondary radiation produced when the β and γ rays of radium impinge on metallic plates is published by Prof. J. A. McClelland in the *Transactions* of the Royal Dublin Society (vol. viii., No. 14). It is shown that the secondary rays are not produced merely at the surface of the plate struck by the primary rays, but that they come from all parts of a layer of considerable depth. Apparently the less penetrating β rays are more efficient in producing a secondary radiation than the γ or highly penetrating rays. The nature of the secondary radiation depends largely on the character of the metal employed; the greater the atomic weight of the latter the greater is the amount of the secondary radiation produced by it. Of all the substances experimented with, lead gives rise to the greatest effect, both as regards the quantity of the secondary radiation and its penetrating power. The secondary radiation consists, apparently entirely, of a species of β rays, that is, of negatively charged particles capable of deflection in a magnetic field. Perhaps the most important feature of the paper lies in its directing attention to the necessity of considering secondary radiations in all measurements of the absorptive power of substances with regard to the rays produced by radio-active bodies.

WE have received a copy of a memorandum on the construction and verification of a new copy of the imperial standard yard, by Mr. H. J. Chaney, superintendent of the Standards Department of the Board of Trade. Since the original standard yard of bronze was made some sixty

years ago, it has been found that bars which are constructed of copper alloys do not retain their original length with that degree of accuracy now demanded for scientific purposes. The new copy (I.P.) is made of an alloy containing 89·81 per cent. of platinum and 10·10 per cent. of iridium, such an alloy being little affected by changes of temperature and not at all by oxidation; as the alloy admits of a high specular polish, the fine lines marking the extremities of the yard can be traced directly on the bar without the intervention of gold plugs or pins as in the older type. Instead of using the old solid 1-inch section, for the purpose of lightness the so-called "Tresca" section has been adopted. The memorandum gives full details of the verification of the length and a description of the apparatus used, including the thermometers by which temperature was measured and a new microscopic "comparator" similar to that used at Paris by the Comité international des Poids et Mesures. This instrument has been purchased by the Board of Trade and mounted in a special chamber at Old Palace Yard, Westminster.

VESSELS of fused quartz can now be obtained commercially, and on account of the remarkable properties of this substance, a wide field of research at high temperatures would appear to be opened up by their use. In high temperature gas thermometry, for example, where glass is excluded on account of its comparatively low melting point, and platinum on account of its permeability to hydrogen, fused quartz promised to be an ideal envelope. Unfortunately, Villard has found that fused quartz is also permeable to hydrogen at high temperatures, well below its melting point, and Jacquerod and Perrot have proved that helium resembles hydrogen in this respect. In the current number of the *Comptes rendus* (March 27) M. Berthelot shows that the use of quartz vessels is still further limited, as both oxygen and nitrogen can penetrate into hermetically sealed quartz bulbs at 1300° C. Thus carbon, heated in sealed vacuous quartz tubes for half an hour at 1300° C., gave a mixture of nitrogen and carbon monoxide on cooling the tube and extracting the gases. Experiments were made on other substances, and all the facts pointed to the conclusion that at a high temperature fused silica behaves towards gases like an animal membrane, susceptible of endosmosis and exosmosis, the phenomenon depending partly on the thickness of the wall. It is clear, therefore, that before this substance can be used with confidence in high temperature work, a further study will have to be made of its defects in this direction.

THE *Comptes rendus* for March 27 contain an interesting paper on the cryoscopic behaviour of hydrocyanic acid, by M. Lespieau. According to the views of Nernst and Thomson on the relation between the dielectric capacity and the power of electrolytic dissociation, the fact that the dielectric constant of prussic acid is higher than that of water should give the acid a higher dissociating power. M. Lespieau has accordingly carried out a series of experiments on the lowering of the freezing point of this substance by the addition of alcohol, chloroform, benzene, water, trichloracetic acid, sulphuric acid, potassium iodide and nitrate, and has found that for the first six substances the cryoscopic constant is between 19 and 20, whilst for the two latter it is approximately double. Hence the two acids, which are strongly dissociated in water, are not sensibly dissociated in prussic acid solutions of the same strength, and this is in accord with the experiments of Kahlenberg, who found that these solutions were bad conductors, these facts being in contradiction with Nernst's theory. On the other hand, the solutions of potassium salts in hydrocyanic acid were found by Kahlenberg to be better conductors than aqueous solutions of the same concentration, and this agrees with the cryoscopic results, according to which the two salts are nearly completely dissociated into their ions in prussic acid.

MR. W. WOODS SMYTH will give a lecture on "The Bible in the Light of Modern Science" at Stafford Rooms, Tichborne Street, Edgware Road, to-morrow, April 7, at 5 p.m.

MESSRS. WATTS AND CO. will shortly publish, for the Rationalist Press Association, Prof. Haeckel's "Evolution of Man," being a translation of the recently issued fifth edition of "Anthropogenie."

OUR ASTRONOMICAL COLUMN.

COMET 1905 *a* (GIACOBINI).—A second telegram from the Kiel Centralstelle announces that comet 1905 *a* was observed by Prof. Aitken at Lick on March 27. The position at March 27d. 7h. 57·1m. (Lick M.T.) was R.A. = 5h. 48m. 55s., dec. = +12° 35′ 43″.

Apparently, then, the northern declination is increasing, and not decreasing as previously stated. An error in the key by which the code telegrams are translated substituted declination for N.P.D., so that the daily movement in declination should be read as *plus* 1° 15′.

The following elements have been computed by Dr. E. Strömgren from observations made on March 26, 28, and 30, and are given in *Circular* No. 76 of the Kiel Centralstelle, together with a bi-daily ephemeris extending from March 30 to April 23 :—

Elements.

T = 1905 April 3·2098 (M.T. Berlin).
ω = 357° 9′·49
Ω = 156° 7′·94 } 1905·0
i = 41° 37′·48
log *q* = 0·05232

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

1905		α h. m. s.		δ ° ′		log Δ		Brightness
April 7	...	6 31 16	...	+25 26·9	...	9·8661	...	0·98
9	...	6 40 5	...	+27 39·9				
11	...	6 49 13	...	+29 48·1	...	9·8745	...	0·93
13	...	6 58 39	...	+31 50·9				
15	...	7 8 22	...	+33 47·9	...	9·8855	...	0·87

Brightness on March 26 = 1·0.

PHOTOGRAPHY OF THE CORONA WITHOUT A TOTAL ECLIPSE.—According to a note communicated to the French Academy of Sciences, and in the opinion of M. J. Janssen, M. A. Hansky has succeeded in photographing the corona of the uneclipsed sun. The photographs were taken with a 12-inch telescope in the exceptionally transparent atmosphere which obtains at the observatory situated on the summit of Mont Blanc.

After a number of preliminary experiments on the selective absorption of screens dyed with various aniline colours, M. Hansky obtained a combination which absorbed all radiations more refrangible than 660 $\mu\mu$, and, as the red radiations of the corona are very intense and do not suffer absorption or dispersion in passing through the terrestrial atmosphere, he used this screen in obtaining twelve negatives. The individual screens were prepared by soaking a fixed undeveloped Lumière film in each of the suitable dyes, and, between each exposure, they were re-arranged *inter se* so that no false effect due to any particular disposition of the "grain" might affect the resulting picture. The direct photospheric and chromospheric rays were prevented from reaching the plate by

the interposition of a blackened brass disc slightly larger than the solar disc.

The resulting negatives showed distinct halos around the disc, and, notwithstanding the fact that some time elapsed between the successive exposures, these halos exhibited the same form, thus testifying to their solar origin. Some of the negatives were photographically intensified by repeated copying, and reproductions of them were submitted to the academy. In presenting the communication M. Janssen—to whom M. Hansky acknowledges his obligations for assistance and advice—stated that "the photographs actually show the solar corona with an intensity and a perfection only known on the photographs obtained during total eclipses" (*Comptes rendus*, No. 12).

