THURSDAY, JUNE 2, 1904.

SIR WILLIAM FLOWER.

Sir William Henry Flower, K.C.B., &c.; a Personal Memoir. By C. J. Cornish. Pp. xi+274; illustrated. (London: Macmillan and Co., Ltd., 1904.) Price 8*s.* 6*d.* net.

THAT the life of a man of the social and scientific position of the late director of the natural history branch of the British Museum should be written, and written, moreover, by a master of popular literature, will, we think, be admitted on all hands, and in tendering a hearty welcome to this record of a distinguished career and a fine character, we trust we shall be expressing the views of no inconsiderable section of the public, and of all our readers. Mr. Cornish, whose name needs no introduction of ours to the reading public, has been fortunate in securing the cooperation of several members of the late Sir William's family in the compilation of the memoir before us, so that all the details with regard to early life and family history may be accepted as thoroughly authentic. The first two chapters, dealing with the period ending with the return from the Crimea, are, indeed, written by Mr. Victor Flower, Sir William's youngest son, while the final chapter of the biography, describing the closing scenes, is from the pen of his widow, Lady Flower. Nor is this by any means all in the way of contributions by members of the family to the biography, for the eldest daughter of Sir William, Mrs. Shann, takes the public into her confidence with regard to family life in the well known house adjacent to the Museum of the Royal College of Surgeons, while another daughter, Mrs. Biddulph, communicates a note on the summer holidays of the Flower family in early days. No critic can therefore complain of any lack of breadth in the lines upon which the biography has been drawn up; we have, indeed, not only the life-history of the central figure, but a large amount of information with regard to the family generally.

The memoir, as the author says in his preface, is essentially a personal one, and does not in any way claim to give an account of Sir William's scientific work, which must remain for a future biographer.

Although the biography of a scientific man in which there is no detailed reference to, or criticism of, the work from which he gained his reputation reminds us of the well known saying in regard to the play of "Hamlet," yet, if we may judge from what little he has attempted in this line, Mr. Cornish has been decidedly well advised in confining himself in the main to the personal aspect of his subject. When, for instance, he strays even such a short distance away from this track as to compile a list of Sir William's scientific papers, he displays a lamentable carelessness and a lack of knowledge of both the principles of bibliography and of zoological nomenclature. The want of accuracy in matters of this nature is indeed displayed even on the title-page of his memoir, where we find Sir William described as president of the *Royal* Zoological Society.

To justify our assertion as to the want of care displayed in the compilation of the list of scientific papers and books given in one of the appendices,[1] we need only refer, in the first place, to the following "misprints," as we suppose they must be euphemistically termed. On p. 252 we have, for instance, *Hylobatus* for *Hylobates, syndactilis* for *syndactylus,* and *javenicus* for *javanicus.* On the following page, and elsewhere, we find *Physalius* for *Physalus,* on p. 254 *geoffrensis* for *geoffroyensis,* and on p. 256 *Helitherium* for *Halitherium* and *arnuschi* for *arnuxi.* Nor are such errors confined to the appendix, for in the text (which is wholly the author's) we find on p. 121 Etteridge for Etheridge, and on p. 175 *Hyperodon* for *Hyperöodon.* In the case of the bibliography, at any rate, such errors (at which no one would have been more annoyed than Flower, who was the very spirit of accuracy in such matters) might have been easily detected by checking the list with the Royal Society's "Catalogue of Scientific Papers."

Nor is this all, for we find want of uniformity in regard to the references to the serials in which the papers originally appeared. For instance, we have on p. 257 *Journ. Anth. Inst.* and on p. 258 *Anthropol. Inst. Journ.,* while on the latter page we find *Zool. Soc. Proc.* as the equivalent of *Zool. Soc. Proc. London* on p. 260. Again, we should much like to know the meaning, so far as the Roman numerals are concerned, of the following entries on the page last mentioned, viz. "Zool. Soc. Proc. London, 1884, cxi. p. 417," and "Zool. Soc. Proc. London, 1884, xi. p. 206."

Reverting to the book itself, we find the fourth and fifth chapters devoted to the period during which Flower was officially connected with the Museum of the Royal College of Surgeons. Here the author records the energetic manner in which Flower set himself to work to render the museum more useful to students, and the inventions he devised for the better display or more convenient handling of the specimens exhibited. Family life during this period forms the subject of chapter vi., while in the following chapter we are introduced to some of Sir William's personal friends, among whom were Dean Stanley, Prof. Huxley, and the late Duke of Argyll. Chapters ix. to xiii. treat of the second portion of Sir William's official career, during which he was head of the museum in the Cromwell Road. Here, in the main, the author records very fairly the changes and improvements introduced gradually and tactfully during Flower's administration, dwelling especially on the installation of the "index museum" and the other contents of the central hall, and also directing attention to the better manner of displaying specimens introduced under the new *régime.* We fail, however, to understand the meaning of the sentence on p. 149, in which it is recorded that

"In 1898 the rearrangements of the mammals on Flower's system were nearly completed for the classes Chiroptera (bats), Edentata, and Primates."

As a matter of fact, the provisional arrangement of all the orders (not classes) had been by that time com-

[1] The list is stated to have been compiled by Mr. Victor Flower, but the author must be held responsible for its inaccuracies.

pleted (so far as anything in a museum can be said to be complete), while the Edentata, which was one of the first groups taken in hand, had been arranged at least a couple of years previously.

Limitations of space forbid fuller notice, and we may conclude by mentioning that while special chapters are devoted to his favourite subjects, anthropology and cetaceans, the three final chapters deal with the later and closing scenes of Sir William's life. Of four excellent portraits, those taken in his later years serve to remind old friends of Flower's striking personality. Bearing in mind the limitations already mentioned, the author is decidedly to be congratulated on the attractive manner in which he has laid before the public the main features of a very interesting and highly successful scientific career. R. L.

THE IDENTIFICATION OF ORGANIC COMPOUNDS.

A Method for the Identification of Pure Organic Compounds. Vol. i. By S. P. Mulliken, Ph.D. Pp. xii+364. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 21*s.* net.

THIS is the first of a series of volumes which are intended to facilitate the identification of organic substances. The scheme commonly, though not invariably, adopted by organic chemists in this connection is to determine the molecular formula of the compound under investigation, and then to refer to Richter's "Lexicon," in which all known organic compounds are tabulated according to their molecular formulæ. Further agreement is established by a comparison of physical and chemical properties. The author considers that the difficult technique of conducting an ultimate organic analysis, upon which the above system mainly depends, "is fully mastered only by long practice," and that there is a shorter cut to the same result. This short cut consists in finding, in the first instance, to what class of compounds—hydrocarbon, alcohol, aldehyde, acid, &c.—the substance belongs, and, when this has been done, in determining such simple physical characters as melting-point, boiling-point, specific gravity, colour, smell, &c., which will lead to its identification. It is therefore necessary for purposes of reference that all the known organic compounds should be grouped into separate classes. This is what the author has done. In each class the individual members are arranged in the order of increasing boiling-point or melting-point. For example, let us suppose that the substance, the identity of which is required, proves to be an acid. All the known organic acids are divided into tables of liquid and solid acids, and these again into categories, which are either soluble or insoluble in water. Suppose that the acid under investigation is a liquid which is soluble in water. Having turned to the table containing the liquid acids soluble in water, an examination of the first column of boiling points will lead, perhaps, to the discovery of one corresponding to the unknown acid. Under this compound a series of characteristic reactions are described which will enable the investigator to fix the identity of his compound by means of a few simple tests.

There is very little that is new in the above method. It is one which is adopted, consciously or otherwise, by the majority of chemists, whether they possess the skill requisite to conduct an ultimate organic analysis or not. That carefully elaborated methods are at present in use for determining the constitution of a substance by chemical tests is clearly shown by the existence of such a volume as Hans Meyer's, which has been translated into English, and has already reached a second edition.

In point of fact, when a substance has been obtained in a state of purity, its identification is as a rule not a serious undertaking. The character of the substance from which it is derived will usually furnish a clue to its nature, and a few characteristic tests will soon set the matter at rest. If the identification of a compound is a crucial matter, few chemists would rest content with anything less than a direct comparison of the product with the known substance, for melting- and boiling-points are apt to vary a little with the apparatus and form of thermometer employed, and colour reactions do not always produce quite the same tint unless the conditions of the experiment are the same.

It is the separation of a compound from a mixture and its purification which make the greatest demands on the skill and experience of a chemist. Compared with this, an ultimate organic analysis and the characterisation of a compound by chemical tests offer little difficulty.

There is no intention to disparage the labour which has been expended on this work. The careful revision of the reactions of many of the substances found in the tables would entitle the book to grateful recognition, in addition to which there is much useful and practical information on the method of applying the different reactions which every organic chemist will appreciate. It would be incorrect, moreover, to state that the tables will not serve the object for which they have been compiled. The question is only whether the object is worth the labour which it entails, seeing that most of the information may be derived indirectly from other sources.

The biological system of classification of substances into orders, genera and species cannot be commended. It is unnecessary and undesirable. There is no analogy in the application of these terms in the two sciences, and their use may be misleading. Chemical nomenclature still suffers in this country from such a false analogy, when *radicle* was adopted in place of *radical*. J. B. C.

THE MIND OF THE CHILD.

Educational Psychology. By Edward Thorndike, Adjunct Professor of Genetic Psychology in Teachers' College, Columbia University. Pp. vii + 177. (New York: Lemcke and Büchner, 1903.)

THIS volume embodies the results of investigations in which Prof. Thorndike has interested himself and his pupils for some time past, applying the methods

of experimental psychology to educational problems. Seeing that it is the first serious treatise on the subject which has yet appeared, such a pioneer work naturally deserves warm welcome and temperate criticism, even though there be important points of detail, both in the methods employed and in the conclusions drawn, which can hardly be accepted without reservation. As Prof. Thorndike ably points out in the last five pages of his book, there are numerous problems and experiments described by him which any trained teacher "can attack with a fair promise of success." His obvious aim in publishing this work at the present primitive stage of genetic psychology is to encourage a greater number of workers in the field of research with which he has so closely identified himself in the United States. For this reason, doubtless, he has omitted all consideration of the comparative data already available in other countries than his own.

The first two chapters are devoted to the methods of measurement and to the statistical distribution of mental traits within the community. The view is upheld that "the distribution of any mental trait in a homogeneous species undisturbed by selection is that given by the probability integral." It is to be regretted that the author has not devoted more space to statistical methods. Such sentences as the following, on p. 20, are surely unwise:—"The mathematical formulæ by which this is done need not concern us here." "Here again the mathematical formulæ are best omitted. The reader may take it on trust that such a transposition as the following is correct."

The third chapter concerns the correlation between different mental abilities in the same individual. An endeavour is made to define the certainty with which any scholar who is especially proficient in one subject of study will surpass or fail to reach the average in other subjects. It is experimentally shown that the phrase "ability in arithmetic" is "but an abstract name for a number of partially independent abilities."

The remaining chapters are concerned with experimental work upon the connection of mental traits with sex and age, upon the relation between mental and physical traits, and upon the influence of heredity and environment. Within the limits of this notice it is impossible even to summarise the many highly interesting results of the experiments of the author and his countrymen. As the author observes,

"The science of education when it developes will like other sciences rest upon direct observations of and experiments on the influence of educational institutions and methods made and reported with quantitative precision. . . . It is the vice or the misfortune of thinkers about education to have chosen the methods of philosophy or of popular thought instead of those of science. We ruminate over the ideas of Pestalozzi or Herbart or Froebel as if writing a book a hundred years ago proved a man inspired. . . . We are like chemists who should quarrel over the views of Paracelsus or Arnauld of Villeneuve. . . . In education everything is said but nothing proved" (p. 164).

This book is a worthy and welcome attempt to apply exact method to educational problems, although it leaves some little to be desired in style and general appearance. CHARLES S. MYERS.

OUR BOOK SHELF.

Précis d'Électricité Médicale, Technique Électrophysiologie, Électrodiagnostic Électrothérapie, Radiologie, Photothérapie. By Prof. E. Castex. Pp. vii+672; 208 figures. (Paris: F. R. de Rudeval, 1903.)

THE object of the author has been to furnish the medical student with a work which will be useful to him in the present state of electrical knowledge, but the author hopes that it will also not be without value to medical men who are devoting themselves to the special study of electrotherapeutics, and likewise to practitioners who have not had such opportunities.

The work is divided into five different sections, including technique, electrophysiology, electrodiagnosis, electrotherapy, and lastly the study of X- and other rays.

The author has been very successful in the arrangement of his matter, and the physical aspect of the question has not been neglected, judging, of course, from the medical point of view. The various currents employed in medicine, continuous, interrupted, sinusoidal, high-frequency, and static, have all been practically and efficiently explained. The second and third chapters, dealing with electrophysiology and diagnosis, will be found particularly useful to those who desire a practical and not too exhaustive guide. The application of electricity to the diseases of the different organs is described in concise and practical terms, a fact which will be useful to physicians who have not had the advantages of modern training at one of the electric departments which now form a part of most large hospitals. The last chapter, which is devoted to X-rays, occupies something like 120 pages, and cannot, of course, be expected to compete with the larger treatises, such as Bouchard's, recently published. But again Prof. Castex has shown his practical tendency by giving under each heading a short and very useful guide to the interpretation of photographic as well as radioscopic diagnosis, and radiotherapy itself, although briefly treated, has not been forgotten.

The work contains about 208 illustrations, well chosen to assist the student in understanding the theories, instruments, and clinical charts.

A careful perusal of the work will show that it has been written by one who understands his subject and the needs of the student and practitioner. It is concise, thoroughly practical, and just such a guide as should appeal to those for whom the author has written the work. J. M.

Radium and All About It. By S. Bottone. Pp. 96; with four figures and four full-page plates. (London: Whittaker and Co., 1904.) Price 1s. net.

THE appearance of a popular shilling volume dealing with the properties of the salts of radium and the theory of radio-activity may be regarded as an indication of the wide interest that has been aroused by the discovery and investigation of the radio-active elements. There is much to be said in favour of the production of a book that shall satisfy the curiosity of those whose interest has been aroused but whose knowledge of chemistry and physics is insufficient to enable them to follow the developments of the subject in the technical journals. In spite of its rainbow-tinted cover and its somewhat boastful title, the present volume gives a substantially accurate account of the most important phenomena. It contains liberal quotations from the chief workers in the subject, though these are taken chiefly from articles that have appeared in the non-technical journals and reviews. The author appears to have derived his information almost entirely

from English sources, and to have devoted more attention to popular expositions than to the original literature of the subject. The volume is consequently not free from the faults that are almost inseparable from a compilation of this kind, and the arrangement of the matter is in places somewhat confusing. But the author has made a sober and honest attempt to give a simple explanation of a very complex subject, and has attained a fair measure of success. The figures are clearly and simply drawn, and the full-page plates, which include reproductions of the spectra of radium, calcium and helium, and of Sir William Huggins's two series of spectra, are valuable features of the book.

Second Stage Botany. By J. M. Lowson. Pp. viii+452. (London: W. B. Clive, 1904.) Price 3*s.* 6*d.*

THE syllabus of the second stage examination in botany of the Board of Education has been judiciously framed on broad lines, and those students generally shape best who possess a reasonable knowledge of the structure and activities of plants and apply that knowledge in their answers. In the preparation of students for this examination the primary object should be to emphasise leading principles, and further to stimulate reflection by making the student observe many facts for himself. Instead of this one finds in the book under notice the usual attempt to supply directly all the information required to answer the manifold questions which are possible, and important facts are lost in the mass of detail. In the latter part of chapter ii., which deals with tissues, the most essential fact is the importance of the vascular tissues as continuous conductive strands, but this is relegated to one of the final sections, which is reached after wading through descriptions of meristems, stereid bundles, sclerotic cells, &c. The chapter on the leaf bristles with terms, including the "incubus" of phyllotaxis, but any suggestions as to the reasons for the variety of form are considered unnecessary. Another defect in the book is the inclusion of antiquated terms and ideas, of which the most noticeable, because it is accompanied by a diagram (Fig. 105), is the existence of centrospheres in Phanerogams. The description of "double-fertilisation" is peculiar; on p. 199 it is stated that the generative cells pass down into the pollen tube, and one cell fuses with the oosphere; "the fate of the other generative cell is described on p. 304." One is tempted to find a correlation between this method of incorporating the result of recent research and the statement which appears in the introduction, that a large portion of this work has already appeared in the author's "Textbook of Botany."

Les Frontières de la Maladie. Maladies latentes et Maladies atténuées. By Dr. J. Héricourt. Pp. xi+285. (Paris: Ernest Flammarion, 1904.) Price 3.50 francs.

ALTHOUGH in well marked cases health and sickness are distinct and opposite conditions, in a large number of instances the boundary between the two is indefinite, the one passing insensibly into the other, and it is with this borderland that the author of the work under review deals. Commencing with dyspepsia, he shows how this may pass on into more grave conditions, and by natural stages finally comes to consider the mild types of such infective diseases as scarlatina, enteric fever, and diphtheria, which in their mildest forms cause little disturbance, and may pass unnoticed and undiagnosed.

Among others, an interesting chapter is devoted to a consideration of how epidemics of disease spontaneously die out. As treating of a little studied branch of medicine, the book is suggestive and to be recommended. R. T. HEWLETT.

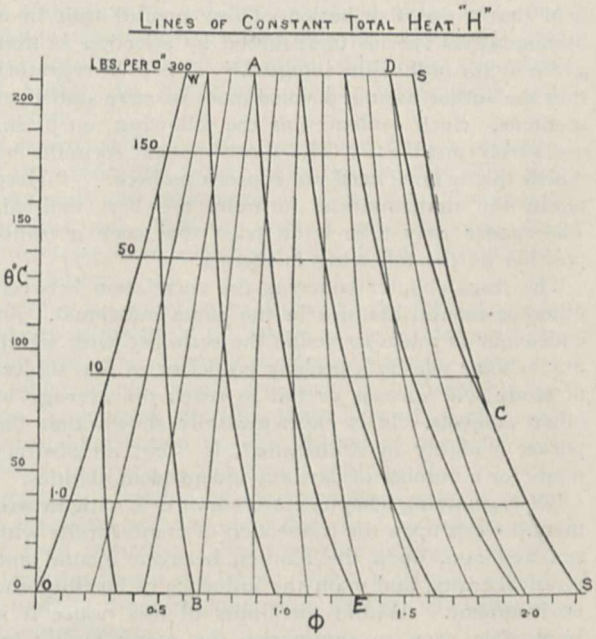
LETTERS TO THE EDITOR.

[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.]*

$\theta\phi$ Lines of Total Heat.

I THINK that $\theta\phi$ diagram curves showing constant total heat, although often drawn by students, have never yet been published, and I venture to ask you to publish a set made more carefully than usual by one of my students, Mr. A. W. Steed. Total heat is intrinsic energy + pv, so that for steam it is what Regnault called his total heat. In the figure I have indicated the pressure, but of course the ordinate is proportional to temperature and the abscissa is entropy. Along OW the stuff is all water. Along SS the stuff is all saturated steam. The thin lines, like AB, show the stuff maintaining the same fractional dryness; for example, along AB the stuff is 0·3 of steam, 0·7 of water. Along the thicker lines, like AE, the stuff has constant total heat.

Many people have the notion that when steam is throttled it is very greatly dried. Of course the drying is greater if



the place of throttling is well protected from loss of heat by a non-conducting covering, and in this case total heat remains constant. Now if the line DC is looked at, it will be seen that steam which is 90 per cent. dry at 300 lb. pressure, if throttled to 150 lb. pressure is about 93 per cent. dry, and if throttled to 50 lb. pressure is about 95½ per cent. dry. Thus the drying effect is not very great.

The effect is evidently more marked with very wet steam. Thus, looking at AE, steam 30 per cent. dry at 300 lb. pressure becomes 42 per cent. dry if throttled to 50 lb.

The lines show at once how much steam at any pressure will result on the Halpin system of storage from each pound of stored hot water. Thus imagine a total heat line from the point W in the figure. A pound of water stored at 300 lb. pressure and reduced to 150 lb. pressure will generate about 0·07 lb. of steam.

I need not mention the other important applications of this diagram. To the right of SS, in the superheated part, lines of constant total heat are horizontal, being lines of constant temperature. JOHN PERRY.

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The Nature of the α Rays emitted by Radio-active Substances.

THE α rays emitted by radium and other radio-active substances have been shown by Rutherford ("Radio-activity," pp. 115–141) to consist of positively charged particles for which $e/m = 6 \times 10^3$. They are rapidly absorbed by gases and solids, the absorption coefficient being approximately proportional to the density of the absorbing medium. The value of the absorption coefficient in air divided by the density varies between 350 and 1300 for different types of α rays. The velocity of these rays is about 1/10th to 1/20th that of light.

It is interesting to compare the properties of these rays with those of kathode rays moving with about the same velocity; e/m for such rays is about 10^7, and the value of their absorption coefficient in air at 1 mm. pressure is 0·85 (Lenard, *Ann. der Phys.*, Bd. 12, p. 714, 1903) when the velocity is 1/10th that of light and 3·9 when it is 1/20th.

The absorption coefficient for these rays is also proportional approximately to the density of the absorbing medium. Dividing 0·85 by the density of air at 1 mm. pressure we get 540,000, and in the same way 3·9 gives 2,500,000. The corresponding numbers for the α rays are about 350 and 1300. Thus we see that the α rays are nearly 2000 times as penetrating as kathode rays moving with the same velocity.

Assuming that $-e$ for the kathode rays is equal to e for the α rays, we have for the ratio of their masses $10^7/6 \times 10^3 = 1700$. It thus appears that the penetrating power of the α rays is to that of kathode rays, moving with the same velocity, approximately as the mass of the α rays is to the mass of the kathode rays. We may conclude from this that an α particle loses as much energy in colliding with an atom as a kathode-ray particle or corpuscle. If we regard the α particles as being of atomic dimensions (that is, as having a radius about 10^{-8} cm.), while an electron or corpuscle only has a radius of about 10^{-13} cm., it is very difficult to understand this result. On the view that all atoms are assemblies of electrons, the fact that the absorption of kathode rays depends only on the density of the absorbing medium is regarded as indicating that the electrons penetrate the atoms and are absorbed by colliding with the electrons which compose the atoms. Since α particles lose the same amount of energy as electrons in penetrating matter, it seems probable that they also penetrate the atoms and lose energy by colliding with the electrons in exactly the same way. If this view is taken, it becomes difficult to regard an α particle as of atomic dimensions, and we may look upon it as a positive electron exactly similar in character to an ordinary negative electron. The mass (m) of an electron is now regarded as being purely electromagnetic in character, and is given by the formula $m = 2e^2/3a$, where a is its radius and e its charge. For a negative electron this gives $a = 10^{-13}$ cm. Regarding an α particle as a positive electron, we get in the same way for its radius about $\frac{1}{2} \times 10^{-16}$ cm. On this view, therefore, the α particles are enormously smaller than the negative electrons.

The properties and modes of occurrence of the α particles are in agreement with the view that they are really positive electrons. For example, they are produced like kathode rays in electric discharges at low pressures (being then known as canalstrahlen), and have very similar properties to kathode rays. The writer therefore suggests the view that α particles may be positive electrons having a radius about 2000 times smaller than negative electrons.

Trinity College, Cambridge. HAROLD A. WILSON.

A Suggested Explanation of Radio-activity.

I AM venturing, in the present note, to add another to the already large number of suggestions as to the meaning of the phenomenon of radio-activity.

It seems to be well established that the apparent instability of the atoms of radio-active substances is not to any great extent dependent on the temperature of the mass; the instability, therefore, is not the outcome of intermolecular collisions. Neither does it seem to arise from an excess of the internal energy of the molecule. For the internal agitation of the molecule, so far as is known, shows itself in the emission of light, and this is associated with high mass-temperature. There is, of course, the possibility, suggested by Prof. J. J. Thomson, that there are internal degrees of freedom not represented in the spectrum of the gas, and that it is the energy of these which forms the starting point of the radio-active process. On the other hand, it is possible that the atomic instability, not being the result of the agitation of the molecules or of the component material parts (ions or corpuscles) of which the molecules are composed, must be traced to the agitation of the ultimate constituents of these ions or corpuscles. If, for instance, we take a definite mechanical illustration, and imagine our universe constructed on the model suggested by Prof. Osborne Reynolds, the source of instability must be looked for in the agitation of the "grains" of which he supposes the ether to be constituted. The velocities of these grains follow Maxwell's law of distribution, so that very high velocities, although rare, are not impossible. It is at least thinkable that a grain moving with exceptionally high velocity may succeed in breaking down the normal piling in its immediate neighbourhood when this is possible (*i.e.*, probably, when in the immediate proximity of matter), and may therefore effect a rearrangement of the adjacent ether structure. A process of this kind would be independent of the mass-temperature; it would, so to speak, depend solely on the ether temperature, which is supposed, on Prof. Reynolds's hypothesis, to be constant throughout space. It seems probable that the rearrangement would consist of the combination and mutual annihilation of two ether strains of opposite kinds, *i.e.* in the coalescence of a positive and negative ion, and would therefore result in the disappearance of a certain amount of mass. There would, therefore, be conservation neither of mass nor of material energy; the process of radio-activity would consist in an increase of material energy at the expense of the destruction of a certain amount of matter.

Apart, however, from this special mechanical model, it seems probable, on grounds of general dynamics, that the ether does not transmit waves in a perfectly unaltered form, and that there is therefore a continual degradation of the energy of regular waves into an energy of random agitation of the ultimate ether structure. This agitation would afford a sufficient cause for the beginnings of the process which results in the breaking up of the atom. Naturally this agitation would have the best chance of effecting a rearrangement when the strain is greatest, and therefore when the ions are most closely packed together. A larger energy of agitation would be necessary when the ions were less closely packed. We should, therefore, expect all matter to be radio-active to some extent, but should expect the greatest amount of radio-activity to be shown by the heavier atoms.

If the instability results from a rearrangement of an ether structure, and not solely of a material structure, we should, *a priori*, on general grounds of physical dimensions, expect the velocity of the ejection to be comparable with the velocity of waves in the ether, this being the only unit appropriate to the measurement of processes depending on the physical constants of the ether. [Just as, for instance, the velocity of a gas streaming into a vacuum might, *a priori*, be expected to be comparable with the velocity of sound in the gas.] The suggested cause of instability is therefore in agreement with the observed velocity of the α particles. J. H. JEANS.

Trinity College, Cambridge.

The First Record of Glacial Action in Tasmania.

IN a recent paper on the Glacial geology of Tasmania (*Quart. Journ.* Geol. Soc., vol. lx. p. 38), I referred to Gould's recognition of Glacial action in Tasmania as not having been directly published. This view I accepted on the strength of the statement by Mr. R. M. Johnston ("The Glacial Epoch of Australasia," *Proc.* Roy. Soc. Tasmania, vol. iv., 1893, 1894, pp. 92–3), than whom no one knows better the geological literature of Tasmania, that it was "through verbal communication to a personal friend of my

own, and one of his (*i.e.* Gould's) early associates, that I first, about 20 years ago, became aware of his discovery of many evidences of glaciation in Tasmania."

I have recently found a Parliamentary Paper, issued in 1860, in which Gould describes his recognition of Glacial action in some of the high valleys of central Tasmania. The passage is as follows ("A Report of the Exploration of the Western Country by Mr. Gould," Parl. Pap., Tasmania, 1860, No. 6):—

"In the Cuvier Valley I was struck, both in going and in returning, by the similarity to the terminal moraine of a glacier presented by an enormous accumulation of boulders which chokes the lower end of the valley, and, somewhat like a dam, extends completely across it, with the exception of the point where it is broken through by the river."

I am glad, therefore, to be able to give to Gould the credit of having published the discovery, which in my paper I could only quote as a verbal tradition.

The Cuvier Valley is one day's journey west of Lake St. Clair. A hut, five miles due west of the top of Mount Arrowsmith, occurs in it. J. W. GREGORY.

The University, Melbourne, Victoria, April 25.

The Origin of the Horse.

IN your issue of May 19 (p. 53) Prof. T. D. A. Cockerell refers to *Equus caballus celticus*, Ewart, as "still surviving in the pure state in Iceland." Prof. Ewart, in his paper on "The Multiple Origin of Horses and Ponies," says that "the few pure specimens of the Celtic pony survive" in the north of Iceland. I take it that Prof. Ewart does not mean that the northern Icelandic breed of ponies is a pure one, but only that certain individuals of this breed exhibit the "Celtic" characters in a very marked degree. In a recent paper (*Proc.* Camb. Phil. Soc., vol. xii., part iv.) Mr. F. H. A. Marshall and I have brought forward both historical and zoological evidence for the mixed origin of the Icelandic pony. It is perhaps worth noting that the people of north Iceland still claim a social superiority over those of the south as being descended chiefly from the second body of colonists which reached the island. In considering the origin of different breeds of the domestic animals ethnological considerations are often important, and, conversely, the examination of local breeds may sometimes throw light on ethnological problems. For example, in the Malay Peninsula the breed of dogs owned by the majority of the jungle tribes usually classed as Sakais differs from that of the Malay pariah, which has recently been adopted in some cases by Semang tribes and also by those Sakais who live in close intercourse with the Malays. The pariah seems likely to oust the Sakai dog completely, and I am not aware that any zoologist has yet made a detailed examination of the latter, which shows certain resemblances to the local race of *Cyon rutilans*.

Of course, investigations into the ethnological distribution of animals must be made with the very greatest care, for not only may one breed oust or swamp another, but the characters of a single individual may prove so dominant that they may prevail in a great number of cross-bred descendants, and so change the character of a breed in a very short time. This has recently happened in the Færöe Isles. As we know from the statements of Landt ("Description of the Faroe Islands," 1798), there were at least two distinct breeds of dogs in these islands at the end of the eighteenth century, one resembling the modern Danish hound, but smaller; the other a short-legged, rough-haired terrier. The two breeds can still be traced on some of the islands, notably on Naalsoe; but in the neighbourhood of Thorshavn, the capital, great alteration has taken place quite recently. Some ten or twelve years ago a Danish governor introduced a well-bred dachshund dog, which inter-bred with the native bitches. In 1903 I could hardly find a single dog in the town which did not show traces of dachshund ancestry—short, bent legs, long body, &c.—more or less marked. The in-bred highly specialised individual has proved prepotent when crossed with the more or less generalised types which, judging from the statements of Lucas Debes (1623–1670) and Landt, have been somewhat cross-bred for at least two and a half centuries. We are apt to forget factors of the kind when discussing the breeds of domestic animals, and also when investigating the different races of men, but it should be remembered that they are of the very greatest importance in both lines of inquiry. NELSON ANNANDALE.

34 Charlotte Square, Edinburgh.

Insular Races of Animals and Plants.

IF we accept the view that species are such by virtue of segregation, and consider subspecies to be groups as yet imperfectly segregated, we seem logically bound to regard insular forms as valid species. According to this way of looking at the matter, a subspecies is in biology what a peninsula is in geography, while a species corresponds to an island. Hence it follows that many subspecies are far more widely distributed and for most purposes more important than many distinct species; just as many peninsulas are more important than the small islands off their coasts.

While it appears illogical to treat insular races as subspecies, there are difficulties in the way of regarding them all as distinct species. In former years, the most distinct were so recognised, and the others were simply ignored. This practice, while it smoothed the way for the systematist, deprived us of the use of a large body of facts of the greatest possible interest to the evolutionist, and the time has come when it must be given up. As a result of the new methods, the number of "species" recognised is increasing very rapidly, as shown, for example, by the description of seventy new Malayan mammals in a single paper by Mr. G. S. Miller, jun. Many of the "species" described in this paper are excessively similar and yet distinguishable, and inhabit different islands. It is evident that one could take a map of the Malay Archipelago and prophesy with some degree of accuracy the number of insular species of Mus and some other genera awaiting discovery by simply counting the islands, eliminating those too closely adjacent. In mountain regions something of the same sort is found, the tops of the mountains or mountain ranges serving the same purpose as islands. For freshwater organisms, lakes and river systems afford similar phenomena, as shown, for example, by the races or species of Salmonidæ.

The objections to the recognition of all these isolated forms as valid species are two. First, their extreme similarity in many instances, and second, the specific name does not indicate the immediate relationships of the form. It has seemed to me that these difficulties might be overcome by the recognition of a new category, for which the name "idiomorph" suggested itself. This name may be objectionable on account of the term idiomorphic, used in crystallography, and it is probable that someone can think of a better. If it is accepted, it may be abbreviated to "id.," as "var." is written for variety, and "subsp." for subspecies.

To illustrate the different methods, we may take certain bats of the genus Chilonycteris, found in the Greater Antilles, using the facts recently published by Mr. Rehn.

C. macleayii group.

	i. (Species).	ii. (Sub-species.)	iii. (Idiomorphs).
Jamaica ...	*C. grisea*, Gosse.	*C. macleayii grisea.*	*C.* (*macleayii* id.) *grisea.*
Cuba ...	*C. macleayii*, Gray.	*C. macleayii.*	*C. macleayii.*
Haiti ...	*C. fuliginosa*, Gray.	*C. macleayii fuliginosa.*	*C.* (*macleayii* id.) *fuliginosa.*
Porto Rico	*C. inflata*, Rehn.	*C. macleayii inflata.*	*C.* (*macleayii* id.) *inflata.*

C. parnellii group.

Jamaica ...	*C. parnellii*, Gray.	*C. parnellii.*	*C. parnellii.*
Cuba ...	*C. boothi*, Gundlach.	*C. parnellii boothi.*	*C.* (*parnellii* id. *boothi.*
Haiti ...	*C.* ?[1]	*C. parnellii?*	*C.* (*parnellii* id.)?
Porto Rico	*C. portoricensis*, Miller.	*C. parnellii portoricensis.*	*C.* (*parnellii* id.) *portoricensis.*

[1] Doubtless exists, but not yet discovered.

The proper name of the idiomorph would be a binomial, the name of the superspecies being inserted when advisable, just as subgeneric names are inserted, within brackets.

T. D. A. COCKERELL.

Colorado Springs, Colorado, U.S.A., May 7.

Graphic Methods in an Educational Course in Mechanics.

I AM glad to have succeeded in calling forth some correspondence on this subject. But since I have evidently failed to make my views clear, may I briefly restate my contention?

By an educational course in mechanics, I mean a course intended to teach a beginner the principles of mechanics; a course that will leave him properly equipped for more technical work.

By "analytical methods" I mean those methods in which we resolve forces and take moments about axes. Working diagrams and plotted curves (as is quite clearly implied or stated in my former letter) would accompany such work, and would not come under the head of graphic statics.

By "graphic methods" I mean those methods that depend on accurate drawing only, there being no calculation; methods in which "resolution" is replaced by the drawing of force polygons, and "taking moments" by the drawing of funicular polygons.

I advocated the exclusive use of the former methods in bringing the beginner up to the desired point at which there would no longer be danger of confusion of ideas as to principles. Such methods demand the use of simple equations and of a little elementary trigonometry.

Mr. Milne, I see, agrees with me in the main. I cannot, however, agree with him in his view that the employment of analytical methods implies that the teaching is not to be experimental, or leads to impressing on the pupil the idea that "statics is practically useless." Surely he would find "*resolving*" and "*taking moments*" more practical than drawing polygons of forces and funicular polygons in introducing a beginner to the action of machines, to matters of friction, to the nature of bending moments and shearing forces, to the torsion of shafts, and, indeed, to most of the problems of practical mechanics.

Even in the case of "statics of structures," if we limit ourselves (as I do here) to such a range as will be sufficient to make the principles clear, there is much to be said for the analytical "*method of sections*"; and if this be employed there is less temptation to present to the beginner the *un*practical "weightless frame, loaded at the joints only." However, in this branch of mechanics, graphic methods must be employed sooner or later when the learner passes beyond the simpler forms of structures.

Mr. Trotter has quite misunderstood me! He speaks much about (or against?) mathematics; says that my pupils should "emerge as mathematicians"; and refers (deprecatingly?) to "wranglers."

I cannot see that the employment, with beginners, of the methods of *resolution* and *taking moments* would produce a race of wranglers, any more than that the employment of graphic methods would produce a race of geometricians or artists.

Further, he considers me as opposed to the use of diagrams, and as preferring formulæ to explanations given in "quite ordinary language"; and he asks (indignantly?) whether I "would deny the use of a piece of string on a globe to explain great circle sailing?" I may state briefly that I am not a mathematician, that I am fond of diagrams, that I delight in simple language, and that I would give two pieces of string to any pupil who had serious aims in view. I do not think that the above were quite reasonable deductions from my letter.