SEARCH-EPHEMERIS FOR TEMPEL'S FIRST PERIODIC COMET (1867 II).—Although Tempel's first comet has not been seen during its last three perihelion passages, *i.e.* since 1879, M. A. Gautier, of the Geneva Observatory, thinks that the probability of its re-discovery this year is great enough to justify a careful search. For this reason he re-publishes, in No. 4008 of the *Astronomische Nachrichten*, the elements he prepared for the 1898 apparition, reduced to the mean equinox of 1905·0. As the probable time of perihelion is somewhat uncertain, he gives three ephemerides, extending from March 31 to July 13, in which this time is reckoned as May 2·5, April 20·5, and April 8·5 respectively, the mean date being the most probable. The declination varies from $-16°$ to $-31°$, so that the more southerly observatories are more likely to be successful in the research.

RIGHT ASCENSIONS OF 2120 SOUTHERN STARS.—In an appendix to "Observations made at the Hong Kong Observatory during 1903," Prof. W. Doberck, the director, publishes the right ascensions of 2120 southern stars for the epoch 1900, as determined from observations made by Mr. J. I. Plummer and himself during the years 1898 to 1904.

The observations were made with a 3-inch Simms semi-portable transit instrument, which, together with the method of reduction and the comparisons with other catalogues, is briefly discussed in the director's preface.

In the catalogue itself, the number of the star as given in Lacaille, or Stone, or both, the R.A., epoch and magnitude, the variation of the R.A. from Stone's corresponding value, the proper motion, and several other particulars are given for each star.

THE IRIS DIAPHRAGM IN ASTRONOMY.—In a communication to the French Academy of Sciences, M. Salet states that he has recently and usefully adapted the iris diaphragm to a telescope in which the magnification employed is 500. The diaphragm is placed very near to the plane of the micrometer wires in front of the field lens, and its *raison d'être* is to prevent the light from the sky, and from the illumination of the wires, from reaching the eye when feeble objects are being observed, the diaphragm being closed by an external cylinder when the object has been brought to the centre of the field. By reducing the extent of the micrometer wires, the diaphragm also reduces, or eliminates, the effect of astigmatism when observations of double stars are being made (*Comptes rendus*, No. 9).

CONSTANCY OF "SPARK" WAVE-LENGTHS.—A question which is of first importance to those observers engaged in stellar line-of-sight work, viz. that of the constancy of wave-lengths in spark spectra taken under various conditions of discharge, has recently been re-investigated by Mr. G. W. Middlekauff at the Johns Hopkins University. A detailed description of the apparatus and methods employed, together with the results obtained, appear in No. 2, vol. xxi., of the *Astrophysical Journal*.

Mr. Middlekauff used a concave Rowland grating of 20,000 lines to the inch and a focal length of 21·5 feet. The self-induction in the spark circuit could be varied from 0·00007 to 0·0012 of a henry, and the capacity from 0·0085 to 0·0739 of a microfarad, and the results obtained afford strong evidence that in the case of a spark discharge in air, at atmospheric pressure, no "shift" in wave-length is produced by variations of self-induction or capacity within the above limits. A further result obtained was that the analogous wave-lengths in the arc and the spark spectra of the same elements are not measurably different.

STATISTICS OF VARIATION.[1]

A PAPER consisting mainly of a large number of elaborate records bearing on the important subject of variation has recently been issued by the Washington Academy of Sciences. The data, which have been collected with much care and industry, cannot fail to be of high interest to all students of evolution. They afford an excellent example of the peculiar value of insect studies in reference to many difficult problems in biology—a point which has lately received fresh emphasis from Prof. Poulton's valedictory address as President of the Entomological Society of London.

The authors start with an "Introduction," in which they declare their "belief in the marked betterment and effectiveness of practically all variation study when pursued from the point of view of the biometrician"; adding, however, that "from the writers' point of view the study of variation is a phase of biology, and not of mathematics." Dealing with the special advantages presented by insect data in this inquiry, they assert that the phenomena of complete metamorphosis afford a ready means of distinguishing "variations which are strictly blastogenic from others which may be in large part acquired." This, it may be remarked, is only true under certain limitations. It is not the case, for instance, as the authors appear to think, that the imaginal colour-patterns of lepidoptera are uninfluenced by the conditions obtaining during individual development.

Coming now to the main substance of the paper, we find a series of short articles or sections giving statistics of variation in some two dozen species of insects. Among the structures thus dealt with are the venation and costal wing hooks in bees and ants, the venation in gnats, the colour-patterns of sundry beetles, wasps and bugs, the eye-spots of certain butterflies, the tibial spines, tarsal and antennal segments, tactile hairs and elytral striæ of other insects of various orders. In the case of the hive bee it is incidentally shown that the parthenogenetically produced drones are as subject to variation in their wings as are the workers of biparental ancestry. The results are in many cases graphically summarised in the form of the frequency polygon; and the "mode," "standard deviation," "index of variability," and "coefficient of variation" are duly reckoned and recorded in accordance with approved biometrical methods. It is interesting but not surprising to observe that the frequency curve is usually in fair correspondence with the law of error.

The paper ends with a section devoted to "general results." Here we think that too much is made of the difficulty of distinguishing between congenital variation and acquired modification. For practical purposes the distinction is usually obvious enough. A little later the authors observe, "The most satisfactory answer to the question of the hereditary transmission of acquired characters will come as the result of a quantitative (statistical) study of variations known to be blastogenic compared with a similar study of variations known to be acquired, both studies to be made on complete series of individuals bred under quantitatively determined life conditions." This seems to us somewhat like using a steam-hammer to crack an egg. It is not astonishing to find that there is little or no evidence of differing selection-value in the variable number of spots on the elytra of a ladybird; but it hardly seems clear that the authors are justified in claiming this fact, together with an apparent change of "mode" between the years 1895 and 1901, as evidence in favour of "determinate variation." Before any such inference can properly be drawn, the question of possible correlation ought at least to be considered. The authors, however, arrive on the whole subject at the satisfactory conclusion that natural selection "is after all a logical necessity and undoubtedly an actual actively-regulative factor" in the formation of species. F. A. D.

[1] "Studies of Variation in Insects." By Vernon L. Kellogg and Ruby G. Bell, of Leland Stanford Junior University. From the *Proceedings* of the Washington Academy of Sciences, vol. vi. (Washington, D.C., 1904)

INTERRUPTERS FOR INDUCTION COILS.

IT has been thought that an account of the more important forms of interrupter would not be unwelcome to readers of NATURE.

A rotating air-break interrupter is shown in Fig. 1. An accurately balanced brass fly-wheel, F W, driven by a small motor, is fitted with two insulating segments, I S, let into its periphery. Bearing on the fly-wheel are two copper gauze brushes, B_1 and B_2; the circuit is interrupted as each brush slips over from the brass to the insulating

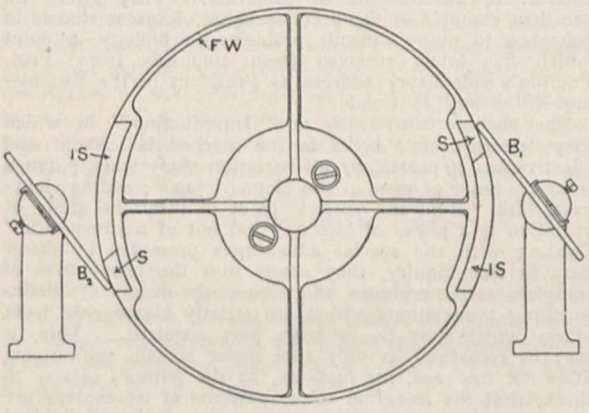

FIG. 1.

portion of the rim. It is evident that the arcing which occurs at the break necessitates the use of a fire-proof insulator. A small piece of slate (S in Fig. 1) is fitted immediately behind each brass segment, and this takes the spark; it is easily renewed, the remainder of each insulating segment consisting of vulcanised fibre.

So far as the writer is aware, this type of interrupter was first described by Wadsworth in 1894, and was used by Prof. Michelson in some Geissler-tube experiments (*American Journal of Science*, pp. 496–501, December, 1894).

As might be expected, the suddenness of the break depends

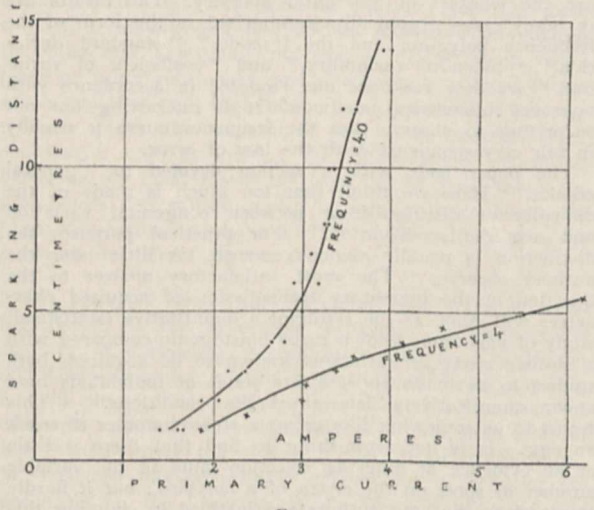

FIG. 2.

on the speed of the motor (or frequency of interruption). In Fig. 2 are plotted the results of some experiments bearing on this point. It will be seen that for a given value (root-mean-square) of the primary current, an enormously greater spark-length—especially with the larger currents—is obtained at the higher speed.

This form of interrupter is not very expensive, and works very satisfactorily so long as the primary current does not exceed about 5 amperes. It shares with the platinum interrupter the advantage of cleanliness. Renewals and repairs cost very little, as the only parts which are subjected to any considerable wear are the slate distance-pieces; the rim of the fly-wheel may occasionally require truing-up. It is important to keep the edges of the brass contact-segments and the surfaces of the slate distance-pieces clean by the occasional application of fine sand-paper.

In Fig. 3 are shown the essential parts of the mechanism of a "double-dipper" interrupter. The double motor-driven crank, C, carries two connecting-rods, C R, each of which is attached to a cross-head, C H. Each cross-head is fixed to the top of a stiff rod, R, which passes between the guide-springs, G S, and through the guide-block, G B. The latter is supported by a strong bracket, B, screwed to the stand supporting the motor. Each reciprocating rod ends in an amalgamated copper wire, C W, which dips into the mercury. It will be readily seen that by the adoption of the two-crank arrangement the frequency is doubled for a given speed as compared with the single-crank interrupter; for while with the latter there is only a single break per revolution, the former gives two breaks per revolution, one of the contact-rods or "dippers" entering the mercury shortly after the other has left it. The mercury cup itself is made adjustable in a vertical direction, and is, as usual, immersed in alcohol.

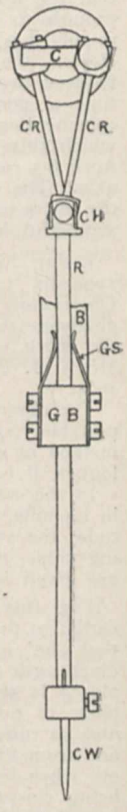

FIG. 3.

The curve marked "double dipper" in Fig. 4 gives the results of a test with this form of interrupter. The frequency of interruption was 22. The results correspond fairly well with those plotted in Fig. 2 for the rotary air-break interrupter at a frequency of 40.

This type of interrupter is comparatively cheap and simple, and works very steadily. There is no complicated mechanism to get out of order, and only a small quantity of mercury is required (about 2lb.).

One of the most successful types of rotary interrupter is the mercury jet interrupter. Several varieties of this have been used. One of the best known is shown in Fig. 5. The vertical motor-driven shaft, S, carries a cylinder, C, the lower portion of which is cut up into a number of teeth, T. The shaft S is continued downwards, and passes through the mercury pump casing. The mercury pump is of very simple construction, and is shown in Fig. 5 (*b*). Inside a flat oval box, which forms the pump casing, are arranged two thick toothed wheels. One of these is mounted on the lower end of the shaft S, which carries the toothed cylinder, Fig. 5 (*a*), and drives the other. The wheels fit the inside of the casing very closely, and are arranged to rotate as indicated by the arrows in Fig. 5 (*b*). The mercury imprisoned between the teeth of the wheels and the casing is consequently carried round and forced through the nozzle. The issuing fine jet of mercury, M J—Fig. 5 (*a*)—is directed against the rotating teeth, the break taking place at the vertical edge of a tooth. The height of the nozzle N is adjustable, and by this means the magnitude of the current may be regulated, as by raising the nozzle the jet will be directed against a tooth for a longer period, and the current will attain a larger value before the break takes place. The entire mechanism of this interrupter is contained in a strong cylindrical glass vessel, the lower portion of which contains mercury, in which the pump is immersed, and with which the pump chamber freely communicates by means of a suction orifice, while above the mercury is the usual alcohol filling the bulk of the vessel.

If in good working order, the mercury jet interrupter gives excellent results, as may be seen by referring to the curve marked "mercury jet" in Fig. 4, which corresponds to a frequency of interruption = 40. A comparison of this curve with that given in Fig. 2 for the rotating air-break interrupter at once shows the superiority of the jet interrupter. The mercury jet interrupter is much more expensive and complicated than the "double-dipper" type, and requires a larger amount of mercury; but it yields somewhat better results.

In Fig. 6 is shown the Wehnelt interrupter. A large rectangular glass vessel containing dilute sulphuric acid is fitted with an ebonite cover, E C, which supports the electrodes. The terminal T_2 is in connection with the lead plate, L P, which forms the kathode. The bridge-piece, B,

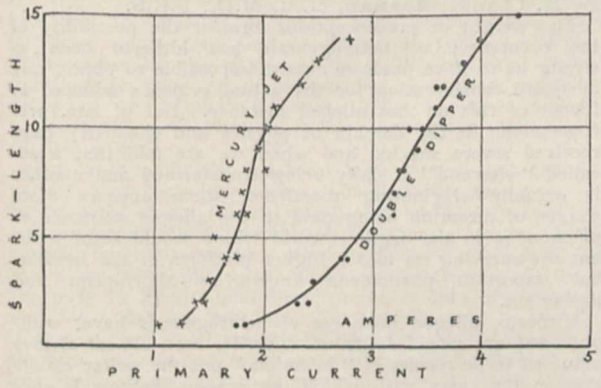

FIG. 4.

supports two rack rods, R, and the anode terminal T_1. Each rack rod is geared with a pinion by means of which it may be raised or lowered as required, M H being the milled heads for turning the pinions. The rack rods are continued downwards in the form of thinner rods encircled by glass

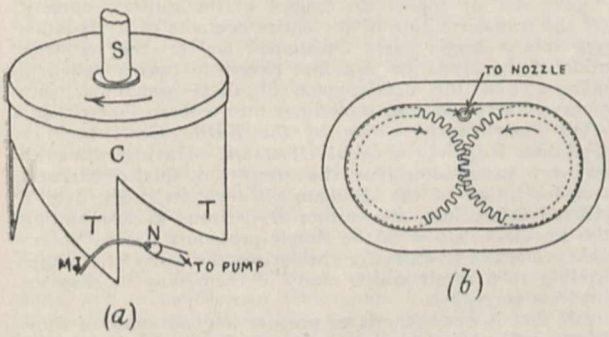

FIG. 5.

tubes, G T, and finally end in stiff platinum points, P P, around which the tapered ends of the tubes fit very closely. By raising or lowering either anode, a smaller or greater surface of it may be exposed to the surrounding electrolyte. The density of the acid depends on the voltage at which the

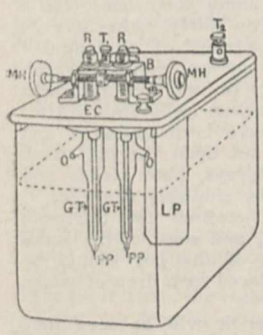

FIG. 6.

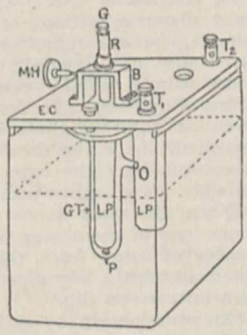

FIG. 7

interrupter is to be supplied. The interrupter is connected in series with the primary of the induction coil, and, if necessary, with an additional self-inductance. As soon as the circuit is closed, and provided the area of anode surface exposed to the electrolyte is not excessive, and the self-inductance not too small, the interrupter begins to act. A pink glow appears around the extremities of the anodes, the interrupter emits a loud note of definite pitch, and a shower of sparks is produced across the space between the secondary terminals of the coil. Bubbles of gas rush up each glass tube, G T, the electrolyte rises in each tube, and may overflow through the side openings, O.