I do not wish in my turn to misunderstand Mr. Trotter. But I gather from the second paragraph of his letter (vol. lxx. p. 81) that he claims the use of "quite ordinary language" as the prerogative of those teachers who use graphic methods in preference to the analytical methods of "resolution" and "taking moments"? I gather also, from the last paragraph, that, in his opinion, *to resolve forces* and *to take moments about axes* "confuse learners of statics"; and that these analytical methods are a failure when applied to dynamics? Certainly there is here a real difference of opinion between Mr. Trotter and myself.

Devonport, May 28. W. LARDEN.

THE graphic methods are the complement of the analytical, and a mind brought up on either to the exclusion of the other is but half trained. I agree with Mr. Milne that the best results are obtained when the two methods are used side by side. But there is another and potent reason for including graphic methods in an elementary course; they can to a great extent be used at an earlier stage and before the student has proceeded far in his mathematical training. The triangle of forces is practically the only principle involved, and if this is satisfactorily taught, so that in any practical application the student can write out clearly an explanation of his diagram showing what the different lines represent, he will then proceed naturally to the analytical methods of *resolving* and *taking moments*. But he will never abandon the graphic methods, which should now be developed simultaneously with the analytical. His mastery of the two, with the analytical, as I think, resting on the graphic, will give him greater resourcefulness than he would be likely to obtain from an exclusive use of one method.

I want to see the study of mechanics, even in its elementary stages, brought into closer union with practical requirements, and the barrier which usually separates theoretical from applied mechanics to a considerable extent removed. The inclusion of graphic methods tends to prevent the discussion of fantastical problems invented by the mathematician from usurping the consideration of the more practical kinds required by the engineer. In the elementary work it is not usual to take account of the internal forces which are called into play when any solid is in equilibrium under external forces. I think that the stresses induced in a bar of no appreciable weight by forces applied at its extremities should be considered at a very early stage, and then the student may work easy problems on the equilibrium of simple frames. Of course these problems are all more or less idealised, but they will serve to show him that he is at work upon something of practical value, and he will not fail to grasp and appreciate it. W. J. DOBBS.

East Putney, May 27.

The Drumming of the Snipe.

IT is disputed whether the snipe's drumming—a curious noise, suggestive of a miniature threshing machine—is made by the bird with its wings or by its tail, or by both wings and tail. Some recent observations incline me strongly to believe that the tail plays at any rate the more important part. During the performance the bird flies at a great height round and round in a wide sweeping circle. At intervals he makes a sudden and rapid descent, holding his wings partly flexed and his tail spread to its full extent. The outermost tail feather on either side points outward at a greater angle than those adjoining it, so that when the bird is watched through a good field glass daylight shows between it and the next; and, if I am right in my view, the drumming sound is due to the rush of air against this isolated feather. The snipe's tail feathers seem so puny that it is at first difficult to believe that they can produce so great a result. But if an outer one be taken—it is slightly scimitar-shaped with the outer web much reduced—and swung rapidly through the air, the drumming noise may be distinctly heard, though it seems but a very faint echo of the loud throbbing hum that startles one when it suddenly descends from an ethereal height, and the small bird is descried, hardly more than a speck to the naked eye, circling round in wild career, and now and then swooping headlong downwards and thrilling the air with his weird music. F. W. HEADLEY.

Haileybury.

THE PRESENT POSITION OF GEODESY.

THE article by Commandant Bourgeois in the *Revue Générale des Sciences* for April 30, on the present position of geodetic science is both instructive and useful with reference to those problems in geodesy which are just now before the scientific public of this country. There is, in the first place, a notable scheme for the construction of a geodetic arc in Africa which shall extend from the Cape to Cairo. Of this Commandant Bourgeois has taken due note, entering rather fully into the details of such difficulties as its projectors may find in the way of its successful accomplishment. There is also an agitation recently started amongst astronomers and surveyors, which has for its object the revision of the geodetic triangulation of England in order that it may be brought into line, scientifically, with the geodetic triangulation of adjoining countries, and take its place (as it should) as a link in more than one European system of which the value would be largely increased by this extension. Of this Commandant Bourgeois takes no note (probably because he is unaware of its existence), nor does he concern himself with any past achievements in the field of geodesy in which England has borne a part either at home or in India.

The object of the article is to place before the reader the effect of fresh inventions and new methods in developing existing geodetic projects, but it would have added much to the interest of it if so competent an expert as Commandant Bourgeois had written something about the change which has come over the objective of geodetic science which justifies its continued application to modern fields of surveying. These are utilitarian days, and seeing that the science of geodesy long ago evolved all the necessary factors for the reduction of astronomical and terrestrial observations by giving us certain mathematical formulæ based on the measurement and form of the earth, and that no subsequent investigations will ever seriously affect those deductions, it may well be doubted if any State financial assistance would be justifiable for the mere purpose of refining and polishing the results of what would be a purely abstract scientific inquiry. Geodetic arcs measured simply for the purpose of ascertaining the nature of certain eccentricities in the figure of the globe will no longer be regarded as worthy of the saving grace of State financial support, and it will remain for their projectors to prove that some other and more practical end is to be served by them if they wish for substantial recognition.

There is, of course, another (and an insufficiently appreciated) end to be served by such exact scientific processes as are involved in the measurement of a "great arc"; and if we drop the somewhat misleading term "geodetic," and simply appeal to the absolute necessity for a strong initial backbone of first-class triangulation as the basis of every survey scheme of any consequence at all—a backbone which will support the weight of any subsequent superstructure of looser and more rapid forms of triangulation which may be built upon it, and thus give solidity and homogeneity to the whole mapping of a vast area (such as Africa, for instance), we only indicate the same thing under a far more practical and intelligible form. All surveyors are agreed as to the necessity for such an initial backbone, although perhaps opinions may differ as to how far it should be extended. The great value of Commandant Bourgeois's article lies in this—that he shows clearly and concisely how the best possible scientific results may be obtained by means which not long ago were unattainable, and which involve half the expense, with (possibly) double the accuracy of those older methods which cost the country so much in the past, and (in the case of England, at least) have not proved satisfactory in the end.

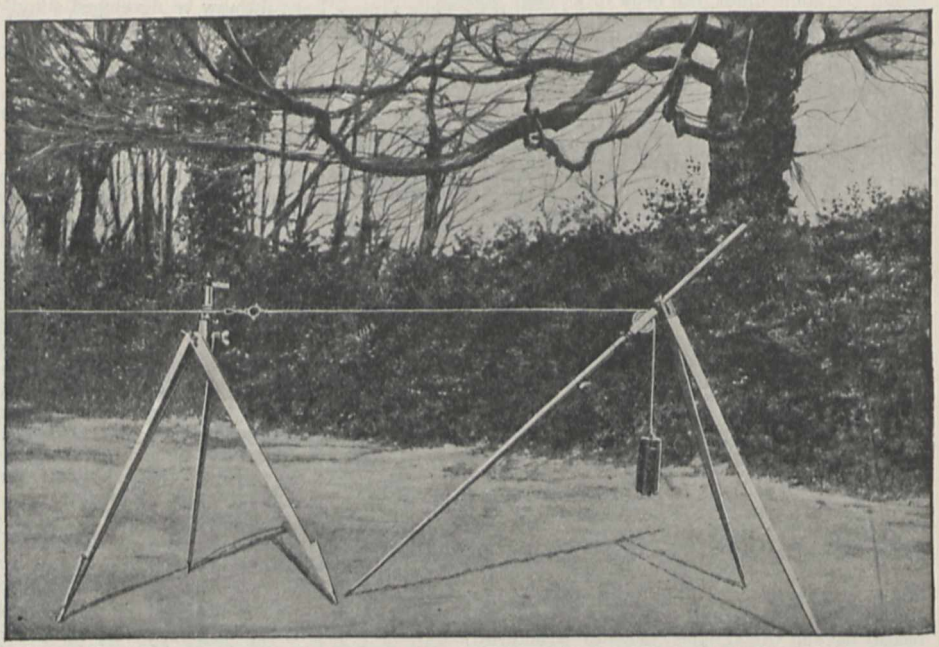

FIG. 1.—Jäderin apparatus placed in position for base measurement.

The Jäderin apparatus for base measurements, and the application of the French metal "invar" (an amalgam of 64 steel to 36 nickel) to it, is perhaps the most important of all recent improvements in the process of constructing a primary, or "first-class," triangulation. The old, clumsy, and inconvenient method of measurement by compensation bars has, we hope, disappeared for ever. The Jäderin tape has been exhaustively tested under other conditions than those mentioned by Commandant Bourgeois, and it has been found to stand the test of extremes of climate quite sufficiently well. The author indeed advocates its use for the measurement of long bases in supersession of the system of extension by triangulation from a short one. The rapidity and accuracy with which this method can be applied to the base measurements connected with a long series of principal triangulation is instanced in the case of the North American meridional arc, which has been measured on the 98th degree of west longitude. In this instance nine bases were measured in one field-season

lasting six months. Five tapes were made use of, all five being tested over one kilometre of distance to determine their relative equations. These may be expressed by 1/690,000 maximum and 1/1,200,000 minimum of probable error. Altogether more than 69 kilometres of base measurement were effected at a cost of 160 dollars per kilo. Commandant Bourgeois maintains that the limits of probable error in linear measurement are in satisfactory relation to the limits of probable error in the angular measurements of the instrument used for triangulation. But he does not fully describe the latter. One of the essential features in modern principal triangulation is the employment of instruments of half the size and about one quarter the weight of those which were deemed necessary twenty-five years ago. Improvements in graduation and, above all, the introduction of the micrometer eye-piece have so far added to the accuracy of modern theodolites that a 12-inch instrument in India now takes the place of the 24-inch

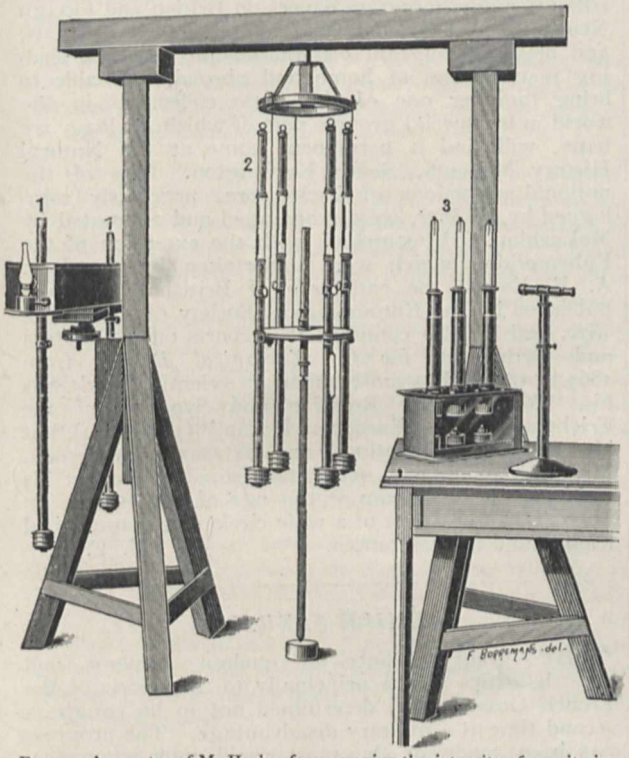

FIG. 2.—Apparatus of M. Hecker for measuring the intensity of gravity in the open sea by comparison of the readings of the barometer (1 and 2) and hypsometer (3).

and 36-inch instruments formerly used. Surveyors will probably have their own opinions as to the methods of observation indicated by Commandant Bourgeois. The German method approved by him, and adopted in France, appears to contemplate certain irregularities in the signals for observation which ought not to exist. It will probably be found that the system of observing should be adapted to the atmospheric peculiarities of the district in which the observations are taken. But the German method is well worth the careful attention of English surveyors.

That part of the article which deals with the deflection of the plumb line and the intensity of the force of gravity, has a most interesting reference to M. Hecker's apparatus for investigating these problems in ocean spaces by means of a comparison between barometric and hypsometric observations; the general result of such observations taken in the Atlantic between Bahia and Lisbon being to prove that there is no great variation between the results determined in the deep sea and on the Continent. M. Hecker is still engaged in this branch of geodetic inquiry.

The reference to the African are now contemplated, and to an equatorial arc recently measured by French scientists in the Republic of Equador in South America, should be studied together, for the experience obtained in the latter points some useful morals for the consideration of those who may undertake the measurement of the former. The physical conditions of the country and the variations of an unusually tempestuous season presented but small obstruction to the progress of the work compared to the hostility of the indigenous Indians. Stations were destroyed and markstones uprooted with such persistent animosity in Equador that a great part of the observations had to be repeated. If principal, or geodetic, triangulation is to serve the purpose of scientific investigation only, the destruction of the observing stations would not be of so much consequence, when once the chain of triangles composing the arc was finally complete. But it is obvious that if any useful ulterior purpose of map-making is to be served by the expensive process of laying down a backbone of well-fixed points, it is all important that every station and every markstone should be preserved with the utmost care. In spite of most elaborate precautions these most necessary indications are sometimes lost in India, and fresh observations have to be made in order to redetermine their position. Isolation of the instrument during the process of observing is almost always imperative, although it occasionally happens that a considerable area of hard rock exists of sufficient stability to serve as the basis of the observing station without involving any artificial isolation. But the building of isolating pillars and the erection of cairns over them for protection almost inevitably attracts the attention of the tribespeople in the neighbourhood, and the result is subsequent destruction.

The only way to safeguard with any prospect of success against the utter waste of time and money which is involved by the destruction of signals and markstones, after the triangulation has been effected with scientific precision and rigorous methods of observation, is to fix, *pari passu* with the principal triangulation, a large number of secondary points scattered over the face of the country, consisting of natural features which it is impossible to remove, or for Indians to identify. It cannot but happen that principal triangulation carried through an arc of 65° of amplitude in such a country as Africa will involve a great deal of native hostility, and its preservation finally will be almost an impossibility. It will be most necessary, therefore, to take all classes of observations that have eventually to be taken from any one station at one and the same time of occupation. It may indeed be an open question whether one or two short principal series from the coast westward, following, say, the Zambesi and the Uganda Railway to the meridian of 30° E., would not sufficiently answer the utilitarian purposes of a basis for African surveys were they connected by secondary or even tertiary triangulation at their extremities, and the connection pushed northward to meet a third principal series on the Nile. This, however, is but a side issue prompted by the perusal of the admirable article in the *Revue Générale des Sciences*.

One especially interesting result of the observations for level deflection taken in connection with the Equador arc, is an indication that the compensation of exterior mass by interior deficiency, or want of density, indicated by such observations at certain Himalayan stations, does not exist in the equatorial region of the Andes.

T. H. H.

THE INTERNATIONAL ASSOCIATION OF ACADEMIES.

THE delegates of the International Association of Academies met at the Royal Society on Wednesday, May 25, and Sir Michael Foster, K.C.B., was elected president of the general assembly. A number of resolutions were adopted at that and other business meetings, and are incorporated in the official report of the proceedings, but this has not yet reached us.

The delegates were received by the King at Windsor on May 25, and attended a conversazione at the University of London on May 27. Throughout the evening many objects of scientific interest were on view, but, with a few exceptions, the exhibits were the same as those shown at the recent conversazione of the Royal Society, and already described (May 19, p. 70). Among the additional exhibits were the following:—Horse face-pieces and other ornaments from the trappings of cart-horses, Miss L. Eckenstein; prehistoric Egyptian stone vases, Mr. Randolph Berens; (1) Japanese paintings (Kakemono), (2) photomicrographs of iron and steel, Prof. W. Gowland; series of Egyptian beads, Prof. W. M. Flinders Petrie, F.R.S.; mimetic resemblance of the different forms of a single species to two or three different models, Prof. E. B. Poulton, F.R.S.; seed-bearing plants from the Coal-measures, Mr. E. A. Newell Arber, Miss M. Benson, Mr. R. Kidston, F.R.S., Prof. F. W. Oliver, and Dr. D. H. Scott, F.R.S.; paradoxical shadows in a non-homocentric beam of light, Prof. Silvanus P. Thompson, F.R.S.; freshwater phytoplankton from various parts of England and Ceylon, Dr. F. E. Fritsch; series of rubbings of brasses, Hilda Flinders Petrie; stone implements and model of raft from the lowlands of eastern Bolivia, Dr. J. W. Evans; (1) model of steam ship *Turbinia*, (2) (*a*) 4 kilowatt turbine-driven dynamo, (*b*) model of 4000 kilowatt turbine-driven alternator, (3) turbo-blowing engines, the Parsons Marine Steam Turbine Company, Limited.

On Saturday the foreign delegates visited Oxford and Cambridge in two parties, and the honorary degrees referred to elsewhere (p. 115) were conferred by the universities. A complimentary banquet to the delegates was given at the Mansion House on Monday by the Lord Mayor of London.

ROBERT McLACHLAN, F.R.S.

THE death of Robert McLachlan, familiarly known to his friends as "Mac," removes from our midst one of the most prominent characters in the London entomological world during the last half-century. He joined the Entomological Society as long ago as 1858, and always interested himself greatly in its welfare, having successively filled the offices of secretary and president, and still holding (as he had done for many years past) the office of treasurer at the time of his death. Till the last few months, when failing health compelled his absence, he was most regular in his attendance at the meetings. He was also one of the five original founders of the *Entomologists' Monthly Magazine* (in 1864), and up to the last was still one of the acting editors—the last of the founders—the other four having all died or retired many years ago.