Another form of electrolytic interrupter, originally due to Caldwell, but subsequently improved and modified in various ways by others, is shown in Fig. 7. The terminal T_2 is, as in the Wehnelt interrupter, connected to a lead plate. But instead of a platinum anode, a lead plate is also used for the other electrode. This second lead plate is surrounded by a glass tube, G T, which completely separates it from the remainder of the electrolyte except for a small perforation at the bottom of the tube, through which passes the pointed end, P, of a long glass rod, G, supported in a tubular rack rod, R, which may be raised or lowered by means of a pinion fitted with the milled head, M H. The area of communication between the electrolyte in the tube and that outside is controlled by raising or lowering the conical glass plug. Either electrode may be used indifferently as anode or kathode. The break takes place at the perforation of the glass tube.

In conclusion, thanks must be expressed to Mr. A. C. Cossor, of 54 Farringdon Road, E.C., who very kindly provided an induction coil and a number of interrupters required to carry out the tests recorded in this article.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is stated that Sir William MacDonald, of Montreal, has decided to give 800,000*l.* toward the erection of a normal school at St. Anne de Bellevue, a few miles distant from Montreal, and the erection and endowment of an agricultural college at the same place.

THERE is no sign of diminution in the interest shown by public authorities and by private benefactors for higher education in the United States. We learn from *Science* that by the will of Mrs. Stanford about 400,000*l.* is bequeathed to Leland Stanford Junior University. The university also comes into possession of the house built by Senator Stanford at San Francisco and its contents, which are valued at more than 400,000*l.* The legislature of North Carolina has appropriated 10,000*l.* for the erection of a chemical laboratory at the University of North Carolina.

WE have received a copy of the prospectus of courses of instruction in poultry-keeping held at University College, Reading, and the college poultry farm at Theale. The farm, which is of about 40 acres, largely meadow land, is used also as an experimental station. The courses are of varying lengths and different degrees of difficulty to meet the requirements of all grades of students. The practical work is exhaustive, and due attention is given to kindred technical subjects such as carpentry. It appears that this branch of the work of the college has had an important influence on the development of scientific poultry-keeping in Berkshire and neighbouring counties.

A STRONG committee has been formed for the purpose of securing suitable conditions of work, and providing opportunities for development, of Bedford College for Women in London. An appeal to the public on behalf of the college has just been issued. The college, which is a school of the University of London, must before long come to an end unless it can obtain a large amount of public support. A freehold site and a new building are essential, and it is estimated that their cost may amount to 150,000*l.* Experience has shown that the fees of the students and the allotted share of the Treasury grant to university colleges are not sufficient without considerable additional support to carry on the higher education supplied by the college, the cost of which is constantly increasing. To make the work of the college fully effective, it is therefore desirable to obtain further endowment to the extent of 100,000*l.*, or the equivalent income. The Senate of the University of London has shown approbation of the scheme for re-

housing and endowing the college by passing the following resolution:—"That the authorities of Bedford College in issuing an appeal for funds in accordance with the scheme submitted to the Senate be permitted to state that the appeal is made with the knowledge and full approval of the Senate." The Princess of Wales has promised a donation to the funds, and Lady Tate has promised 10,000*l.* for a library to be called after the late Sir Henry Tate. Donations to the fund may be sent to Major Darwin, hon. treasurer of the college, or to Miss Henrietta Busk, hon secretary of the appeal fund, at Bedford College, Baker Street, W. Friends of higher education for women are urged to help in placing the college on an adequate and permanent basis.

MR. ARNOLD-FORSTER, M.P., Secretary of State for War, distributed the prizes to successful students of the Woolwich Polytechnic on Saturday last. In his speech which followed the presentation of the prizes Mr. Arnold-Forster emphasised the importance of sound scientific and technical education. He said that the great lesson this country has to learn is the importance of scientific organisation. There was a time, not so long ago, when we were in the habit of laughing at the methods and ways in vogue on the Continent, and of considering ourselves immeasurably superior to Germany and other nations. But a change has taken place, and these other nations—not by following our example, but by organising on scientific lines—have become immeasurably more advanced and fit to succeed than those who preceded them one or two generations ago; and we have to exert ourselves to protect ourselves from defeat in the industrial contest. Referring to the importance of scientific organisation, Mr. Arnold-Forster spoke of an instance in which he discovered that the electric carbons in use by the Admiralty were largely manufactured in France. Realising the importance of this in case of war, he made inquiries, and, as the result of these and of experiment, it has been found possible to produce electric carbons in this country of the same perfection and accuracy as those formerly brought in from abroad. He expressed his pleasure that a great step forward has been made in the matter of standardising and testing, and that in both these departments this country is abreast of the times. A good deal could be done by scientific organisation, and he looked to such institutions as the polytechnics to accomplish much in that direction.

THE address delivered by Prof. Henry T. Bovey, F.R.S., at the Universal Exposition, St. Louis, 1904, on the fundamental conceptions which enter into technology, has been reprinted as a pamphlet from the *McGill University Magazine*. After defining the "technologue" as an intermediary between the savant and the mechanic, translating the discoveries of the former into the uses of the latter, Prof. Bovey tries to ascertain the controlling ideas common to all technical experts. These, he says, have all observed that nature works in no arbitrary manner, but by fixed laws; that if these laws could be brought into right relation with us, we might be able to gear our small machines to the vast wheel of nature; that in the study of the laws of nature there is certainly revealed more of the infinite possibilities of our environment. In order to study to advantage, workers in pure and applied science must get into line with psychological laws, when it will be found that the apprehension of a fact by the mind requires the exercise of the power of observation, and the observations must be of a special character, minute, accurate, and selective. Observation, he says, means to see with attention, and as soon as concentration takes place, a process of analysis begins and the worker passes to classification and generalisation. Throughout this process the training of the hand stimulates the brain centres. Technology has a two-fold nature; first, learning by specialised study how to understand and apply the principles of mechanics to the construction of works of utility, and, secondly, training the mind to work easily along lines of scientific thought. The idea of utility, he maintains, seems to be the key to the distinction between pure science and technology; indeed, technology may be called the child of science on one hand, and of industrial progress on the other.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 16.—"On the Occurrence of Certain Ciliated Infusoria within the Eggs of a Rotifer, considered from the Point of View of Heterogenesis." By H. Charlton **Bastian**, M.A., M.D., F.R.S.

The weight of preconceptions against the possibility of the occurrence of heterogenesis has hitherto been so strong as to have made it almost impossible to obtain any adequate consideration for the actual evidence adduced in favour of this or that alleged instance. But of late, preconceptions in the domain of physics and chemistry have received severe shocks, and when we are told that a so-called "element" is daily being transformed and another is actually originating therefrom, there appears more chance of attention being paid to the alleged existence of phenomena in the organic world which would seem to be but the carrying on into a higher platform of the familiar but important phenomena known as allotropism and isomerism.

Hitherto, alleged instances of heterogenesis have, without adequate consideration of evidence, been almost always assumed to be results of "infection," but the writer claims that in the cases with which the present memoir is concerned, any such explanation is quite impossible in regard to one of the cases, at least, in which we have masses of living matter so large that they average $\frac{1}{8}$ mm. in diameter, being converted in the course of three days into great ciliated Infusoria of equal bulk.

The communication (which is illustrated by a large number of photomicrographs) deals with two sets of heterogenetic transformations occurring in the great eggs or "gemmæ" of one of the largest of the rotifers, namely, (1) the transformation of the entire contents of a Hydatina egg into a single great Otostoma; and (2) the segmentation of the Hydatina egg into twelve to twenty spherical masses, and the development of these sometimes into embryo Vorticellæ and sometimes into embryo Oxytrichæ.

(1) *The Transformation of the Entire Contents of a Hydatina Egg into a Great Otostoma.*—Having witnessed on very many occasions the stages of this remarkable transformation of the contents of a rotifer's egg into a ciliated infusorium, the author is desirous of acquainting the Royal Society with the simple procedure needful to enable zoologists to study for themselves the series of changes leading to a result which many of them may be disposed to deem incredible.