Mr. McLachlan was the son of a ship's-chandler on Tower Hill, whose instruments were very highly esteemed by the mercantile community. Being possessed of independent means, he devoted his life to entomology, though, as a child, he tells us, in some autobiographical notes in his Presidential Address to the Entomological Society, in January, 1887, he had taken most interest in botany. He made one voyage to the Southern Seas in 1855, and finally settled himself at Lewisham, near his intimate friend Stainton, occasionally visiting various parts of the British Isles, and the Continent of Europe; especially when any entomological congresses were on foot, which he was very fond of attending. Like most of his contemporaries, Mr. McLachlan commenced his entomological studies with British Lepidoptera, as we learn from the list of entomologists in the *Entomologists' Annual* for 1858, where his name first appears, at which time he was living at Forest Hill; but he soon turned his attention to Neuroptera, the study of which order in England received a great impetus just then by Dr. Hagen's papers in successive *Annuals*. McLachlan especially attached himself to the Trichoptera, or caddis-flies, which he studied largely from an anatomical standpoint, often, in later years, speaking contemptuously of coloured figures of butterflies as being only fit for children. He contributed many important papers on British and foreign Neuroptera and Trichoptera to entomological journals, and being in constant communication with the leading neuropticists at home and abroad, was able to bring together one of the finest collections in the world in his special groups, part of which, at least we hope, will find a permanent home at the Natural History Museum, South Kensington. Part of the national collections of Neuroptera, previously catalogued by Walker, were rearranged and annotated by McLachlan. He compiled (with the exception of the Ephemeridæ, which were undertaken by the Rev. A. E. Eaton) the catalogue of British Neuroptera published by the Entomological Society of London in 1870, and he also compiled the reports on Neuroptera and Orthoptera for the *Zoological Record* from 1869 to 1885. His most important scientific work was his "Monographic Revision and Synopsis of the Trichoptera of the European Fauna" (1874–1884), but his smaller publications are extremely numerous. Mr. McLachlan was never married. He died at his residence at Lewisham at the age of sixty-seven, on May 23, to the regret of a wide circle of entomological friends and acquaintances. W. F. K.

ÉMILE SARRAU.

THE great advance in modern artillery and ballistics is due principally to the efforts of the French Government, determined not to be caught a second time at a military disadvantage. The progress has been made in the most rapid and economical manner by the appointment of committees, composed of experts chosen for their exact scientific knowledge, such as Sebert, Berthelot, Vieille, to investigate the problem and to solve the details by a judicious combination of theory and experiment.

Chief among these scientific experts, Sarrau was also the director of the Government factories of modern explosives, and at the same time professor of the theory at the École Polytechnique in Paris, and the School of Application at Fontainebleau.

We can follow the general course of his lectures by his published books on the theory of explosives, these will emphasise the lead taken by the French, and their contempt for any secretiveness about the laws of nature involved in the corresponding phenomena.

His books and other practical achievements serve to show his success in design and invention; at the same time the obituary notices by his colleagues tell us how highly he was appreciated and esteemed as a teacher by his classes of pupils.

NOTES.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday next, June 4.

THE following have been elected honorary and foreign members of the Chemical Society :—Prof. A. H. Becquerel, Prof. C. A. L. de Bruyn, Prof. F. W. Clarke, Madame Curie, Prof. C. T. Liebermann and Prof. E. W. Morley.

A DEPUTATION from the Yorkshire Philosophical Society will wait upon the York City Council on June 6 with the object of asking the corporation to issue an invitation to the British Association to make York the meeting place in 1906.

THE death is announced of M. Charles Soret, formerly rector of the University of Geneva, and a member of council of the French Physical Society.

THE Lombardy *Rendiconti* announces the death of Prof. Amato Amati, one of the most energetic educationists in Italy, and the author of works on Dante and on geography.

THE death is announced of M. E. D. del Castillo, who prepared a flora of the French islands of Polynesia and described a portion of the plants brought from Madagascar by M. Alfred Grandidier.

AT a meeting of the General Medical Council on Tuesday, the following resolution was passed :—" That the president (with the chairman of the Pharmacopœia Committee) be requested to inform the Lord President of the Privy Council that in the opinion of the council it is desirable that after a sufficient period, to be fixed by law, the metric system of weights and measures should become the one legal system for the preparation and dispensing of drugs and medicines; that the council would view with favour the passing into law of a Bill such as that now before Parliament entitled the 'Weights and Measures (Metric System) Bill'; and that in that event the council would be prepared to take all necessary steps to give effect to the law by making the proper modifications in the 'British Pharmacopœia.'"

A REUTER message from Wellington, New Zealand, reports that the King has sent the following telegram to Captain Scott, leader of the National Antarctic Expedition :—" I have read with interest your report, which Sir Clements Markham sent me. I congratulate you and your gallant crew on your splendid achievements, and wish the *Discovery* a safe journey home. I hope to see you on your return to England."

IN a letter to the secretary of the Scottish Antarctic Expedition, says the *Times*, Mr. W. S. Bruce, the leader of the expedition, remarks :—" We have reached the south-eastern extremity of the Weddell Sea, discovering there a great barrier of ice, part of the Antarctic Continent. We have gone 215 miles further south than last year, and 180 further than Ross in this part of the Antarctic regions. We got beset here in 74° S., 23° W., and were frozen in for a week, from the 7th to the 12th of March. When we got out by chance I thought it wisest not to proceed further in trying to get south and west, but to continue our programme to the north-east. We have sounded in depths up to 2900 fathoms and trawled in depths of 2660 fathoms (where Ross marks 4000 fathoms, no bottom)."

A REUTER message from Rome reports that the Marconi wireless telegraph stations at Bari and Antivari (Montenegro) have now been erected for some time, and are in regular working order. The high power station at Coltano (Pisa), near the Royal farm of San Rossore, will be the largest in the world, and will be built entirely of stone. It will be ready in August or September, after which the engines and other apparatus will be installed, so that it may begin working not later than the beginning of 1905. The Coltano station will be able to communicate with Great Britain, Canada, the United States, and the Netherlands, as well as with all vessels in the Mediterranean, the Baltic, the Red Sea, the Atlantic Ocean, and the Indian Ocean.

THE eighty-seventh annual meeting of the Société helvétique des Sciences naturelles will be held at Winterhour from July 30 to August 2. The business of the association will be transacted in seven sections as follows :—mineralogy and geology, botany, zoology, chemistry, physics and mathematics, medicine, and civil engineering. The annual meetings of the Swiss societies of geology, botany, zoology, chemistry and of the Société zurichoise de Physique will be held at Winterhour at the same time. The president of the association will be Prof. J. Weber, the vice-president Prof. E. Lüdin, and the secretary M. E. Zwingli, to whom all communications should be addressed at Geiselweidstrasse, Winterhour.

IN recent numbers of NATURE (March 24 and April 21) Prof. Nagaoka and Prof. Franklin have described methods for demonstrating the change of length of iron wire by magnetisation. Prof. J. C. McLennan, University of Toronto, writes to say that a simple and satisfactory method of exhibiting this phenomenon is described in the *Physical Review*, vol. iv., No. 35, July, 1898, and consists in the use of an optical lever attached to the test specimen.

MR. T. TERADA writes to us from the College of Science, Tokyo, to direct attention to an optical illusion observed when lycopodium powder strewn on the surface of water is made to gyrate by a jet of air. After the whirling powder has been fixedly regarded for some time, and the eyes are directed to an adjoining table, the surface of the table appears to move in a direction contrary to that of the lycopodium.

DR. D. PACINI sends us from Rome an account of careful experiments made by him with the object of observing the effects of *n*-rays described by M. Blondlot and other investigators. Though his observations were made under very favourable conditions, he was unable to detect any increase of luminosity of a phosphorescent screen caused by unknown rays from strained or tempered steel, an Auer lamp, a Nernst lamp, sound vibrations, or a magnetic field, though various French observers have affirmed that in each of these cases *n*-rays are emitted which produce an effect upon the screen.

IN the course of an interview reported in the *Westminster Gazette* of Friday last, Lord Kelvin is reported to have expressed himself as being decidedly of the opinion that the source of energy of the heat emitted by radium is not in the element itself. He remarked :—" It seems to me absolutely certain that if emission of heat at the rate of 90 calories per gram per hour found by Curie at ordinary temperature, or even at the lower rate of 38 found by Dewar and Curie from a specimen of radium at the temperature of liquid oxygen, can go on month after month, energy must somehow be supplied from without."

A PAPER on crystalline glazes and their application to the decoration of pottery, read before the Society of Arts by Mr. William Burton, and printed in the current number (May 27) of the *Journal* of the society, is a noteworthy contribution both to the science and the art of pottery. By applying scientific knowledge and method to the production

of glazes on pottery, Mr. Burton has been able to obtain with precision a variety of crystalline and opalescent effects of decided novelty and beauty. This has only been rendered possible by making many experiments to discover the influence of the materials and the temperature on the effects produced and by having each stage of the process under perfect control. In one of the new glazes produced in this way, artificial crystals which are developed in full perfection at temperatures from 1000° C. to 1030° C. are reabsorbed into the glaze as the temperature is increased, and remarkable changes of colour are assumed until at a temperature of 1070° C. the crystals are entirely reabsorbed. The crystalline effects produced at the different temperatures are of interest to the mineralogist, and the striking appearance of the pottery upon which the crystals are developed demonstrates the advantages of the application of science to industrial art.

THE first excursion of the summer session of the Belfast Naturalists' Field Club was held on May 21, when 167 members and their friends visited Hillsborough to explore and examine the demesne of the Marquis of Downshire. Though this is the largest attendance at any one of the meetings of the society, the Belfast Naturalists' Field Club is, in the forty-second year of its existence, one of the most active Irish societies devoted to the practical study of natural history. The main object of the club is to interest people generally in the study of natural objects, and this is, of course, all that can be accomplished in gatherings of the size mentioned. We are glad to know, however, that many of the members have been able, by private additional visits, to add to the scientific knowledge of the district. The honorary secretaries of the club are Mr. Nevin H. Foster, Hillsborough, co. Down, and Mr. James Orr, 17 Garfield Street, Belfast.

THE *Zeitschrift der Gesellschaft für Erdkunde* contains an extremely interesting report of a lecture on western Asia Minor by Dr. A. Philippson. Having completed his work in Greece, Dr. Philippson has undertaken the investigation of this little known region, which is of special interest to Germany on account of the Anatolian Railway. His paper summarises the results of explorations up to the present time.

UNDER the title "A Case of Geographic Influence upon Human Affairs," Mr. George D. Hubbard discusses the results of glaciation in a limited portion of the State of Illinois in the *Bulletin* of the American Geographical Society. The subject is dealt with "from the point of view of geographic influence upon plants, crops, and animals, and upon man's distribution, occupations, successes, and failures," and the paper is a good illustration of the method of treating the geological element in questions of the kind.

IN an article on the developmental changes in some common Devonian brachiopods (*Amer. Journ. Science*, April), Mr. Percy E. Raymond describes, from abundant material, the life-changes undergone in a number of species of brachiopods, with especial reference to the character of the nepionic shell, the development of the pedicle tube and the deltidial plates, and the acquirement of surface characters. The specimens were obtained from the Moscow (Hamilton) shales, near Canandaigua Lake, New York. They occurred in layers of impure limestone, but were completely replaced by silica, and when the rock was etched in acid the fossils were left in a remarkably perfect condition. The fauna comprised many forms of invertebrates, besides brachiopods, and included many individuals in immature stages.

A RESTORATION of the Ornithosaurian Pteranodon has been prepared by Mr. G. F. Eaton, as the contribution of the Department of Vertebrate Palæontology of the Yale Museum to the St. Louis Exhibition. Particulars, accompanied by a half-tone engraving (which we are enabled to reproduce), have been published in the *American Journal of Science* (April). The genus was originally described by Marsh from the Cretaceous rocks of North America, but further details of its structure have since been obtained. Mr. Eaton points out that the sclerotic circle is composed of twelve thin plates of bone arranged with overlapping edges, so as to form a hollow truncate cone, similar in shape to the avian sclerotic circle. With regard to the vertebræ, there are nine cervicals. In the dorsal series are included eight vertebræ, anchylosed to form the notarium, and four free dorsals intervening between the notarium and the sacrum. By assuming that the first four vertebræ of the sacral series (in the broader sense) are homologues of the lumbars of other groups, the total number of presacral vertebræ would appear to be twenty-five. This compares closely with the supposed number of presacrals in the Eusuchia.

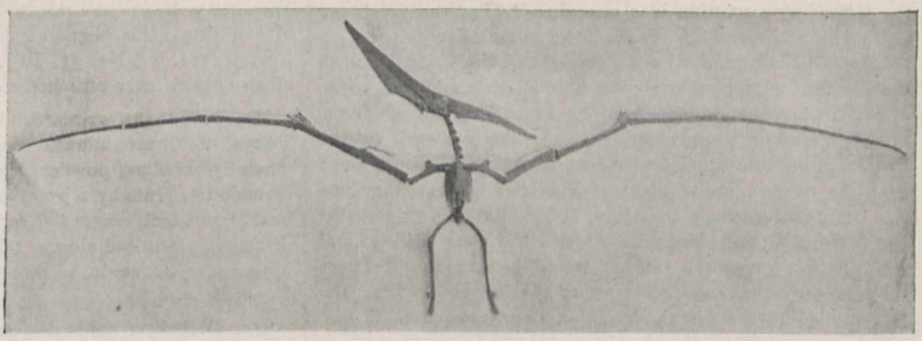

FIG. 1.—Restoration of *Pteranodon longiceps*, Marsh. Scale an inch to about 3 feet.

IN the second part of vol. xxxvi. of the *Memoirs* of the Russian Geographical Society, for general geography, Prof. N. Zarudnyi gives the second part of the account of his journey to eastern Persia. It contains a description of the 421 species of birds found by him, with the addition of a few species previously observed by Dr. Blanford and Dr. Aitchison. It would be premature as yet to draw any general conclusions concerning the relations between the avifauna of eastern Persia and the other parts of the Iran plateau and the Turan lowlands. Consequently, the Russian ornithologist only gives a description of each species, with interesting notes concerning the habits of the species and its distribution. Dividing his region into six districts, he gives the lists of nesting and temporary visiting birds for each district separately.

THE larval eyes of the mollusc Chiton and their ultimate fate form the subject of an article by Mr. H. Heath in the March issue of the *Proceedings* of the Philadelphia Academy.

IN a recent issue (vol. lxxii., No. 3) of the *Journal* of the Asiatic Society of Bengal, Mr. E. P. Stebbing records the occurrence in the Himalaya of a beetle of the genus Thanasimus, a discovery which may be of some commercial importance, owing to the fact that these insects feed on the bark-beetles so destructive to timber.

A FEATURE in the report of the proceedings of the sixteenth annual meeting of the U.S. Association of Economic Entomologists (Ent. Divis. Agric. Dept., *Bull.* No. 46), is an address on insect photography by Mr. M. V. Slingerland. While urging the importance of this comparatively new application of photography, the author points out that many of the replicas of photographs published in current literature are of a very inferior type.

IN the May number of the *Zoologist* the editor continues his notes on the influence of rivers on animal distribution, dealing, first, with their active, and, secondly, with their passive effect as dispersers. A very large number of cases are cited where animals—singly or in parties—have been involuntarily carried down by rivers, while in the second part the author has been equally industrious in collecting records of instances where animals have swum rivers of considerable breadth.

INVERTEBRATES form the subject of the four articles in the latest issue (vol. lxxvi., part iv.) of the *Zeitschrift für wissenschaftliche Zoologie*. Messrs. Schuberg and Schröder describe a new thread-worm infesting the muscles of leaches of the genus Nephelis. The spermatogenesis of sponges and cœlenterates is discussed by Mr. W. Görich, while Mr. C. Julin gives the result of his investigations into the phylogeny of tunicates, and Dr. H. Simroth describes a remarkable new slug, *Ostracolethe fruhstorferi*, from Tonquin, and its bearing on the classification of gastropods.

ACCORDING to the classification generally in use in this country, fishes are divided into the four subclasses Elasmobranchii, Holocephali, Dipnoi and Teleostomi, while the Palæozoic Ostracodermi (Pteraspis, Cephalaspis, Pterichthys, &c.) are placed in a class by themselves. Mr. C. T. Regan, of the British Museum, in a paper on the phylogeny of the Teleostomi, published in the May number of the *Annals and Magazine of Natural History*, has, however, arrived at the conclusion that a much simpler scheme is advisable, and that it will suffice to divide the class (inclusive of the Ostracodermi) into the two groups Chondropterygii and Teleostomi, the former including the Elasmobranchii and Holocephali, together with Pteraspis and its allies, and the latter all the rest. The most primitive group of Teleostomi is considered to be the Chondrostei (sturgeons and Palæoniscidæ), from which all the others are derived. One branch gave rise to the Crossopterygii, from which in turn sprang the Dipnoi (Dipneusti), the author regarding the resemblance which has long been known to exist between the fins of the two latter groups as over-riding the differences in the skull-structure. The Teleostei take origin as a separate branch from the Chondropterygii. The most pronounced departure from the views of others is, however, the brigading of the Ostracodermi (exclusive of Pteraspis, which is regarded as a chondropterygian) with the Arthrodira (Coccosteus, &c., generally grouped in the Dipnoi), as an offshoot of the Crossopterygii, under the title of Placodermi. Mr. Regan will, we think, have considerable difficulty in persuading palæontologists to accept this part, at any rate, of his scheme.

IT is stated in *La Nature* (May 28) that Dr. Chaput has found that peroxide of zinc (discovered by Elvas) proves an efficient substitute for peroxide of hydrogen for dermatological and other uses, and is much less irritating than the last named substance.

THE April issue of the *Journal of Hygiene* (vol. iv., No. 2) contains a number of most interesting and important contributions. Staff Surgeon Dalton, R.N., and Dr. Eyre have investigated the thermal death point of the *Micrococcus meletensis*, which proves to be 57°·5 C. They describe an apparatus whereby constant temperatures may be maintained, and suggest standard conditions for the determination of the thermal death points of micro-organisms. Dr. Houston, in a paper on the bacteriological examination of oysters and estuarial waters, details the main facts obtained during an investigation undertaken on behalf of the Royal Commission on Sewage Disposal. Dr. Nuttall and Mr. Inchley describe an improved method for measuring the amount of precipitum in connection with tests with precipitating antisera. Dr. Stevenson suggests a method of estimating future populations. Messrs. Bowhill and Le Doux give a note on a case of piroplasmosis canis, a tick disease of the dog, occurring near Grahamstown, and Dr. Nuttall describes the disease in a lengthy article illustrated with photos and temperature charts. Lastly, Dr. Graham Smith describes very fully a study of diphtheria bacilli isolated from 113 individuals during an outbreak of diphtheria at Cambridge in 1903.

THE fifth volume (second series) of the *Publications* of the U.S.A. Naval Observatory is devoted to a complete record of the meteorological observations made at the new Naval Observatory, Georgetown Heights, during the years 1893–1902 inclusive. After a preliminary description of each of the instruments used, the readings of the barometer and the wet and dry bulb thermometers, and the cloud and wind observations at three-hourly intervals during each day are given. The whole of the results are summarised in an exhaustive series of tables which conclude the volume.