All that is necessary is to procure a good stock of these large rotifers by placing some surface mud, having a coating of Euglenæ, from a ditch in which Hydatinæ are known to exist, into a glass bowl, and to pour thereon water to a depth of about 4 inches. In the course of two or three days (with a temperature of 16° C. or 17° C.), if the Hydatinæ are abundant, a good crop of their large eggs will be seen at the surface of the fluid, where it is in contact with the glass.

By the aid of a scalpel passed along their track for a short distance, groups of twenty or thirty eggs may be taken up at one time, and gently pressed off the edge of the blade into a small, white stone pot full of water. Some of such small masses of eggs (mixed, perhaps, with a few Euglenæ) will float, and others will sink. After seven or eight of these masses have been gathered and deposited, the cover should be placed upon the pot so as to cut off from the eggs all light rays, both visible and invisible. Two other pots should be similarly charged.

When the pots have remained covered for thirty-six hours, one of them may be opened, and some of the small masses of eggs from the bottom of the pot should be taken up with a tiny pipette and placed in a drop of water on a microscope slip.

On examination by a low power it will be seen that there are many empty egg-cases, that within some eggs there are embryo Hydatinæ in different stages of development, while within the remaining eggs the contents will be wholly different, consisting of an aggregate of minute pellucid vesicles, each containing a few granules, together with a variable amount of granules interspersed among the vesicles.

When a second pot is opened two and a half or three days after the eggs have been placed therein, and portions of its contents are examined in the same way, a larger proportion of empty egg-cases will be seen. There may be very few or even no developing rotifers still within the eggs, and in other egg-cases, instead of the motionless vesicular contents previously seen, great ciliates may be found slowly revolving, or, under the influence of the light, rupturing the egg-case, struggling out, and swimming away with rapid movements, partly of rotation. Some of the Infusoria before they emerge undergo segmentation into two, four, or rarely, even into eight smaller ciliates.

The large undivided Infusoria have their bodies densely packed with large corpuscles (modified representatives of the vesicles of an earlier stage), and a large elongated nucleus which can be readily seen in some of them. They possess the characteristic ear-shaped mouth indicated by the name Otostoma, and cilia are distributed all over the body in longitudinal lines, so as to give the appearance of a delicate longitudinal striation.

As a control experiment it will be well at the time that the pots are charged to place two or three batches of the eggs with some of the same water into a watch glass, which is left exposed to light; and at the expiration of three or four days, as well as at later periods, to search among its contents for any of the same large ciliates, and also for any eggs in the intermediate vesicular stage above referred to. The author has invariably found that such a search yielded only negative results.

In taking batches of eggs, in the manner indicated, to be placed in the pots, individual eggs will necessarily be of different ages. It is only eggs that have not begun to develop which, under the cutting off not only of ordinary light, but probably of some invisible light rays, become speedily transformed into great ciliated Infusoria. Cutting off ordinary light rays alone from the eggs, by placing them in a small covered glass dish shut up in a cupboard or box and maintained at the same temperature as before, seemed at first not to lead to similar results, but it was subsequently ascertained that the transformation will occur under such conditions, though only after the lapse of about nine days. It looks, therefore, as if the stoppage of some invisible rays, capable of passing through wood but not through stone, notably hastens the process.

During the time that these observations were being made, and previously, no Otostomata had ever been seen in association with Hydatinæ, except those that had been taken from the experimental vessels. On two occasions since, though from wholly different localities, Otostomata had been found in association with Hydatinæ. The adult forms have been found to be much larger, having from two to three times the length of the great embryos which issue from the egg-cases, and also to be more highly organised.

Many of these adult specimens the author has been able to keep for two months, and he has seen them pass into an encysted condition, when they constitute masses the bulk of which is several times greater than that of Hydatina eggs. They are, likewise, enclosed in thick cyst walls, wholly unlike the thin egg-cases of the Hydatina.

A Hydatina egg could not possibly be confounded with an adult encysted Otostoma, and the embryo Otostoma which emerges from the egg-case embodies the whole of the transformed substance of the egg. *No minute Otostoma is ever to be seen within an egg, devouring its contents.* No ciliate is seen until the total contents of the egg having been transformed, the whole mass begins to revolve within the egg-case as a great embryo Otostoma.

(2) *The Origin of Twelve to Twenty Vorticellae or Oxytrichae from the Substance of a Single Hydatina Egg.*—These are most remarkable variations, which at different times have been occasionally met with in Hydatina eggs taken from the experimental vessels.

If the egg-substance is found to have segmented into twelve to twenty more or less equal spherical masses, there is at first no means of knowing whether such masses are to be developed into embryo Vorticellæ or into embryo Oxytrichæ. But if either of the masses is seen to be revolving within its own delicate cyst, we may be sure that this particular egg will not yield Vorticellæ, as these embryos do not revolve before rupturing their cysts, and the Hydatina egg produces either the one or the other form—never a mixture of the two.

It cannot be supposed that twelve to twenty of either of these ciliates in an embryo condition could penetrate the egg-case, could devour its contents without being seen, and would then, as embryos, encyst themselves (all in two days, or less)—only, almost immediately after, again to pass out of their encysted condition, and to appear as the active young Vorticellæ or Oxytrichæ the development of which the author has traced.

In its normal development the Hydatina egg never goes through changes in which it is converted into an aggregate of minute vesicles, or into a smaller number of separate and larger spheres, such as occurs as a prelude to the transformation of the egg-contents into ciliated Infusoria of this or that kind.

Geological Society, March 8.—Dr. J. E. Marr, F.R.S., president, in the chair.—*Exhibits.*—A series of photographic views illustrating the geological structure and physical features of the mountains of Skye: A. **Harker.** The "Cullinan" diamond: Dr. F. H. **Hatch.** By means of lantern slides from photographs the diamond was shown from four points of view. The stone was a portion (probably less than half) of a distorted octahedral crystal. As it now existed, the stone was bounded by portions of four original octahedral surfaces and by four cleavage-planes. The former showed in places a slight curvature, a mammillary structure, striations, and triangular pittings, while the cleavage-surfaces were distinguished by greater regularity and smoothness. The stone weighed 3024¾ carats. Its greatest linear dimension was 4 inches. It was of remarkable purity for so large a stone, approaching "blue-white" in colour. It was found at the beginning of the present year, in the "yellow ground" of the Premier Mine, at a depth of 18 feet below the surface. The Premier Mine was a true "pipe," situated on the farm of Elandsfontein, twenty miles north-east of Pretoria (Transvaal).—*Papers.*—Observations on some of the Loxonematidæ, with descriptions of two new species: Miss J. **Donald.** Shells having more convex whorls, or less sigmoidal lines of growth than *L. sinuosum*, cannot be left within the genus Loxonema. The two new species described resemble the type in form and in the sinuosity of the lines of growth; but the whorls are ornamented with spiral striæ, two of which frequently stand out and give the shell a banded appearance.—On some Gasteropoda from the Silurian rocks of Llangadock (Caermarthenshire): Miss J. **Donald.** These fossils occur almost entirely in the state of casts and moulds. Eleven distinct forms have been made out, referable to seven genera; but only seven are sufficiently well preserved for specific determination. Five of these are new, including one described in the previous communication; a new genus is described, for the reception of *Euomphalus funatus.*