IN the *Annals of Botany* for January, Mr. Harold Wager discusses the function of the nucleolus in plants and animals, and, basing his deductions upon the investigation of the nucleus in the cells of the root-apex of Phaseolus, he comes to the conclusion that the nucleolus is intimately bound up with the formation of the chromosomes, and that there is a definite continuity of nuclear substance from mother-nucleus to daughter-nucleus through the chromosomes. Mr. Wager has also attacked the problem of the cell structure in the Cyanophyceæ, and in a preliminary paper communicated to the Royal Society he claims that the central body of the Cyanophyceæ is a nucleus of a simple or rudimentary type.

THE second volume of the second revised and enlarged edition of Prof. W. Pfeffer's work on "Pflanzenphysiologie" (Leipzig: Engelmann; London: Williams and Norgate) has been received. The volume is chiefly concerned with transformations of energy resulting in various movements in plants.

THREE pamphlets on radium and radio-activity have just been received from German publishers. One is a second edition of a useful summary, by Prof. K. Hofmann, of investigations of Becquerel and other rays from 1896 to the present time; the title is "Die radioaktiven Stoffe nach dem neuesten Stande der wissenschaftlichen Erkenntnis" (Leipzig: Barth). The same publisher has

issued a translation, by Prof. G. Siebert, of Mr. F. Soddy's Wilde lecture (see NATURE, March 3, p. 418) on the evolution of matter as revealed by the radio-active elements. A translation, by Mr. E. Ruhmer, of a lecture by Mr. W. J. Hammer, delivered before the American Institute of Electrical Engineers, on radium and other radio-active substances, has been issued by the publishers of *Der Mechaniker*, Berlin.

OUR ASTRONOMICAL COLUMN.

THE EXTREME ULTRA-VIOLET SPECTRUM OF HYDROGEN.—In No. 4, vol. xix., of the *Astrophysical Journal*, Mr. Theodore Lyman, of Harvard University, gives a list of wave-lengths for the lines in the extreme ultra-violet spectrum of hydrogen, first discovered by Dr. Victor Schumann. In Mr. Lyman's experiments the light from the discharge tube was transmitted through fluorite windows and a tube containing hydrogen at very low pressure, and the spectrum was formed by a concave grating ruled on speculum metal. He found that from the region about λ 1854 to about λ 1700 the spectrum is almost continuous, containing only a few faint lines. About λ 1700 there is an absorption band, the width of which seems to depend upon the purity of the hydrogen enclosed in the apparatus. Beyond λ 1650, towards the more refrangible limit of the spectrum, numerous fine lines exist, and of these Mr. Lyman has measured 134. In the table accompanying the paper the wave-lengths (to five figures) and intensities of 133 lines between λ 1033 and λ 1878 are given. It is interesting to note that the superior reflecting power of speculum metal for these short wave-lengths has been incidentally demonstrated by the use of the grating.

VARIABLE RADIAL VELOCITY OF η PISCIUM.—A series of spectrograms of η Piscium obtained by Prof. H. C. Lord, of Columbus (Ohio), and extending over the period December, 1901, to January, 1904, indicate that this star has a variable radial velocity of long period.

From measurements of Hγ and thirteen carefully selected iron lines the following results, among others, were obtained :—

Date	Radial vel. (Reduced to Sun)	Date	Radial vel. (Reduced to Sun)
Dec. 15, 1901 ...	+18·5 kms.	Dec. 15, 1903 ...	+ 9·5 kms.
Jan. 10, 1902 ...	+25·4 ,,	Jan. 9, 1904 ...	+10·6 ,,

The sharp definition of the lines in the spectrum of η Piscium render its radial velocity especially suitable for spectroscopic measurement, and this fact, with other confirmatory evidence, leads Prof. Lord to the conclusion that the variability is real (*Astrophysical Journal*, No. 4, vol. xix.).

PROPOSED NEW OBSERVATORIES.—In a report published by the Carnegie Institution at Washington (December, 1903), a committee consisting of Profs. Boss, Campbell and Hale, which was appointed by that institution "to consider certain large projects in astronomy," strongly urge the establishment of an observing station in the southern hemisphere for the prosecution of certain definite observations which it is hoped might be completed in ten or twelve years. They also recommend that an observing station for solar investigations in an exceptionally favourable atmosphere should be established and maintained throughout one full sun-spot period (eleven years) at least. Further, they urge the construction and maintenance of a large reflector for astrophysical investigations at one, or both, of the proposed stations. These recommendations are supplemented by a detailed programme of the work that might be accomplished and a carefully prepared scheme for the necessary buildings and staffs.

In Appendix A Prof. J. W. Hussey, who was deputed to explore California and Arizona in order to determine the most suitable site for the proposed solar observatory, gives an interesting account of his search, which led to the recommendation of Mount Wilson (California) as offering the best facilities for the work. Appendix B consists of a number of letters from eminent astronomers in answer to a confidential inquiry as to their views on the establishment of the proposed observatories.

VARIABILITY OF SPARK SPECTRA.—Some interesting results have been obtained by Mr. A. S. King, of Bonn, from a long series of experiments on the variability of spark spectra with various conditions of current, discharge and environment. So far, the spark spectra of six metals, Cd, Zn, Mg, Ca, Hg and Al, have been studied under different conditions, and the results of the experiments have led to the following conclusions :—

(1) The lines of each metal may be divided into two groups according to their behaviour when the conditions are varied. The first group contains all the "series" lines and a few others, whilst the second group includes the lines for which no "series" relations have yet been discovered. (2) The lines of both groups are enhanced by capacity and weakened by self-induction, but those of the second group are much more affected in this way than those of the first. (3) Of the two "subseries" of each metal the first is much more sensitive to all changes. (4) The last members of a series are reduced more by self-induction than the first, a shift of maximum intensity towards the greater wave-lengths being produced. "Capacity" has the opposite effect.

Mr. King describes his experiments, and discusses the results in detail in a paper published in No. 4, vol. xix., of the *Astrophysical Journal*, where some of his photographs are reproduced.

REPORT OF THE OXFORD UNIVERSITY OBSERVATORY.—In the twenty-ninth annual report of the Oxford University Observatory, Prof. H. H. Turner gives a *résumé* of the work accomplished during the twelve months from May 1, 1903, to April 30, 1904. He again refers to the urgent need for a residence attached to the observatory, but on account of the general lack of funds at the university he does not press the matter.

The measurement and reduction of the plates for the Oxford section of the International Astrographic Chart is now complete, and the press copy of the work has been lodged at the Bodleian Library for safety until it is possible to raise the 2000*l.* necessary for its printing and publication. It was proposed that the experience gained by the observatory staff in the production of this work might be utilised in measuring the plates taken at one of the southern observatories where the lack of funds and instruments prohibits the completion of the work. To this end fifty plates were received from the Perth (W. Australia) Observatory, and on measuring twenty-one of them it was found that their reduction could be easily and economically carried out at Oxford.

A stereo-comparator, which is essentially an elaborate and improved stereoscope for the comparison of the star-places on any two plates of the same region, but taken at different epochs, has been presented to the observatory by Mr. C. L. Brook, and has been proved to be efficient and easily manipulated.

THE STEREO-COMPARATOR.—In No. 5, vol. xii., of *Popular Astronomy*, there appears a translation of a paper communicated to the Astronomical Society of Belgium by Dr. G. van Biesbroeck, in which the author traces the evolution of, and describes, the stereo-comparator invented by Dr. Pulfrich; he also gives brief accounts of the researches wherein the instrument will prove to be an extremely useful aid. Amongst the latter he notices the study of cometary features, the detection of stellar proper motions, and the discovery of minor planets. As evidence of the comparator's efficacy in the last named field, he mentions that Dr. Pulfrich, who was totally without experience in minor planet work, not only found several asteroids which Prof. Wolf had recognised on a pair of plates taken at Heidelberg, but also discovered a new one, which the careful scrutiny of the latter observer, under the ordinary conditions, had failed to reveal.

EMERGENCE AND SUBMERGENCE OF LAND.

AT the recent anniversary of the Geological Society, when the president was unable from illness to be present, his place was taken by Sir Archibald Geikie, who prepared an address for the occasion on the evidence supplied by the British Isles as to the problem of the causes of changes in the relative levels of sea and land. This address appears in full in the *Quarterly Journal* of the society, and we here reproduce it in abstract.

(i.) *Emergence.*—Geologists in the British Isles have long indulged the confident belief that Raised Beaches afford demonstrative proof of changes in the relative levels of sea and land. The abundant and striking examples of them around our coasts have been universally accepted among us as marking former sea-margins, whether the sea be supposed to have risen upon the land or the land to have been upheaved above the sea. The recurrence of precisely similar terraces along the western coast of Norway, but on a still more impressive scale, has been regarded as furnishing evidence of an extensive emergence of land, from the south of Britain to the northern end of the Scandinavian peninsula. Prof. Suess, however, seeks to show that, at least as regards the north-western coast of Norway, these opinions are based upon a misreading of the evidence. After his visit to that region, and his study of the literature of the strand-lines, there so wonderfully developed, he has come to the conclusion that the Norwegian fjords furnish no argument against his doctrine that there has been no recent upheaval of the land. He asserts that "we must interpret all the *seter* [rock-shelves] and the great majority of the terraces in the fjords of Western Norway as proofs of the retreat of the ice that once covered so much of the peninsula, and not as proofs of any oscillations of the surface of the sea, still less of any movement of the solid land." It would widen the inquiry too much to enter upon an examination of the evidence as it is presented in Scandinavia. But the author of the address, having been all his life familiar with the strand-lines of this country, and having traced those of the Norwegian coast from Bergen to Hammerfest, directed attention to one or two of the insuperable difficulties with which Prof. Suess's theoretical explanation seemed to him to be beset. The great Austrian geologist appears to have unwittingly confounded two sets of beach-lines, which differ a good deal from each other in general character, and are entirely distinct in origin. Availing himself of the remarkably full and interesting researches of Scandinavian geologists regarding the glaciation of their country, he dwells upon the importance of the terraces left by the fresh-water lakes that were dammed back by the great ice-sheet as it retired. He believes that these phenomena extended even to the Norwegian coast, and that the strand-lines of the fjords, whether in the form of platforms eroded out of the solid rock (seter) or terraces of sediment, mark former levels of lakes that filled these valleys when their mouths were blocked up with the ice-sheet. As the lowest of these strand-lines includes sands and gravels crowded with marine shells, he is compelled to admit that it marks a former sea-beach. But he endeavours to discriminate between it and the other horizontal shelves, which follow it in parallel lines at higher levels. He affirms that the latter present a series of "characters absolutely irreconcilable with what we know of the action of the sea along a shore"—such as the series of fragmentary terraces found at increasing heights inland, their absence from the parts near the general coast-line, and the breadth of the seter. He passes lightly over the fact that some of these higher terraces have yielded marine organisms which are progressively of more Arctic character, according to their altitude, and according, consequently, to the antiquity of the sediments in which they lie.

Now, according to the experience of those northern geologists who have specially studied Scandinavian glaciation, the lakes that were formed by the ponding-back of the drainage against the flanks of the ice-sheet lie to the east of the watershed of the peninsula. These observers have ascertained that when this ice-sheet was waning, it retreated eastward from the backbone of the country and lay on the eastern or Swedish slope, leaving a gradually increasing breadth of ground clear of ice. The streams flowing eastward over this liberated area had their drainage arrested against the margin of the ice; and hence arose a vast series of lakes which lasted for longer or shorter periods, until, by the continued creeping backward of the ice, their contents were drained off to lower levels. A multitude of records of old water-levels, or "strand-lines," was thus left over the surface of the country. It is the opinion of Scandinavian geologists that all the terraces not of marine origin lie within that area.

As one of the distinctive characters of the shore-lines left by the glacier-lakes, the author of the "Antlitz der Erde" cites the occurrence of the rock-shelves or platforms (seter) eroded out of the solid rock, and he refers the origin of these common features of the fjords to the daily oscillations of temperature at the surface of the lakes. A reference to the abundant examples of such rock-shelves in our own islands showed that this explanation is at least inadequate. If, however, for a moment, we grant that the strand-lines, including the seter of the Norwegian fjords, do mark levels of former fresh-water lakes, it is obvious that, in order to pond the drainage back and produce these lakes, the mouths of the fjords must have been in some way blocked up by a barrier which has disappeared. If this barrier were land-ice, as Prof. Suess appears to assume, the water would rise behind it, until, if the overflow found no escape into the Atlantic, it would pass over the watershed, and joining the various bodies of water that were there intercepted by the great Swedish ice-sheet, would eventually find its way into the Gulf of Bothnia. There would thus be two huge bodies of ice, between which the drainage was accumulated. We must remember, however, that the strand-lines are not confined to the fjords, but sweep round the coast on either side, and even appear on the islands that flank the mainland of Norway, some of them actually looking out to the open sea. The supposed ice-sheet must therefore have lain mainly outside these islands. But there is absolutely no evidence of any such detached western ice-body, and every reason to believe that it never existed.

At the period of maximum glaciation the ice-sheet probably advanced westward beyond the present limits of the land. But, when it began to retreat, it would naturally creep backward up the fjords, which would be still the main lines of ice-drainage. We can conceive, indeed, that at an early stage of this retreat, a glacier or ice-lobe may here and there have blocked up a large valley and produced a lake, as in the instances cited by Prof. Suess from Greenland. But the strand-lines of western Norway are not exceptional phenomena. They continue as characteristic features of the coast-line and of the fjords for several hundred miles, and must owe their origin to some general and widely extending cause. That they are true sea-beaches, as has been generally believed, Sir Archibald Geikie had not the smallest doubt.

Fortunately, we possess in our own islands a body of evidence bearing on this question, not certainly as voluminous and impressive as that of Scandinavia, but having the compensating advantage of great simplicity and clearness. On the one hand, the famous Parallel Roads of Glen Spean and Glen Roy, and those of other less known valleys, stand out as acknowledged relics of glacier-lakes; while round our coasts, on both sides of the country, raised beaches, which have been hitherto regarded as old sea-margins, run for hundreds of miles. These two series of terraces are found close together, yet there is no difficulty in drawing a satisfactory distinction between them. Indeed, their proximity enables us all the more clearly to perceive their contrasts.

There must, of course, be certain general resemblances between the littoral formations of lakes and of the sea. The erosion produced by the waves or wavelets of a body of fresh water is similar in kind to that performed by the sea, although different in degree. In like manner, the beaches of deposit formed in lakes possess, on a minor scale, many of the characters of those accumulated along the sea-shore. And it may readily be granted that, in isolated exposures of some old beach, it may be difficult or impossible to decide, in default of evidence from elsewhere, whether the phenomena observable are to be assigned to the work

of the sea or of a lake. Nevertheless, on a review of the whole evidence, at least as it is presented in this country, Sir Archibald felt very confident that there is no risk of confusion in this matter. The marine terraces maintain their distinctive features up to the very foot of the slopes where the lake terraces begin, while those in turn are marked by other special peculiarities.

Let any observer who has followed the great 50-foot raised beach along the western coast of Scotland and up the Linnhe Loch to the mouth of the Great Glen, look away to the right hand where the wide Strath of Spean leads into the interior. While yet standing on the platform of the raised beach, if the air be clear, his eye may detect the beginning of a line, drawn as with a ruler, at the same height along the slopes on either side of the valley. This is the lowest of the three great Parallel Roads of Glen Roy, and runs at a height of 850 feet above the level of the sea. If he will now ascend into Glen Roy, where the three terraces are best seen, he will soon be struck by the distinctive differences between these old lake-margins and the raised beaches with which he has already made himself familiar. In the first place, he will remark their faintness as compared with the marine platforms of the coast. Though readily traceable from a distance in their horizontal continuity, they are in many places hardly discernible when one is actually standing upon them. A little examination soon reveals that each of them has been produced mainly by the arrest of sediment washed from the slopes above into the water of the vanished lake. Instructive illustrations of this process may often be observed along the sides of reservoirs which have been constructed in steep-sided valleys: there each prolonged halt of the water at a particular level is marked by a shelf of detritus which, blown in by wind and washed down the declivities by rain, is stopped when it enters the water, where it accumulates as a miniature beach.

Here and there, especially on more exposed projections of the hillsides, there has been a little cutting-back by the shore-waves or drifting ice-floes of the old lake in Glen Roy. Occasionally also, where a streamlet has entered the water, its arrested detritus has accumulated as a broad, flat delta or terrace. But it is manifest that, in such limited expanses of water, wind-waves could have had comparatively little erosive power. Nor can we imagine that, even if the water froze, its floe-ice could have had any potent influence in sawing into the rocks of the declivities, and producing seter or rock-shelves. Certainly throughout this wonderful assemblage of lake-shores, there is nothing for a moment to be compared to the incised platforms of rock so abundant as part of the raised beaches of the western coast of Scotland. We must remember also that the production of such ice-dammed lakes took place as a mere episode in the retreat of the ice. No means are available to determine what may have been the length of time during which the water stood at the level of any one of these Parallel Roads. We may probably infer, from the absence of well marked and continuous intervening shore-lines, that the shrinkage of the ice and the consequent lowering of the level of the water were somewhat rapid.

The Parallel Roads of Lochaber, although the most imposing, are not the only examples of the shore-lines of ancient glacier-lakes in this country. Another striking case is that of Strath Bran in Ross-shire, where the glaciers descending from the mountains on each side ponded back the drainage of the valley, and sent it across the present watershed of the country at a height of about 600 feet above the sea. The conspicuous gravel-terraces at Achnashean are a memorial of this vanished sheet of water.

Now, with these undoubted records of ancient lakes, let us compare the structure and distribution of our Raised Beaches. These shore-lines are found, on both sides of Scotland, at approximately the same heights above the level of the sea. They are partly terraces of deposit, and partly true seter or platforms cut out of the solid rock, the same beach presenting frequent alternations of both structures. In general, it may be said that the detrital terraces are found chiefly in bays, sea-lochs, or other sheltered places, while the rock-terraces are conspicuous in more open sounds and exposed parts of the coast, where the tidal currents and wind-waves are most powerful.

As the highest terraces are the oldest, they have been longest exposed to the influences of denudation, and are thus the faintest and most fragmentary. But the dimensions and perfection of a raised beach do not depend merely on age, but in large measure on the length of time that the water stood at that level, and the varying local conditions that favoured or retarded the planing-down of solid rock or the deposition of littoral sediment.

That these beaches unquestionably mark shore-lines of the sea may be inferred on three grounds:—(1) Their position on both sides of the island at corresponding heights. No possible arrangement of ice-dams in the Atlantic and in the basin of the North Sea can be conceived that would have everywhere ponded back the land-drainage to similar levels. (2) Their independence of local conditions. The same terrace may be traced down both sides of a sea-loch and round the coast into the next loch, retaining all the while its horizontal continuity. Not only on the mainland, but on the chain of islands outside, the same parallel bar has been incised, both on the inner or sheltered side and also on the outer flank looking to the open Atlantic. (3) Their organic remains. From the youngest of the beaches up to the highest, the terraces of deposit contain marine organisms which have not been scooped out of some earlier formation, but lie in the positions in which the animals died, or into which they were washed by shore-waves and currents. The fossils of the latest beaches are entirely identical, or almost so, with forms still living in the adjacent seas, while those of the higher beaches are boreal or Arctic.

In some sheltered places, such as the Dornoch Firth, especially near Tain, and some inlets on the west side of the island of Jura, a number of successive bars or terraces of deposit may be observed up to heights of 100 feet or more above the sea. But there are in Scotland three strand-lines so conspicuous and so persistent that attention may be confined to them. From what has been taken to be their average height above mean sea-level or Ordnance-datum, they are known respectively as the 100-foot, the 50-foot, and the 25-foot beaches.

The author here adverted to what he had long regarded as a reproach to the geologists of this country. No systematic effort has ever yet been made to determine accurately, by a series of careful levellings, the precise heights of these old shore-lines. We only know that, roughly speaking, a raised beach retains its level for long distances, and appears to lie at the same height on both sides of the country. But we are still ignorant whether or not an appreciable difference of level might not be detected between the western and the eastern development of the same beach, nor do we know whether it would not betray some variation in its height between its northern and southern limits. There seems to be a tendency for the levels of the beaches to rise slightly towards the head of an estuary or sea-loch. But whether this difference is more than can be accounted for by the ordinary elevation of the tidal wave as it ascends a narrowing inlet remains to be determined.

Obviously, until accurate information is obtained on all ascertainable differences of level in the system of our raised beaches, we must remain unprovided with some of the most important material for a discussion of the history of these beaches. It is surely not too much to hope that one or more observers, endowed with the requisite geological knowledge and geodetic skill, may before long be found who will undertake the investigation of this interesting subject, and thus aid in the solution of a problem which does not merely concern the evolution of our own islands, but is of high importance as a question in geological theory.

The 100-foot, 50-foot and 25-foot beaches of Scotland were briefly described, and it was pointed out that in the structure of these old sea-margins a feature of special interest is presented by the platforms which have been eroded out of the solid rock, and which afford not a little light as to the origin of the Norwegian seter. The surface of these rock-terraces is flat, and usually covered with a thin coating of grass-grown soil through which harder knobs and stacks of the underlying rock here and there protrude. At the inner margin of the terrace, the rocks rise into a cliff or steep bank, the base of which is frequently pierced with caves. That these caves were mainly due to erosion by moving water is abundantly evident in

the rounded and smoothed surfaces of their sides. Their floors are often rough with round shingle, which has undoubtedly been the material employed by nature in their excavation. No one who has made himself familiar with the rock-platforms which at the present day are in course of erosion by the sea along these same coasts can for a moment doubt that the rock-platforms of the raised beaches which, down to the minutest point, resemble them, have likewise been eroded by the waves of the sea.

That the daily oscillations of temperature invoked by Prof. Suess in explanation of the Norwegian seter have had their share in the erosion of these Scottish examples cannot be doubted. But this share is evidently feeble in amount now, although it may have been more considerable during the Glacial period. More potent as a contributory influence in the erosion of the older terraces was probably the action of floating ice, driven along the shores by winds and tidal currents. Down to the time of the 50-foot beach, when glaciers in the north of Scotland descended to the edge of the sea, there may have been a good deal of such ice in the more enclosed sea-lochs, where the water, freshened by the discharge of melting snow-fields and glaciers, might itself be covered with a cake of ice. And there was not improbably a good deal more ice in the fjords of Norway. The grinding and rasping action of such ice, driven by gales ashore, has long been remarked. But in any case we are justified in regarding the Scottish seter as examples of truly marine erosion, and there appears to be no reason why those of Norway should not have had the same origin. It is at least clear that the statement that the characters of seter "are absolutely irreconcilable with what we know of the action of the sea near its surface," cannot be sustained.

Certain features of the extension of the raised beaches throughout Britain appear to be of fundamental importance in relation to the discussion of the problem of the emergence of land. Though so persistent along both the western and eastern coasts of Scotland, these beaches, as is now well known, do not stretch northward into the Orkney and Shetland Isles. Along precipitous sea-fronts we could not expect to meet with them, but among these islands there are endless sheltered inlets and bays which, had they indented the shores of the mainland of Scotland, would undoubtedly have had their fringe of terraces. The conditions for the development and preservation of the beaches were so entirely favourable, that their absence can only be legitimately accounted for on the supposition that they can never have existed here. Still farther north, among the Færöe Isles, no trace of any raised beaches has been found among the numerous natural harbours and creeks that break the monotony of the vast ranges of basalt-precipice. Here, again, we cannot suppose that any such beaches were ever formed.

In the southward extension of the Scottish raised beaches these features begin to lose their distinctness as they are traced into England. The 100-foot beach, which has not been recognised along the northern coast of Sutherland or in Caithness, appears also to fail before it reaches the English coast. It is well marked in the estuaries of the Clyde and Forth, whence in a fragmentary condition it has been traced into Wigtonshire on the one side and to the north of Berwickshire on the other. But no remnants of it appear to have been detected in the North of England.

The raised beaches of the north and east of England were briefly referred to, and it was then shown that in England and Wales the most continuous and best preserved examples are to be seen on the coasts of the southern counties. The lower raised beaches along the coasts of Dorset, Devon and Cornwall have long been known, although their geological age, their history, and their relation to the later phases of Pleistocene time, have not yet been satisfactorily cleared up. William Pengelly, who devoted so much time to this subject, clearly proved that these beaches do not stand now at their original level, but that after their formation the region was upraised to the amount, as estimated by him, of not less than 70 feet, when the lowest sunk forests flourished as land-surfaces, and that thereafter came a submergence of certainly 40 and perhaps many more feet.

Mr. Tiddeman has shown that, in Gower, on the coast of Glamorgan, a raised beach which lies from 10 to 30 feet above the level of the modern beach, and contains littoral shells of common species, is yet older than at least some part of the Glacial period, for it is overlain by Glacial drift. In this case, also, its present is probably not its original level. There is evidence of considerable submergence, at a comparatively late period, farther east in the same county and along the southern coast of England, and the inter-Glacial or pre-Glacial raised beaches of the whole of this region doubtless stood at one time higher above the sea-level than they do now.

The raised beaches of Ireland were alluded to, special attention being directed to an ancient shore-line at Cork Harbour, which has recently been traced by Messrs. Muff and Wright, of the Geological Survey, not only within the harbour, but for a long distance on the shore to the east and west of that inlet. Though only a few feet above the present high-water mark, this beach has been ascertained to be older than the oldest Irish Boulder-clay, for it is overlain by the so-called "shelly marl" which was brought in upon the land from the sea-basin. The similarity of position and antiquity between this beach and that underlying the drift in Gower is obviously as important as it is interesting. A shore-line, which must be of pre-Glacial or inter-Glacial age, is traceable in the south of Ireland and in South Wales. It has not only survived the erosive processes of the Glacial period, but it appears to have outlived some serious alterations in the relative levels of sea and land, which have taken place since its formation. Moreover, we have to note the fact that neither at Cork nor in Gower does any younger post-Glacial terrace appear to be recognisable. If we might judge from the analogy of other parts of these islands where the succession of raised beaches is tolerably complete, we should infer that if ever any later terrace existed here it must now be submerged—an inference which, it will be observed, is supported by the evidence of considerable submergence in South Wales and on the southern coast of Hampshire.

(ii.) *Submergence.*—Of the various kinds of proof of the submersion of terrestrial surfaces furnished in these islands only two were dealt with: first, the extension of land-valleys beneath the sea, and, secondly, the existence of what are known as sunk forests.

(1) That the fjords of Norway, the sea-lochs of the west of Scotland, and the harbours or inlets of the west of Ireland were originally valleys on the dry land, although now deeply submerged, has long been an accepted belief among those geologists who have specially considered the subject. The interval of time which has elapsed since this submergence has not sufficed to fill up with sediment these submarine depressions. By a study of the sea-charts, we can still trace the winding curves of the ancient valleys, and can even here and there detect among them the basins which, when the present sea-bottom was a land-surface, were filled with fresh-water lakes. On the sea-floor to the east of our own country and of Scandinavia, such relics of subaërial denudation are less imposingly preserved, yet evidence of the submergence of land-valleys has been noted there also. It must of course be remembered that the land on that side is of much lower altitude than on the western coasts, that the ground slopes gently under the sea, and that the valleys are comparatively insignificant depressions on its general surface. Moreover, the more abundant drainage on the longer slope east of the watershed, and the much greater development of drift on that side, leads to a far more copious discharge of sediment into the shallow North Sea and the Gulf of Bothnia, and the submarine prolongations of the old land-valleys are thus apt to be buried under recent accumulations of detritus. There may, however, perhaps be another cause for the contrast between the profoundly indented and precipitous western coast and the comparatively low and monotonous trend of the eastern coast. The author had long been disposed to believe that the submergence has been greater towards the west than towards the east. In the prolongation of the West Highland sea-lochs on the floor of the Atlantic outside, the original land-surface sometimes lies 600 feet or more below the present sea-level. If the submerged land-surface of north-western Europe could be upraised some 600 feet, the submarine prolongations of the sea-lochs would once more become glens and straths, and their rock-basins would again be turned into fresh-water lakes.

There is no similar series of well marked submerged valleys on the floor of the North Sea from which to estimate the amount of submergence of that tract, at least half of which, at no very distant date, formed a land-surface that connected Britain with the rest of the Continent. The charts show this sea-floor to consist of two distinct portions. The northern half forms a plain, which appears to slope gradually towards the north. The southern half, however, rises somewhat rapidly from the edge of that plain into an escarpment that runs in a north-easterly direction for a distance of 500 miles, from off Flamborough Head to the Skagerrak. From the top of this escarpment the surface undulates southward as a higher submarine plain, traversed by the still feebly traceable submerged valleys of the Elbe, the Rhine, and the Thames, and covering an area of more than 50,000 square miles. An uprise of not more than 300 feet would turn this tract into a rolling plateau of dry land, like the downs and wolds of Yorkshire, which are its emerged continuation. Such an amount of uplift would probably be amply sufficient for the transaction of all the later geological history of the region. The conversion of the area into a sea-bottom may not have been a continuous process. It was probably in operation during the early stages of the Glacial period, and its latest phases come down at least into Neolithic time.

(2) The sheets of peat with stools and trunks of trees, known as sunk or submerged forests, and of such frequent occurrence around the coasts of the British Isles, have long been confidently regarded as proofs of recent subsidence of the land. That they generally mark former land-surfaces cannot be doubted, for the tree stumps are seen to send their roots down into the soil underneath, and manifestly stand in the places where they originally grew. The presence of hazel-nuts, elytra of beetles, land-snails, and other terrestrial organisms, affords further confirmation of this conclusion. The great majority of these vegetable accumulations are found between tide-marks in bays and estuaries, and in many cases they can be seen to pass below the limits of the lowest tides, and thus to be constantly in part submerged. The trees and the fresh-water plants must have lived above the reach of the sea, so that they now lie 20 feet or more below the level at which they originally grew, and the conclusion has been drawn that they mark a general subsidence of these islands, to the amount of at least 20 feet, at a comparatively recent date.

Sir Archibald Geikie was inclined to believe that this conclusion has been rather too sweepingly drawn. That some of the submerged forests may be satisfactorily accounted for without any change in the level of the land or of the sea was urgently enforced more than eighty years ago by John Fleming, in reference to the examples first brought to notice by him in the estuaries of the Tay and the Forth. It will be readily understood that, in the later stages of the Glacial period, when much detritus was swept off the land into the sea, the conditions would probably be especially favourable for the formation of alluvial bars along our coasts, such as are now in course of accumulation for hundreds of miles on the southern coast of Iceland, where some of the features of that period may still be said to linger. Behind these barriers lagoons would arise, which in course of time might become marshes, and eventually peaty flats, supporting a growth of trees. But when the supply of sediment failed, and the sea, instead of heaping up the bars, began to breach them, the level of the bogs would sink by the escape of their water to the beach, and the tide at high-water would overflow and kill off the forests. Occasionally, owing to the action of underground drainage, the seaward margins of forest-covered peaty flats may have been detached from the main body and launched downward on the beach, even beneath low-water mark.

Had our littoral sunk forests been confined to a few places where the topographical conditions were specially favourable for their production, we may concede that they would not in themselves furnish sufficient proof of a shift of level, either on the part of the land or of the sea. But when we consider their widespread distribution all round the margin of these islands, even on those shores where it is difficult to believe that there has been any subsidence or slipping downward of a land-surface owing to the draining off of underground water, we may well doubt whether the old belief should be disturbed, that the facts, taken as a whole, prove a general submergence.

Fortunately, the evidence available on this subject allows us to go a step farther. We need not be content with such debateable proofs as are furnished by the sunk forests between tide-marks, for land-surfaces can be adduced which are buried beneath marine accumulations in circumstances that leave no doubt as to the facts of submergence.

The author, after presenting some details proving submergence at Belfast, at Hull, and at Grimsby, to the extent of sometimes as much as 52 feet, stated that on the coast of South Wales interesting sections had been laid open in the excavation for the Barry Docks, in Glamorgan, furnishing conclusive proof of a succession of at least four layers of peat overlain by estuarine deposits, and in a situation which precludes any recourse to local settlement by drainage of underground water or downward slipping. The strata are manifestly undisturbed, and the lowest is an unmistakable land-surface. It consists of peat full of remains of oak, hazel, cornel, hawthorn, and willow, together with crushed shells of Hyalinia and, apparently, Pisidium and Planorbis. The soil underneath this forest-growth has yielded specimens of Helix, Hyalinia, Succinea, Limnæa, Pupa, and Valvata. This buried forest-growth lies at a depth of 35 feet beneath Ordnance-datum, or 55 feet beneath the line of high-water of ordinary spring tides. It proves a submergence of at least 55 feet, and the peat-bands at higher levels mark successive pauses in this submergence. That the movement was in progress in Neolithic time may be concluded from the occurrence of a portion of a polished celt in the uppermost layer of peat, from which also two bone needles are reported to have been obtained. Mr. Strahan informed the author that, wherever excavations have been made at the mouths of the valleys on the coast of South Wales, similar layers of peat have been cut through at depths below low-water mark. It would thus appear that the submergence has been general all along the coast-line.

On the southern English coast similar evidence of a considerable change of level has long been known. During the extensive excavations for new dock accommodation at Southampton, a bed of peat, 10 feet thick, has been found, descending to a depth of 43 feet below Ordnance-datum. This vegetable accumulation has yielded many land and fresh-water shells; abundant trunks of oak with roots, sometimes 2 feet long, passing down into the loam beneath; plentiful remains of beech and hazel, together with some birch and pine. The plants also include bulrush, sedge, bog-myrtle, heaths, and bracken. From this bed, bones, horn-cores, and part of the skull of *Bos primigenius* were obtained; likewise horns and bones of red deer, tusk of boar, bones of hare, and horn of reindeer. Traces of man were found in the same deposit, as shown by the occurrence of dark flint-flakes, a round perforated hammer-stone, and a fine bone needle polished by use.

There is thus evidence of a comparatively recent submergence of the south-west of England to the extent of at least 50 or 60 feet. We are probably justified in considering the present position of the Glacial raised beach in Gower as a further indication of the same movement, and there seems no reason why we should not connect the evidence of this beach with that of the terrace lately detected in Cork. If these tracts are included in our survey, we see that the submergence probably stretched across South Wales and St. George's Channel to the south of Ireland. The evidence from Hull and Grimsby, which shows that a similar marked submergence has taken place along part of the east coast, not improbably indicates that the change of level extended across Wales and the centre of England. This submergence appears to be the latest in the long series of oscillations which have affected the southern portions of our islands. No proof has yet been obtained that so serious an amount of recent submergence has extended farther north. In the northern tracts the latest recorded change of level has been an emergence of the land in Neolithic time.

(iii.) *Bearing of the Evidence on the Causes of Emergence and Submergence.*—In conclusion, the author pointed out the inferences that appeared to him to be deducible from the

evidence obtainable in the British Isles, in regard to the causes which, in this region, have determined the emergence and submergence of land. The vertical range of the changes of level to which the discussion in this address was limited amounts at least to as much as 700 feet, that is, some 600 feet below and 100 feet above the surface of the sea. But it will be remembered that, if we include all the deposits that contain recent marine shells *in situ*, the range of movement will be found considerably to exceed 1000 feet. The problem to be solved is whether this wide amplitude of shift in the relative levels of sea and land should be attributed to variations in the height of the surface of the oceanic envelope, or to secular movements of the terrestrial crust.

Any change of sea-level might be expected to be general and fairly uniform over long distances. The area of the British Isles is too restricted to permit us to believe that there could ever have been any serious difference in sea-level between the eastern and western coasts, or between the northern and southern limits of the country. Whether, therefore, the surface of the sea rose upon the land or sank away from it, we should find the records of these changes to extend over the entire region, and to be marked on the whole by a persistent uniformity of level. But an examination of the evidence fails to furnish proofs of any such extension and uniformity.

In the first place, the raised beaches, although so perfectly developed over nearly the whole of Scotland, disappear towards the north among the Orkney and Shetland Islands where, had they ever existed, they had every chance of being as well preserved as anywhere on the mainland. These islands obviously lay outside of the area affected by the movement that led to the formation of the beaches. But they could not have escaped from the effects of any rise in the level of the sea. Again, it is incredible that if the great 100-foot terrace, so prominent a feature in Scotland, had been formed by an uprise of the surface of the sea, the same terrace should not have been visible in thousands of favourable positions in England, Wales, and Ireland. Its entire absence cannot be accounted for by the presence of former ice-sheets in these regions, or by subsequent denudation. This absence may surely be taken as proof that the terrace never extended over these parts of our islands.