Chemical Society, March 15.—Prof. W. A. Tilden, F.R.S., president, in the chair.—It was announced that Prof. Percy Frankland had presented to the society the eudiometer made and used by the late Sir Edward Frankland for the analysis of ethyl in 1849; that Prof. Retzius, of Stockholm, had presented an engraving of Berzelius; and that Mr. Oscar Guttmann had presented a bronze medal struck in honour of Roger Bacon in Paris in 1818. The council, on behalf of the society, had expressed its thanks for these gifts.—The following papers were read:—The velocity of oxime formation in certain ketones: A. W. **Stewart.** The results of measurements of these velocities are generally in agreement with those already found for the addition of sodium hydrogen sulphite to ketonic compounds, and since the two reactions belong to different types, it seems probable that the hindrance to the reactions in the case of ketones containing many methyl groups near the carbonyl is due to stereochemical and not to purely chemical causes.—The ultra-violet absorption spectra of certain enol-keto-tautomerides, part ii.: E. C. C. **Baly** and C. H. **Desch.** The results indicate that the absorption band in these compounds is due to change of linking taking place when one tautomeric form passes into the other. It is possible to account for the formation of the absorption bands by adopting the physical

conception of the atoms as a system of electrons, and in this way the formation of the bands is placed in the same category as other spectral phenomena.—Esterification constants of substituted acrylic acids: J. J. **Sudborough** and D. J. **Roberts.** The esterification constants of some twenty-two substituted acrylic and allied acids with methyl alcohol have been determined. The results indicate that a substituted acrylic acid is esterified less readily than the corresponding saturated acid, and more readily than the corresponding acetylenic acid, and that the effect of introducing substituents into acrylic acid is to lower the rate of esterification.—α-Chlorocinnamic acids: J. J. **Sudborough** and T. C. **James.**—Di*ortho*-substituted benzoic acid, part vi., conversion of methyl into ethyl esters: J. J. **Sudborough** and T. H. **Davies.**—Simple method for the estimation of acetyl groups: J. J. **Sudborough** and W. **Thomas.** The acetyl derivative is hydrolysed with benzenesulphonic acid and the mixture subjected to steam distillation.—Gynocardin, a new cyanogenetic glucoside: F. B. **Power** and F. H. **Lees.** This substance, obtained from the seeds of *Gynocardia odorata*, has the formula $C_{13}H_{19}O_9N$, and is readily hydrolysed by *gynocardase*, the enzyme present in the seeds, and with difficulty by boiling 5 per cent. hydrochloric or sulphuric acid yielding *d*-glucose, hydrogen cyanide, and an undetermined aldehyde or ketone. With alkalis it yields *gynocardinic acid*, $C_{12}H_{19}O_9.CO_2H$.—Catechin and acacatechin. Supplementary note: A. G. **Perkin.**—The action of ethyl dibromopropanetetracarboxylate on the disodium derivative of ethyl propanetetracarboxylate. A correction: W. H. **Perkin,** jun.—Glutaconic acid and the conversion of glutaric acid into trimethylenedicarboxylic acid: W. H. **Perkin,** jun., and G. **Tattersall.**—The transformations of highly substituted nitroaminobenzenes: K. J. P. **Orton** and A. E. **Smith.**—An asymmetric synthesis of quadrivalent sulphur: S. **Smiles.** It is shown that the two isomeric *d*- and *l*-methylethylthetine *l*-menthyl ester bromides are produced in equal amount from the interaction of methylethyl sulphide and *l*-menthyl bromoacetate.—The action of α-halogen ketones on alkyl sulphides: S. **Smiles.** It has been found that certain α-halogen-substituted ketones interact with alkyl sulphides, forming the halides of sulphine bases. Descriptions of the products formed in several cases are given.—Pinene *iso*nitrosocyanide and its derivatives: W. A. **Tilden** and H. **Burrows.** Pinene *iso*nitrosocyanide is shown to be a nitrile, and from it has been obtained the corresponding pinene *iso*nitrosocarboxylamide,

$$C_{10}H_{15}(:NOH).CO.NH_2,$$

which on hydrolysis with hydrochloric acid yields an oily substance which is probably the ketonic acid

$$O : C_{10}H_{15}.CO_2H.$$

—Some interactions of metallic cyanides with organic bases: R. de J. **Fleming-Struthers.** Descriptions of a number of compounds produced by the interaction of phenylhydrazine with various metallic cyanides are given.

Royal Microscopical Society, March 15.—Mr. A. D. Michael in the chair.—A review of the work done by metallographers: J. E. **Stead,** F.R.S. Illustrations were shown of the changes produced in metals by strains, a diagram of the apparatus by which rapid reversals of strains were effected being exhibited in illustration of this portion of the subject. The effect of the continued heating of an alloy of copper and tin in boiling mercury, and also that produced by immersion in liquid air, were demonstrated. Slides were also shown to illustrate "surface flow" in antimony, and the microscopic structure of the new silver standard.

Linnean Society, March 16.—Prof. W. A. Herdman, F.R.S., president, in the chair.—*Exhibits.*—Animated photographs of plants taken by the kammatograph, showing the natural movements of the plants accelerated so as to be followed readily by the eye: Mrs. D. H. **Scott.**—A series of thirty lantern-slides, from photographs, of bird-life in the Falkland Islands: R. **Vallentin.**—*Paper.*—Contributions to the flora of Liberia: Dr. Otto **Stapf.** Descriptions of 3 new genera and 56 new species, in a collection of about 260 species, collected by Mr. Alexander Whyte in the neighbourhood of Monrovia, in three different localities. The flora shows a specific likeness to that of Sierra Leone, and the new genera are not endemic.

Physical Society, March 24.—Prof. J. H. Poynting, F.R.S., president, in the chair.—Note on the voltage ratios of an inverted rotary converter: W. C. **Clinton.** The values of the voltage ratios usually given for an inverted rotary converter make no allowance for the resistance of the armature. In this note terms due to the effect of armature resistance are introduced into the ordinary theoretical equations. The resultant voltage on the alternate current side is found to be less than that given by the usual rule. The calculation is only made for open circuit conditions on the alternate current side.—On the flux of light from the electric arc with varying power supply: G. B. **Dyke.** The paper records the results of experiments made on the electric arc with the following objects:—(1) To obtain a series of curves for alternating and continuous arcs of different lengths showing the relation between the mean spherical candle-power and the power supplied to the arc; (2) to compare the efficiencies of the alternating and continuous arcs under different conditions of arc-length and power-supply.—On the application of the cymometer to the measurement of coefficiencies of coupling of oscillation transformers: Dr. J. A. **Fleming.** This paper deals first with the latest pattern of instrument called by the author a cymometer, designed for the measurement of the frequency of electric oscillations, and also the length of long electric waves.

CAMBRIDGE.

Philosophical Society, March 13.—Prof. Marshall Ward, president, in the chair.—On the relation in size between the megalosphere and the microspheric and megalospheric tests in the Nummulites: J. J. **Lister.** At the meeting of the society on October 31, 1904, the author directed attention to the fact that in the three English species of Nummulites, viz. *N. laevigatus, variolarius* and "*elegans*," both megalospheric and microspheric forms were represented and associated in the Bracklesham and Barton beds of the Hampshire basin. A comparison of the sizes of the megalospheres in these species suggested that a definite relation might exist between them and the sizes of the whole microspheric tests. To examine this question several species have been studied. Arranging these species in order of the sizes of the megalospheres, this is found to coincide with the order of the volumes of the microspheric tests (with the exception of the variety *obesus* of *N. perforatus*, the microspheric test of which falls one place out in the series).—The penguins of the Antarctic: E. A. **Wilson.**—The old moraines of South Victoria Land: H. T. **Ferrar.** The paper first dealt with the topography of South Victoria Land, a land consisting of a range of mountains some 800 miles long in a north and south direction, with a steep eastward face on an average 10,000 feet high, facing the sea and buttressing a vast interior ice-field. Details were given of the stranded moraines on Cape Adare, on the Possession Islands and on Franklin Island, as well as those high on the slopes of Mount Erebus and Terror. The latter could only have been landed there by the Ross ice-sheet being thicker than it is at present. Reversed glaciers, glaciers not reaching the sea, and beheaded glaciers were mentioned, all pointing to the same conclusion, a retreat of the ice. This retreat is now going on, so that increase of cold could not produce a greater glaciation. If this former greater extension was due to a warmer climate, why have the New Zealand glaciers decreased of late, and what is the connection of the "Ice-age" of Europe with the "Great Glacier Epoch" of New Zealand and Patagonia?—Notes on a collection of parasites from the museum of University College, Dundee: A. E. **Shipley.** The collection consisted of fifteen species of Nematoda and ten Cestoda, and came mainly from marine animals of the northern seas, as might have been expected from the importance of Dundee as a whaling centre.—On the maturation of the egg and early development in certain sawflies (Tenthredinidæ): L. **Doncaster.** In the eggs of sawflies which produce males when unfertilised (*Nematus ribesii, N. lacteus, N. pavidus*), the second polar nucleus conjugates with the inner daughter nucleus of the first polar body. The conjugating nuclei then break up into a group of chromosomes which contain twice the number that is found in the maturation mitoses. These chromosomes persist for some hours, but finally dis-

appear. In the species which produce females from unfertilised eggs (*Poecilosoma luteolum, Hemichroa rufa, Croesus varus*) no conjugation between polar nuclei takes place. In all cases the egg-nucleus sinks into the yolk and gives rise to the cells of the embryo, and the chromosome number remains the same as that observed in the maturation divisions. Centrosomes were never seen in the maturation mitoses, but are present in the division-spindles of the yolk-nuclei and blastoderm of both fertilised and virgin eggs.—Densities of the earth's crust beneath continents and oceans compared: Rev. O. **Fisher.**

PARIS.