In the second place, had the position of the buried forests in the southern half of England and Wales been due to a rise in the sea-level, similar evidence of submerged land-surfaces at corresponding depths should have been met with generally round our coast-line. Neolithic man was an inhabitant of the country before this submergence was complete, and has dropped his handiwork in the beds of peat. In the north of Ireland and in central Scotland, however, during Neolithic time the land was emerging from the sea, and man has left his flint-flakes and weapons in the youngest raised beaches. Thus in the same period of geological time the sea-level must be supposed to have risen 50 or 60 feet in the south, and to have sunk 25 or 30 feet in the north. But we cannot suppose that within a distance of 300 or 400 miles there could have been a difference of 75 feet or more in the level of the water.

In the third place, there can be little doubt that when accurate levellings are taken of the raised beaches, it will be found that their apparent horizontality is not absolute, but that they rise slowly in certain directions, more particularly towards the axis of the country. It is not improbable also that a difference of level will be detected between the same beach on the eastern and on the western coast, and between its most northerly and most southerly parts. Such evidence of a deformation of the land can only be determined by careful geodetic measurements still to be undertaken.

In the meantime, on a review of the whole evidence, the author felt confident that the balance of proof is largely in favour of the old belief that the changes of level, of which our islands furnish such signal illustrations, have been primarily due, not to any oscillations of the surface of the ocean, but to movements of the terrestrial crust connected with the slow cooling and contraction of our globe. If this belief is to be overthrown, better evidence must be brought against it than has been hitherto adduced.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On Saturday, May 28, the following honorary degrees were conferred on foreign delegates of the International Association of Academies:—D.C.L., Chevalier Edouard Descamps (of the University of Louvain), Ministre d'État, Sénateur Belge. D.Litt., J. L. Heiberg, University of Copenhagen; M. Émile Senart, Académie des Inscriptions et Belles-Lettres, Paris; M. Boutroux, Académie des Sciences Morales et Politiques, Paris; Prof. Collignon, Académie des Inscriptions et Belles-Lettres, Paris. D.Sc., Prof. Dr. Flechsig (Leipzig), Kgl. Sächsische Ges. der Wissenschaften; Prof. E. Ehlers, Kgl. Ges. der Wissenschaften, Göttingen; M. A. Giard, Académie des Sciences, Paris; Dr. Victor von Lang, Kaiserl. Akad. der Wissenschaften, Vienna; Prof. H. Mohn, chairman of the committee of the Videnskabs Selskab, Christiania; and Prof. H. Obersteiner, of the University of Vienna.

A meeting of the Junior Scientific Club was held on May 27. Papers were read by Mr. R. T. Lattey, on "Electrochemical Actinometers," and by Mr. E. C. Atkinson, on "Surveying in South Africa."

The following are among the honorary degrees to be conferred at the Encænia on June 22:—D.C.L., Mr. Charles Booth, F.R.S., president of the Royal Statistical Society. D.Sc., the Hon. C. A. Parsons, F.R.S.; Prof. Pierre Curie; Sir W. S. Church; Sir Andrew Noble, F.R.S.; Sir William Crookes, F.R.S.; Sir David Gill, F.R.S.; Sir John Murray, F.R.S.; Prof. Alfred Marshall; Prof. J. J. Thomson, F.R.S.; Prof. Horace Lamb, F.R.S.; Prof. A. R. Forsyth, F.R.S.; Prof. Dewar, F.R.S.; and Prof. Larmor, Sec.R.S.

CAMBRIDGE.—The following are the speeches delivered by the Public Orator, Dr. Sandys, on May 28, in presenting the under-mentioned members of foreign academies for the degree of Doctor in Science, *honoris causâ*:—

PROF. BAKHUYZEN, OF LEYDEN.

Inter doctores nostros novos primus hodie progreditur Scientiarum Academiae Amstelodamensis praeses, Batavorum astronomus insignis. Abhinc annos septemdecim consilii magni inter auctores fuit, quo caeli totius stellae, luminis ipsius auxilio chartis impressae, accuratissime redderentur. Etiam altero in opere immenso cum aliis consociatus est, quo caeli parte Boreali in regiones sedecim divisa, stellarum multitudo infinita minutissime observaretur. Iuvat hodie recordari caeli regionem astronomo Leidensi assignatam regioni Cantabrigiensi esse conterminam. Idem latitudinis (ut aiunt) varietatem, orbis terrarum axe leviter vacillante exortam, diligenter exploravit. Talium virorum ope Europae gentes scientiae amore excitatae, etiam in orbe terrarum accuratius dimetiendo invicem certant, astronomi illius antiqui laudem aemulatae,

"descripsit radio totum qui gentibus orbem."

PROF. FAMINTSYN, OF ST. PETERSBURG.

Russorum ab imperio adest botanicae professor eximius, qui studiorum provinciam nactus pulcherrimam, rerum omnium, quas terra gignit, physiologiam inter primos exploravit. Quam exquisitis usus experimentis, ostendit artificio quam admirabili herbarum genus omne solis radiis tactum virescat; etiam subter aquas algae minutissimae motu tremulo vibrent; foliorum denique omnium in cellis primordia quaedam viriditatis sese explicent, sed eadem solem nimium reformident. Quam feliciter idem novo lumine rem obscuram illustravit, vitamque illam communem, quae inter animalia quaedam minutissima et algarum cellulas intercedit, diei in lucem nuper protraxit.

"sic unumquicquid paulatim protrahit aetas
in medium, ratioque in luminis erigit oras."

EDMUND MOJSISOVICS, EDLER VON MOJSVÁR, OF VIENNA.

Vindobonensium ab Academia insigni ad nos advectus est vir de geologia praeclare meritus, qui duodequadraginta per annos palaeontologiae studiis deditus, Ammonis praesertim cornua, rupium in sinu insculpta, aevi prioris indicia (prope dixerim oracula) verissima existimavit. Quid dicam

de montium Dolomitorum serie et in Rhaetia et prope Venetos ab eodem dilucide descripta? quid de ratione illa quam inter Europae atque Asiae montes maximos intercedere indicavit? Oceanum certe ingentem, quem ex mari Mediterraneo ad oceanum Pacificum quondam extendere magister eius probavit, argumentis novis revera exstitisse discipulus confirmavit, ultraque Atlantida quandam, etiam maris "Arcto-Pacifici" fines antiquos determinavit. Nemo mortalium fortasse Oceanorum antiquorum amplitudines metiri audacius conatus est, nemo tot Alpium ingentium varietates accuratius inter sese comparare.

EMERITUS PROF. RETZIUS, OF STOCKHOLM.

Scandinavia, cuius etiam Regem inter doctores nostros numeramus, auspiciis optimis ad nos misit anthropologiae physicae conditoris insignis filium illustrem, qui anatomiam olim praeclare professus, eidem scientiae etiam otium suum et annos emeritos destinavit. Peritis nota sunt volumina illa maxima, eademque et typorum et imaginum splendore pulcherrima, et cerebri ipsius et sensuum omnium anatomiae et physiologiae explicandae dedicata. Idem, patriae non immemor, etiam Scandinaviae priscae "crania antiqua," arte eximia depicta, in libro singulari ordinavit. O terram felicem, quae non modo regia in domo artium et scientiarum tot cultores, tot patronos, numerat, sed etiam inter professores suos virum munificentia prope regia insignem non immerito admiratur.

PROF. RIECKE, OF GÖTTINGEN.

Academiae Goettingensis, et regiae domus Hanoverianae vinculo antiquo et hospitii iure vetere nobis coniunctae, socium eximium salutamus, qui scientiae physicae provincias multas peragravit; qui et de vi electrica cum crystallis consociata, et de corpusculis illis electricis inter nosmet ipsos primum indicatis, non minus breviter quam dilucide disputavit; qui denique, in scientiae illius experimentis libro in unico explicandis, inter tot res minutissimas ab alio aut alio observatas, rationem ipsam ubique eminere et apparere passus est. Illa vero rerum omnium domina est; illa nos praesertim et in scientiarum inventis praeteritis delectat et spe maioris in posterum incrementi excitat. Etenim de studiis ad lucis leges pertinentibus, non minus quam de ipsa luce, poëtae antiqui verba illa vera sunt:

"suppeditatur enim confestim lumine lumen
et quasi protelo stimulatur fulgere fulgur."

PROF. WALDEYER, OF BERLIN.

Academiam Berolinensem, et in scientiis et in litteris celeberrimam, oculis nostris quasi praesentem hodie reddit vir eximius, Academiae ipsius in scientiis physicis et mathematicis alter e ministris praecipuis, qui anatomiae in provinciis plurimis plurima cum laude versatus, vitae nascentis praesertim e studiis famam singularem est adeptus. Neque vitae ipsius circa limina obscura moratus, etiam urbium magnarum in lucem progressus est. Is certe, qui morum urbanitate et sermonis eloquentia anatomiae professores illos antiquos, Herophilos et Erasistratos, sine dubio superavit, est profecto, velut alter Hippocrates medicinae pater a Celso laudatus, "vir et arte et facundia insignis."

THE honorary degree of Doctor in Letters was conferred upon the Comte de Franqueville, sometime president of the Institute of France; Prof. Goldziher, member of the Hungarian Academy of Sciences and professor of Semitic philology in the University of Budapest; Prof. Gomperz, Emeritus professor of classical philology in the University of Vienna; Prof. Krumbacher, member of the Royal Bavarian Academy of Sciences and professor of mediæval and modern Greek philology in the University of Munich; M. Paul Leroy Beaulieu, of the Institute of France; and M. Georges Perrot, member of the Institute of France.

MR. W. GARDINER, F.R.S., Clare, Prof. C. S. Sherrington, F.R.S., Caius, and Mr. G. T. Walker, F.R.S., Trinity, have been approved for the degree of Doctor of Science.

The John Lucas Walker studentship in pathology, value 200*l.* a year for three years, will be vacant at Michaelmas. Applications are to be sent to Prof. Sims Woodhead before June 27. The student need not be a member of the university.

It is proposed to appoint a demonstrator of surgery, a demonstrator of experimental psychology, and an assistant curator of the museum of botany.

Sixty-seven men and twenty-two women have acquitted themselves so as to deserve honours in the mathematic tripos. The class list will be published on June 14.

A "NATURE STUDY" museum at St. George's Recreation Ground, Cable Street, E., will be opened to-morrow, June 3, at 5 p.m., by Sir William J. Collins, chairman of the Education Committee of the London County Council.

THE governing body of the Northampton Institute has decided to establish day classes in technical optics at the institute next winter. These courses will include full time courses, in which students will attend about thirty hours per week, and also morning classes for two mornings per week for those already engaged in the industry. An appeal is being made to members of the optical trade for donations towards the support of these technical classes with a view to the establishment and maintenance of British supremacy in the optical industry. It is reported that the London Education Committee will proceed shortly to consider the establishment of a central optical institute or college, and it is probable the decision arrived at will depend largely upon the attitude of the optical trade towards classes such as those at the Northampton Institute.

A REPORT prepared by the preliminary scientific education and examination committee of the General Medical Council was considered at the meeting of the council on Friday last, and the following resolutions were passed:—(1) That an examination in chemistry, in order to be sufficient, should comprise a written paper, a practical examination, and an oral examination; (2) that, in respect of chemistry, a synopsis or syllabus of subjects should be issued by each licensing body, and that the scope of the examination in chemistry should not fall below that which has been indicated in the report of the visitors, and has been generally approved by the licensing bodies; (3) that the examination in practical chemistry should not be limited to simple qualitative analysis, but should include easy preparations, simple volumetric analysis, and simple experiments illustrating important principles; (4) that an examination in physics, in order to be sufficient, should comprise a written paper and an oral examination, the latter to include practical questions on the use of physical instruments and apparatus; (5) that, in respect of physics, a synopsis or syllabus of subjects should be issued by each licensing body, and should include the elementary mechanics of solids and fluids and the rudiments of heat, light, and electricity; (6) that elementary biology should be retained in the curriculum; (7) that an examination in elementary biology, in order to be sufficient, should comprise a written paper and an oral examination, the latter to include practical questions on specimens and dissections, and on methods of microscopical investigation; and (8) that, in respect of elementary biology, a synopsis of subjects should be issued by each licensing body.

THE "Code of Regulations for Public Elementary Schools" for 1904 has been issued by the Board of Education. It has been much simplified, both in phraseology and arrangement. In the place of detailed schemes of work in a multitude of subjects suitable for the seven standards of an elementary school, the Board has sketched in broad outline a graduated course of instruction on which the education given in every public elementary school should be based. In this course of instruction a prominent place is given rightly to a "knowledge of the common phenomena of the external world, with special reference to the formation of a habit of intelligent and accurate observation, and to the application of that habit—in conjunction with simple forms of experiment—in the daily life and surroundings of the scholars." Nor is this the only opportunity taken by the Board, in this important official document, to show clearly its belief in the value and essential nature of scientific work in all schemes of education. An introduction to the code defines the purpose of an elementary school education as being "to form and strengthen the character and to develop the intelligence of the children." The introduction continues later to say that "with this purpose in

view it will be the aim of the school to train the children carefully in habits of observation and clear reasoning, so that they may gain an intelligent acquaintance with some of the facts and laws of nature." The importance of practical work and manual instruction is duly emphasised. This recognition of the claims of natural knowledge to an honoured place in the work of our primary schools will go far to reward men of science for their efforts to convince educational authorities of the value of scientific training. It is to be hoped that elementary school teachers will take full advantage of their new charter, and show by the improvement of their work that they value their new freedom to educate on rational lines.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 5.—"On certain Physical and Chemical Properties of Solutions of Chloroform in Water, Saline, Serum, and Hæmoglobin. A Contribution to the Chemistry of Anæsthesia.—(Preliminary Communication.)" By Benjamin **Moore**, M.A., D.Sc., Johnston Professor of Bio-chemistry, University of Liverpool, and Herbert E. **Roaf**, M.B., Toronto, Johnston Colonial Fellow, University of Liverpool.

Summary and Conclusions.

(1) It is believed that the experiments recorded in this paper justify the conclusion that chloroform forms an unstable chemical compound or physical aggregation with the proteids experimented with, and that it is carried in the blood in such a state of combination. Since proteids build up the protoplasm of living cells, it appears to us probable that chloroform, and other anæsthetics, must form similar combinations with protoplasm, and that anæsthesia is due to the formation of such compounds which limit the chemical activities of the protoplasm. The compounds are unstable, and remain formed only so long as the pressure of the anæsthetic in the solution is maintained. Such compounds are formed not only by hæmoglobin, but by serum proteid, and hence the position taken by the anæsthetic in hæmoglobin is not that of the respiratory oxygen. This is further shown by the fact that the oxygen-carrying power of hæmoglobin is not interfered with in presence of chloroform.

The effect of chloroform upon various forms of protoplasm will form the subject of future experiments.

The facts upon which we rely as proofs of the formation of a compound or aggregation between chloroform and serum proteid or hæmoglobin may be summarised as follows:—

(*a*) Chloroform has a much higher solubility in serum or hæmoglobin solutions than in saline or water.

(*b*) *Even in dilute solutions* at the same pressure the amount of chloroform dissolved in serum or hæmoglobin solution is considerably higher than in saline or water.

(*c*) The curve of pressures and concentrations in the case of water and saline is a straight line, while in the case of serum and hæmoglobin solution it is a curve, showing association at the higher pressures.

(*d*) In the case of serum, chloroform causes a marked opalescence, and also a slow precipitation at room temperature (15° C.), and at body temperature (40° C.) a rapid, though incomplete precipitation. In the case of hæmoglobin, 1·5 to 2 per cent. of chloroform causes a change of colour and commencing precipitation at room temperature, which becomes almost complete in the thermostat at 40° C., while 5 per cent. and over causes complete precipitation even at 0° C.

(2) The relations between chloroform pressure and concentration in solution have been worked out throughout a long range, from below the anæsthetising values (8 to 10 mm.) to nearly saturation in the case of water, saline, and serum.

Attention may be directed here to the important practical fact that with the same percentage of chloroform in the air breathed, serum or hæmoglobin, and therefore the blood will take up much more chloroform than would water or saline under equal conditions. Thus at the anæsthetising pressure, and at 40° C., the coefficient of distribution in the case of water and saline is approximately 4·6, while that of serum is 7·3; at room temperature (15° C.) these coefficients become 8·8 and 17·3 respectively.

"Note on the Lymphatic Glands in Sleeping Sickness." By Captain E. D. W. **Greig**, I.M.S., and Lieut. A. C. H. **Gray**, R.A.M.C.

The authors have examined the contents of lymphatic glands during life from fifteen sleeping sickness patients. In all of them actively motile trypanosomes were very readily found in cover-glass preparations taken from the cervical glands. They were also present in other glands, such as the femoral, but were not nearly so numerous.

The authors consider that their observations throw a new light upon the glandular enlargements which have been so constantly noticed in sleeping sickness, and that the disease is essentially a polyadenitis brought about by the arrest of the trypanosomes in the glands where many of them are destroyed, but whence some escape from time to time into the blood stream and thus occasion the increase which has been observed in the peripheral circulation.

They regard their observations upon the presence of trypanosomes in number in the lymphatic glands of both early cases of trypanosomiasis and advanced cases of sleeping sickness as affording important evidence of the unity of these diseases, and further proof that the trypanosomes are the essential cause of sleeping sickness.

"A Note on the Action of Radium on Micro-organisms." By Dr. Alan B. **Green**. Communicated by Sir Michael Foster, K.C.B., F.R.S.

The radium salt used in these experiments was 1 centigram of practically pure radium bromide, contained in a vulcanite and brass capsule fronted with thin talc. The emanations applied to micro-organisms were the β and γ rays.

(1) In the first set of experiments the germicidal action of these rays on various species of bacteria was investigated. A mass of bacteria was placed, as a thin layer, in a hollow-ground glass slide, and the capsule containing the radium was placed over the mass in such a way that the radium was brought within 1–2 mm. of it. All experiments and controls were made at room temperature.

It was found that the specific germ of vaccinia was killed by an exposure to radium of 22 hours or less. Non-spore-bearing bacteria were killed generally by 2 to 14 hours' exposure to radium, while spores were not killed by less than three days' exposure. It was further found that (*a*) as the distance between the radium and the bacteria was increased germicidal action became less evident and finally ceased; (*b*) as increased thicknesses of lead were interposed between the radium and the bacteria, *i.e.* as the β rays were cut off, germicidal action became less and less evident.