Academy of Sciences, March 27.—M. Troost in the chair.—On vessels of fused silica, their employment in chemistry, and their permeability: M. **Berthelot** (see p. 544).—The construction in an opaque homogeneous medium of luminous rays which penetrate by a plane face: J. **Boussinesq.**—On surra and the differentiation of trypanosomes: A. **Laveran** and F. **Mesnil.** An experimental comparison of the trypanosomes of surra arising in the island of Mauritius and in India shows that they are morphologicaly the same, but the pathogenic action upon animals in the laboratory showed some differences between the two trypanosomes. It seems clear that the trypanosomes of surra of Mauritius and of India are the same species. There are three species which differ in their virulence, the order of activity being India, Mauritius, and Mbori.—On the plants from the Coal-measures found in the borings at Éply, Lesménils, and Pont-à-Mousson: R. **Zeiller.** The impressions of plants found at Éply correspond to a well marked Westphalian flora. Of the specimens from the Lesménils boring two, *Lonchopteris Defrancei* and *Cingularia typica,* have hitherto been observed in the Sarre coal basin, and hence would appear to point to the beds now being explored being a prolongation of this field. The specimens from Pont-à-Mousson also point to the Sarrebrück stage of the Westphalian Coal-measures.—On the monochloro-derivatives of methylcyclohexane: Paul **Sabatier** and Alp. **Mailhe.** Chlorine acts readily upon methylcyclohexanone at the ordinary temperature, giving rise to numerous chlorinated derivatives. Of these a special study has been made of the monochlor-derivatives, the main product being shown to consist of two of the five possible isomers.—Prof. van 't Hoff was elected a correspondant for the section of mechanics in the place of the late Prof. Willard Gibbs.—The search for Tempel's periodic comet (1867, 2) in 1905: R. **Gautier.** This comet, first seen in 1867, and again in 1873 and 1879, did not make its reappearance as predicted in 1885, 1892, and 1898. The date of its possible appearance in 1905 is discussed, and its elements calculated. The author expresses the hope that a special search will be made over the regions indicated by observatories possessing instruments of sufficient power or equipped with photographic apparatus.—On Coulomb's law: L. **Lecornu.** A reply to some remarks of M. Painlevé on the same subject.—On a new arrangement for the use of the methods of interferential spectroscopy: Ch. **Fabry.** The method is specially adapted for the study of a spectrum formed of numerous brilliant lines, such as that of iron, in the electric arc. The apparatus is a modification of one previously described by the author. Instead of the interference bands being observed directly, they are viewed through a spectroscope, the slit of which may be left fairly large, unless rays very close together are under observation. The arrangement possesses several advantages over the earlier form, the chief being that there is no possibility of mistaking the radiation under examination.—An electrometer with sextants and a neutral needle: M. **Guinchant.** The theory of the instrument is given, together with its experimental verification. The instrument gave a deflection of 310 mm. for a potential difference of one volt, and the delicacy can be increased three times by a slight modification of the arrangements.—The oxidation of metals in the cold in presence of ammonia: C. **Matignon** and G. **Desplantes.** In the presence of ammonia the slow oxidation by oxygen at the ordinary temperature of a large number of metals takes place, including mercury, silver, nickel, cobalt, molybdenum, tungsten, and copper.—Cryoscopic studies made in hydrocyanic acid: M. **Lespieau** (see p. 544).—Ferric ethylate: Paul **Nicolardot.** The author has repeated the experiments of Grimaux, and concludes that the soluble ferric ethylate described by the latter does not exist. The compound always contains sodium.—On substituted ureas from natural leucine: MM. **Hugounenq** and **Morel.** From the carbimide of the ethyl ester of leucine the authors have prepared leucine-hydantoic acid, the mixed urea of leucine and aniline, and symmetrical leucine urea.—On some iodomercurates of pyridine: Maurice **François.**—On the heat of formation of calcium hydride and nitride: A. **Guntz** and Henry **Basset.** By distilling commercial calcium in a vacuum, with rapid cooling of the vapour, the authors succeeded in obtaining the metal in a pure state, and in a finely divided condition suitable for its conversion into the hydride and nitride. The calorimetric results show that all the heats of formation of calcium compounds, based on Thomsen's data, ought to be increased by 20·4 calories. This gives a positive instead of a negative heat of formation for calcium carbide.—Some applications of Watt's principle to the dissociation of the carbonates of lead and silver: Albert **Colson.**—The heat of formation of oximes: Ph. **Landrieu.** The amount of heat given off by the reaction between aldehydes and ketones has been studied in two ways: firstly, by the interaction of the two substances in aqueous solution in presence of soda, and secondly, indirectly, by the bomb calorimeter. Figures are given for oximes derived from acetone, acetaldehyde, methyl-ethyl-ketone, benzaldehyde, acetophenone, camphor, and diphenyl-ketone, good agreement being obtained between the two methods.—On the origin and composition of the essence of herb-bennet root: Em. **Bourquelot** and H. **Hérissey.** It is found that the essential oil does not exist preformed in the plant, but is the result of the interaction of a new enzyme upon a glucoside. The smell is due to the presence of eugenol, the latter being identified by conversion into its benzoyl ester.—On the experimental bases of the reticular hypothesis: G. **Friedel.**—On a case of commensalism between a species of Balanoglossus and *Lepidasthenia Digueti*: Ch. **Gravier.**—On the cause of the variations in the length of the intestine in the larvæ of *Rana esculenta*: Emile **Yung.** It is shown that the shortening is retarded by the presence of undigested substances, the shortening taking place when the intestine is empty.—On the growth in weight of the guinea-pig: Mlle. M. **Stefanowska.** The relation found between weight and age is shown in the form of two curves, algebraic expressions for which are also given.—On the heats of combustion of the nervous and muscular tissue of the guinea-pig, expressed as a function of the age: J. **Tribot.**—Contribution to the study of acid dyscrasia: M. A. **Desgrez** and Mlle. Bl. **Guende.**—The action of calcium permanganate upon the toxins of tetanus, diphtheria, and tuberculosis: J. **Baudran.**—On a case of osteomalacia causing extreme deformation of the skeleton, and terminated by a spontaneous retrocession of the lesions: P. **Berger.**—On the favourable action of the X-rays in some cases of non-suppurating tuberculous adenopathy: J. **Bergonié.**—The palæontological discoveries of M. de Morgan in Persia: H. **Douvillé.**—On the discovery of coal at Meurthe-et-Moselle: C. **Cavallier.**—On the boring for coal at Meurthe-et-Moselle: R. **Nicklès.**—The discovery of a workable seam of coal in French Lorraine: Francis **Laur.**—On the course of the solidification of the earth: A. **Leduc.** A discussion of the views on this question recently put forward by MM. Lœwy and Puiseux.—On the influence of eclipses on the movement of the atmosphere: W. **de Fonvielle** and Paul **Borde.**—The relation between the density and salinity of sea-water: A. **Chevallier.**

INDIA.

Asiatic Society of Bengal, March 1.—Earwigs of the Indian Museum: M. **Burr.** A list of the specimens in the Indian Museum, with descriptions of four new species.—On the fresh-water polype of the Calcutta tanks, with exhibition of living specimens: N. **Annandale.** The polype of the Calcutta tanks is identical with *Hydra viridis,* Linn. It varies considerably in colour. What is probably the same species has been seen in the botanic gardens at Penang.—The composition of the oil from Bir

Bahoti or the "rains insect" (*Bucella carniola*): E. G. **Hill.** An oil extracted from this mite is used medicinally by the Mohammedans of Allahabad. Analysis shows that its chief constituent is myristodiolein, with small quantities of stearin, cholesterol and colouring matter.—Contributions to Oriental herpetology, ii., notes on the lizards in the Indian Museum, with descriptions of new forms and lists of species recorded from British India and Ceylon, and of specimens collected on Sinkip Island (East Sumatra) by the late Prof. Wood-Mason's collector (part i.): N. **Annandale.** The present contribution deals with the collection of Oriental geckos, eublepharids, agamids, slowworms and monitors in the Indian Museum. Three new forms and a doubtful fourth are described, while notes on the distribution and systematic position of a number of others are given.—Customs in the trans-border territories of the North-West Frontier Province: H. A. **Rose.** A contribution to the customary law of the trans-border tribes on the North-West Frontier of India.—The Agraharis of Sasaram: L. S. S. **O'Malley.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.—On Reciprocal Innervation of Antagonistic Muscles, Seventh Note: Prof. C. S. Sherrington, F.R.S.—The Influence of Cobra-Venom on the Proteid Metabolism: Dr. James Scott.—Further Experiments and Histological Investigations on Intumescences, with some Observations on Nuclear Division in Pathological Tissues: Miss E. Dale.—On the Toxin-Antitoxin Reaction, with Special Reference to the Neutralisation of Lysin by Antilysin: J. A. Craw.—On the Nature of the Silver Reaction in Animal and Vegetable Tissues: Prof. A. B. Macallum.—On Endophytic Adaptation shown by *Erysiphe Graminis* DC. under Cultural Conditions: E. S. Salmon.—Ovulation and Degeneration of Ova in the Rabbit: Walter Heape.

CHEMICAL SOCIETY, at 8.—The Basic Properties of Oxygen at Low Temperatures. Additive Compounds of the Halogens with Organic Substances containing Oxygen: D. McIntosh.—Note on the Interaction of Metallic Cyanides and Organic Halides: N. V. Sidgwick.—The Chemical Dynamics of the Reactions between Sodium Thiosulphate and Organic Halogen Compounds. Part II. Halogen-substituted Acetates: A. Slator.—The Chemical Kinetics of Reactions with inverse Reactions. The Decomposition of Dimethylcarbamide: C. E. Fawsitt.—The Tautomerism of Acetyl Thiocyanate: A. E. Dixon and J. Hawthorne.—A Method of Determining the Specific Gravity of Soluble Salts by Displacement in their own Mother Liquor, and its Application in the Case of the Alkaline Halides: J. Y. Buchanan.—The Combination of Mercaptans with Unsaturated Ketonic Compounds: S. Ruhemann.—A new Formation of Acetylcamphor: M. O. Forster and Miss H. M. Judd.—Preparation and Properties of 1:4:5-Trimethylglyoxaline: H. A. D. Jowett.—Bromomethylheptylketone: H. A. D. Jowett.—On the Existence of a Carbide of Magnesium: J. T. Nance.—The Action of Carbon Monoxide on Ammonia: H. Jackson and D. N. Laurie.—Isomeric Salts of the Type $NR_1R_2H_3$. A Correction. Isomeric Forms of *d*-Bromo- and *d*-Chloro-camphorsulphonic Acids: F. S. Kipping.—Isomerism of α-Bromo- and α-Chloro-camphor: F. S. Kipping.—*l*-Phenylethylamine: F. S. Kipping and A. E. Hunter.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion of the Report to Council on the International Electrical Congress at St. Louis, by W. Duddell, and of Papers on Systems of Electric Units Published in Part clxx. (last issue) of the *Journal*.

ROYAL INSTITUTION, at 5.—Synthetic Chemistry: Prof. R. Meldola, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—Exhibition Evening.

LINNEAN SOCIETY, at 8.—Intra-axillary Scales of Aquatic Monocotyledons: Prof. R. J. Harvey Gibson.—A further Communication on the Study of *Pelomyxa palustris*: Mrs. Veley.

SOCIETY OF ARTS, at 4.30.—The Prospects of the Shan States: Sir J. George Scott.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Design of Concrete-Steel Beams: W. Noble Twelvetrees.

FRIDAY, APRIL 7.

ROYAL INSTITUTION, at 9.—American Industry: Alfred Mosely.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Cofferdams for Dock Use: R. G. Clark.—Bath Corporation Waterworks Extension: J. R. Fox.

GEOLOGISTS' ASSOCIATION, at 8.—The Relative Ages of the Stone Implements of the Lower Thames Valley: M. A. C. Hinton and A. S. Kennard.

SATURDAY APRIL 8.

ROYAL INSTITUTION, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

THE ESSEX FIELD CLUB, at 6.30. (At Essex Museum of Natural History, Stratford).—Twenty-fifth Annual Meeting.—Natural History Museums: F. W. Rudler.

MONDAY, APRIL 10.

INSTITUTION OF CIVIL ENGINEERS, at 8.—"James Forrest" Lecture: Unsolved Problems in Electrical Engineering: Colonel R. E. B. Crompton, C.B.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Problem of the Upper Yangtse Provinces and their Communications: Colonel C. C. Manifold.

TUESDAY, APRIL 11.

ROYAL INSTITUTION, at 5.—Tibet: P. Landon.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Maintenance and Strengthening of Early Iron Bridges: W. Marriott.

WEDNESDAY, APRIL 12.

SOCIETY OF ARTS, at 8.—The Industrial Resources of the State of Matto Grosso, Brazil: G. T. Milne.

THURSDAY, APRIL 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: A Quantitative Study of Carbon Dioxide Assimilation and Leaf-temperature in Natural Illumination: F. F. Blackman and Miss G. Matthaei.—On Colour Vision by Very Weak Light: Dr. G. J. Burch, F.R.S.—On a New Type of Electric Furnace, with a Redetermination of the Melting Point of Platinum: Dr. J. A. Harker.—The Refractive Indices of Sulphuric Acid: Dr. V. H. Veley, F.R.S., and J. J. Manley.—(1) The Improved Electric Micrometer: (2) The Amplitude of the Minimum Audible Impulsive Sound: Dr. P. E. Shaw.—On the Intensity and Direction of the Force of Gravity in India: Lieut.-Colonel S. G. Burrard, R.E., F.R.S.

ROYAL INSTITUTION, at 5.—Synthetic Chemistry: Prof. R. Meldola, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Alternating Current Series Motor: F. Creedy.—Discussion of Mr. Bion J. Arnold's address to the joint meeting at St. Louis.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Kedabeg Copper Mines: Gustav Köller.—Refining Gold Bullion and Cyanide Precipitates with Oxygen Gas: T. Kirke Rose.—Wood Gas for Power Purposes and Gas Generator: G. M. Douglas.—Notes on the Prestea District, Gold Coast Colony: P. Poore.—Notes on the New Dharwar Gold Field of India: R. O. Ahlers.—The Cause of Border Segregation in some Igneous Magmas: J. Park.

MATHEMATICAL SOCIETY, at 5.30.—On Irreducible Jacobians of Degree Six: P. W. Wood.—On Fermat's Numbers and the Converse of Fermat's Theorem: A. E. Western.—On the Strains that accompany Bending: Prof. A. E. H. Love.

FRIDAY, APRIL 14.

ROYAL INSTITUTION, at 9.—The Law of Pressure of Gases below Atmosphere: Lord Rayleigh.

PHYSICAL SOCIETY, at 8.—On Ellipsoidal Lenses: R. J. Sowter.—(1) The Determination of the Moment of Inertia of the Magnets used in the Measurement of the Horizontal Component of the Earth's Field: (2) Exhibition of a Series of Lecture Experiments illustrating the Properties of the Gaseous Ions produced by Radium and other Sources: Dr. W. Watson, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Anatomical and Systematic Notes on Dorcasia, Trigonephrus, Corilla, Thersites, and Chloritis: Henry A. Pilsbry.—Some Account of the Anatomy of *Cassidaria rugosa*, L.: Alexander Reynell.—Notes on a small Collection of Shells from the Victoria Falls, Zambesi River: H. B. Preston.—Descriptions of Six New Species of Land Shells from South Africa: H. Burnup.

SATURDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

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