(2) It was ascertained that after exposure to radium at a distance of 1–2 mm. for 24 to 120 hours, micro-organisms themselves became radio-active. It has not yet been ascertained whether living micro-organisms can exhibit induced radio-activity, but micro-organisms killed by radium emanations show this activity. No radio-activity was found in bacteria not previously exposed to radium. The induced radio-activity of bacteria was shown by the ability of a mass, after exposure to radium, to photograph itself when brought into apposition with the film of a sensitised photographic plate. The best photographs so far have been obtained from cultures containing spores. Radio-active organisms have given off photo-actinic emanations after three months have elapsed since their exposure to radium. Photographs of such bacterial masses have been obtained through a double layer of lead foil, but as the β rays were cut off by interposing greater thicknesses of lead the passage of photo-actinic rays to the sensitised film was prevented.

"Further Note on some Additional Points in Connection with Chloroformed Calf Vaccine." By Dr. Alan B. **Green**. Communicated by Dr. W. H. Power, C.B., F.R.S.

Since a former paper on this subject was read in April, 1903, the use within two weeks of their collection from the calf of a large number of vaccine lymphs prepared by the chloroform process has resulted in high "case" and "insertion" success.

The following further points in connection with these vaccines have been investigated:—

(1) The temperature at which vaccine water emulsion is

subjected to the chloroform process determines largely the rate at which the extraneous bacteria of that emulsion are eliminated. The temperature at which extraneous bacteria are killed most quickly, the specific germ being left meanwhile in a state of full activity, lies probably between 18° C. and 23° C.

(2) It has been found that several additional species of bacteria are rapidly eliminated from vaccine by means of the chloroform process:—*B. proteus vulgaris, B. prodigiosus, B. pyocyaneus, B. fluorescens liquefaciens, B. coli communis, B. typhosus, B. diphtheriae, B. mallei, B. pestis, B. tuberculosis* and *S. cholerae Asiaticae*. These bacteria were added artificially to vaccine collected for experiment only.

(3) The keeping properties of chloroformed vaccine have been investigated. Vaccines prepared by the chloroform process were stored for the same length of time as commonly elapses at these laboratories between the collection from the calf and use of lymphs prepared by glycerination—usually six weeks. The use of these stored chloroformed lymphs was attended with results of high "case" and "insertion" success.

Thus the further use of a large number of chloroformed vaccines confirms the conclusions arrived at in a former paper, and the important additional knowledge has been gained that chloroformed vaccine, if originally of sufficiently high potency, will, when prepared and stored under suitable conditions, retain potency in a high degree for a considerable time.

Linnean Society, May 5.—Prof. S. H. Vines, F.R.S., president, in the chair.—Colour and coloration in mammals and birds: J. L. **Bonhote.** In this the author brought forward further facts in support of the theory that the colour and coloration on animals are primarily due to physiological causes, and showing that where conditions of "high vigour" existed, the animals were as a rule deeply coloured. The second part of the paper dealt with the coloration, and examples were brought forward showing that before a moult the hair bleached along certain definite areas, and also that this bleaching was not a process continuing throughout the period between the moults, but confined as a rule to a few days or weeks immediately preceding the moult. Hence it was argued that both colour and coloration were primarily due to physiological causes, and that natural selection could only make use of those markings which were in the first place due to "vigour."—The cranial osteology of the fishes of the families Mormyridæ, Notopteridæ, and Hyodontidæ: Dr. **Ridewood.** Descriptions were given of the skulls of *Mormyrops deliciosus, Petrocephalus bane, Notopterus kapirat* and *Hyodon alosoides*, together with less complete accounts of those of Marcusenius, Gnathostomus, Hyperopisus, Mormyrus and Gymnarchus. As the result of a study of the skulls of these forms, Dr. Ridewood concludes that the families Mormyridæ, Notopteridæ and Hyodontidæ, though more closely related *inter se* than is either family with any other family of malacopterygian fishes, are not more intimately related with one another than was previously assumed to be the case.

Faraday Society, May 9.—Mr. Bertram Blount in the chair.—Studies in viscosity: Dr. C. E. **Fawsitt.** The paper referred to some relations of viscosity to salt formation and viscosity as an additive property.—The electrolytic oxidation of anthracine: Dr. F. M. **Perkin** and A. **Fontana.** The authors have taken up the study of the oxidation of anthracine primarily to ascertain whether it was possible to obtain a good laboratory method for the preparation of anthraquinone. The first attempts were made with solutions in acetone, platinum electrodes being employed. Although oxidation took place in solutions of anthracine in acetone, it was not found possible to oxidise more than about 55 per cent. of the anthracine. Attempts were then made to electrolyse anthracine suspended in 20 per cent. sulphuric acid, or in caustic alkali to which an oxygen carrier had been added. Various carriers were employed, the most satisfactory being chromium, cerium or manganese salts.

Geological Society, May 11.—Mr. H. B. Woodward, F.R.S., vice-president, in the chair.—On some quartzite-dykes in mountain-limestone near Snelston (Derbyshire): H. H. **Arnold-Bemrose.** The quartzite of these "dykes" consists of angular detritus, quartz-grains with enclosures, a few small grains of felspar, and a few shreds of mica. The grains are cemented by silica, and sometimes by calcite. The silica is present in the limestone in two forms, which have had an entirely different origin. An important bed of sandstone was found by sinking for a well at Marston Common Farm, and the same bed is found also about 800 feet south of the farm. The microscopic aspect of the rock is precisely similar to that of the dykes. It is at a period later than the Keuper that the silica which cemented the sandstone of the dykes and of the Common Farm appears to have been introduced.—Phenomena bearing upon the age of the Lake of Geneva: Dr. C. S. **Du Riche Preller.** The author has examined the low-level gravel-beds and other alluvia in the Rhone Valley. After describing the phenomena around the Lake of Geneva, and comparing them with those around the Lake of Zurich, he draws the following conclusions:—The low-level gravel-beds of the Rhone Valley near Geneva are fluviatile deposits of the second inter-Glacial period, and were formed before the present deep lake-basin. The high-level gravel-beds of La Côte above Rolle and of the Jorat district above Lausanne are true Deckenschotter. Hence the term "alluvion ancienne" should only apply to the high-level deposits. The formation of the present deep lake-basin of Geneva was primarily due to the lowering of the valley-floor by flexures of the Molasse and its contact-zones, posterior to the maximum glaciation. The author holds that the Lake of Geneva, together with the other principal zonal lakes between the Alps and the Jura, was formed under similar conditions and at the same time as the Lake of Zurich, that is, towards the close of the Glacial period.

Zoological Society, May 17.—Mr. Howard Saunders, vice-president, in the chair.—The fifth of a series of papers by Sir Charles **Eliot,** K.C.M.G., on Nudibranchs from Zanzibar and East Africa, was read. Twenty species were treated of in the paper, of which eleven were described as new.—Mr. G. A. **Boulenger,** F.R.S., described a new species of tree-frog of the genus Hyla, from British Guiana, carrying eggs on the back.—Mr. F. E. **Beddard,** F.R.S., read a paper containing notes on the anatomy of certain species of snakes of the family Boidæ.—A communication from Dr. G. Stewardson **Brady,** F.R.S., contained an account of a collection of Entomostraca made in Natal by Mr. James Gibson. Eleven species were enumerated in the paper, of which nine were described as new, one being made the type of a new genus.

Royal Microscopical Society, May 18.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—A note by Mr. A. A. C. Eliot **Merlin** on Mr. Nelson's new formula amplifier was read. The amplifier, which consists of a negative lens placed in the rear of the objective, was calculated by Mr. Nelson at the request of the author to enable him to make some delicate microscopical measurements. With the usual arrangement of a low power eye-piece and screw micrometer, the magnification afforded by objectives of high power was insufficient to ensure accuracy in all cases, and it was not desirable to use more powerful eye-pieces, as the spider lines then appeared too coarse. The author found the amplifier yielded especially good results when used for micrometrical purposes, and he suggested the application of it to students' microscopes for quickly obtaining an increase of magnifying power. Mr. Nelson's formula for the amplifier was given.—A note on Grayson's 120,000 band plate by Mr. **Nelson** was then read. The band was resolved strongly by an apochromatic oil immersion 1/8, 1·43 N.A., and a 5 eye-piece; it was also resolved by a semi-apochromatic 1/10, 1·3 N.A., and a 5 eye-piece, and by an old achromatic water immersion 1/12, 1·2 N.A.; in this case the lines appeared to have irregularities. The 90,000 band was resolved by an apochromatic of 4 mm., 0·97 N.A., quite easily, and by a ¼ dry apochromatic ¼, 0·96 N.A., with some difficulty. The author remarked in passing that the latest books on physical optics state that 1/90,000 inch is the theoretical limit for microscopic vision. After giving particulars of the resolution of other bands, Mr. Nelson stated that ruled lines are more difficult to resolve than diatoms of equal fineness. He said

the best screen for work of this kind is made from a saturated solution of acetate of copper many times filtered, to which a very small quantity of methylene blue should be added. Sunlight with a heliostat was used, and the light made oblique in one azimuth. The theoretical resolving limit for oblique light may be *roughly* taken at 100,000 times the N.A. of the objective. Dr. Hebb said he saw this plate exhibited at the Royal Society's conversazione, and though it was certainly resolved, he remarked that some of the lines appeared weaker than others. Mr. E. E. Hill said this was due to the fact that the objective used had an aperture of only 1·1 N.A.

DUBLIN.

Royal Dublin Society, April 19.—Prof. E. J. McWeeney in the chair.—Mr. G. H. **Carpenter** read a paper on injurious insects, &c., observed in Ireland during the year 1903. The prevalence of the black-currant mite (*Eriophyes ribis*) in certain districts was mentioned, and attention was directed to the economic importance of some species of springtails (*e.g. Achorutes armatus* and *Lipura ambulans*) on account of their habit of attacking healthy seeds and fruits.—Prof. J. A. **McLelland** read a paper on the penetrating radium radiation. As the γ rays act in some ways more like charged particles than like Röntgen rays, the author has made experiments to test directly whether or not a charge is carried by the γ rays. No charge was detected. The sensitiveness of the apparatus is defined by showing how small a fraction of the β radiation could have been detected by means of the charge on the β particles. The second part of the paper deals with the absorption of γ rays by different substances, and it is shown that these rays are to some extent heterogeneous, and that the absorption-density law is followed with remarkable closeness when one deals only with the most penetrating of the γ rays.—Dr. W. E. **Adeney** made a further communication on photographs of spark-spectra from the 21·5 feet Rowland spectrometer in the Royal University, Dublin. In this paper the author deals with the wave-lengths of the lines in the ultra-violet spark-spectra of platinum and chromium. These have been calculated from measurements made from photographs of the first order of spectra, reproductions of which were published in the first part of this work (*Trans.* Roy. Dubl. Soc., vol. vii., 1901, p. 331). Kayser's measurements of well defined lines in the arc-spectrum of platinum have been employed as standards.—Prof. E. J. **McWeeney** read a paper on the cases of carbon-monoxide asphyxiation that have occurred in Dublin since the addition of carburetted water-gas to the ordinary coal-gas. Attention was first directed to the increase of carbon-monoxide in the Dublin coal-gas by Prof. Emerson Reynolds, F.R.S., in a paper read before the Royal Dublin Society in 1900 (*Scientific Proceed.*, vol. ix. p. 304). Analyses made for Prof. McWeeney by Mr. J. Holm Pollok showed 17·2, 16·8 and 14·6 per cent. of CO respectively. The author proceeded to recount in detail the circumstances attending seven fatal cases that had come under his notice during the past three years, each of which presented special features of interest. In one of the cases, which had a fatal termination, the hæmoglobin of the blood was saturated to the extent of 73 per cent. with carbon monoxide; in another the latter amounted to 87·7 per cent. The victim in this case, a young man, was asphyxiated in his bath by the CO-containing fumes escaping from a badly constructed and unventilated "geyser." The author concluded by emphasising the need for increased caution imposed by the more deadly nature of the gas now supplied.

PARIS.

Academy of Sciences, May 24.—M. Mascart in the chair.—On the limits of sensitiveness for odours and emanations: M. **Berthelot.** The rate of loss of musk and iodoform under certain conditions is compared with emanations from a small quantity of a foreign element mixed with a large quantity of an element not giving an emanation.—On γ-diphenylanthracene and on the hydride of symmetrical γ-diphenylanthracene: A. **Haller** and A. **Guyot.** Phenyloxanthranol reacts with phenyl-magnesium bromide, giving about 50 per cent. of the expected diol. The replacement of the phenyloxanthranol by its methyl ether in this reaction gives a nearly theoretical yield. This, on reduction with sodium amalgam, gives the dihydride of diphenylanthracene.—On some new facts observed by means of a phosphorescent screen: E. **Bichat.**—The direct hydrogenation of the homologues of aniline: Paul **Sabatier** and J. B. **Senderens.** By passing a mixture of hydrogen and the vapours of the alkyl-anilines over reduced nickel at 160° C. to 180° C., cyclohexylethylamine, cyclohexyldiethylamine and cyclohexyldimethylaniline have been obtained, the physical properties of which are given. Cyclohexylmethylaniline was obtained with difficulty from methylaniline by this reaction.—The detonation under water of explosive substances: M. **Jacob.** The phenomena of propagation of the motion are completely different in the cases where the coefficient of compressibility is supposed constant and where it is taken as variable. In the first case, the speed of propagation of the motion is constant, in the latter it is variable, and increases with the pressure.—On the energy in the so-called statical actions, its relation with the quantity of motion and its differentiation from the work: Ernest **Solvay.**—The resistance of the air. The comparison of the direct resistances of different aërial vanes; numerical results: Ch. **Renard.** These results were obtained with the dynamometric balance previously described by the author, and prove the law of the square of the velocity to be exact. Numerical results are given for the coefficients of vanes of different shapes.—On an instrument designed to facilitate calculations in screw-cutting: M. **Mœhlenbruck.**—On the thermal ionisation of saline vapours: G. **Moreau.** A current of air drawn through a saline solution is heated in a porcelain tube to about 1000° C., and the conductivity measured. It was found that the ionisation of the potassium salts studied was not analogous to that observed in a flame, where the influence of the acid radical is very small. The mobilities of the ions also differ in the two cases.—The cryoscopic study of solutions of antimony sulphide: MM. **Guinchant** and **Chrétien.** The lowering of the melting point of pure antimony sulphide by varying quantities of lead and silver sulphides was determined by a thermocouple, the temperature being maintained by an electrical resistance furnace of nickel wire. The average cryoscopic constant found was 790. The value for the latent heat of fusion deduced by the application of van 't Hoff's formula was 16·7 calories; the value determined direct was found to be 17·5 calories. The experimental results obtained for the lowering of the melting point of antimony sulphide by metallic antimony are in accord with the view that the antimony is in the atomic condition.—The estimation of atmospheric formaldehyde: H. **Henriet.** The aldehyde is estimated by drawing the air over mercuric oxide mixed with glass wool at a temperature of 250° C., and estimating the carbon dioxide formed. The accuracy of the method was proved by blank experiments with known amounts of formaldehyde. The conclusion is drawn from these experiments that formaldehyde exists in the air in the proportion of from 2 to 6 grams per 100 cubic metres of air, this being very large compared with ozone, which is present to the extent of 2 or 3 milligrams in the same volume. The author proposes to make a study of its physiological action.—A method for the characterisation of the fatty acids: René **Locquin.** The sodium salt of the acid is treated in ethereal solution with monochloracetone, and the acetol ester thus produced transformed into its semicarbazone, the melting point of which is taken. The melting points of five semicarbazones derived from five fatty acids are given.—The transformation of ortho-azo-alcohols into indazyl derivatives: P. **Freundler.**—The limit of combination of diazobenzene and phenol: Léo **Vignon.**—The modifications of the radiations from the nervous centres under the action of anæsthetics: Jean **Becquerel** and André **Broca.** From the variations of the *n*-rays, as measured by the lustre of a phosphorescent screen, the action of the anæsthetic can be followed, the point when danger to life commences and the point of death being easily distinguished.—On a physical proof of the adaptation between natural reagents and their perceptive organs: Augustin **Charpentier.**—The action of the *n*-rays on biological phenomena: M. **Lambert** and Ed. **Meyer.**—On cases of rapid expulsion of calculi by d'Arsonvalisation: A. **Moutier.**—On the sterilisation of cork: F. **Bordas.** Superheated steam was found to give the best results.—Study of the

lypolytic action of the cytoplasma of the castor oil seed: Maurice **Nicloux.**—On the hydrolysing properties of the castor oil seed: Ed. **Urbain** and L. **Saugon.**—On the modifications of the ergographic constants under different experimental conditions: Mlle. I. **Ioteyko.**

DIARY OF SOCIETIES.

THURSDAY, JUNE 2.

ROYAL SOCIETY, at 4.30.—On the Aurora Borealis and the Electric Charge of the Sun: Prof. Svante Arrhenius.—Colours in Metal Glasses and in Metallic Films: J. C. Maxwell Garnett.—On a Direct Method of Measuring the Coefficient of Volume-elasticity of Metals: A. Mallock, F.R.S.—A Method of Measuring Directly High Osmotic Pressures: The Earl of Berkeley and E. G. J. Hartley.—The Advancing Front of the Train of Waves Emitted by a Theoretical Hertzian Oscillator: Prof. A. E. H. Love, F.R.S.—On the General Circulation of the Atmosphere in Middle and Higher Latitudes: Dr. W. N. Shaw, F.R.S.—On the Magnetic Changes of Length in Annealed Rods of Cobalt and Nickel: Dr. S. Bidwell, F.R.S.—On the Electric Effect of Rotating a Dielectric in a Magnetic Field: Dr H. A. Wilson.

LINNEAN SOCIETY, at 8.—The Species of Impatiens in the Wallichian Herbarium: Sir Jos. D. Hooker, G.C.S.I., F.R.S.—Biscayan Plankton. Part III. Chætognathia: Dr. G. H. Fowler.—The Flow of Fluids in Plant-stems: Prof. R. J. Anderson.

RÖNTGEN SOCIETY, at 8.30.—Experiments to Determine the Effects of Form and Winding upon Resonance Phenomena: Dr. Clarence A. Wright.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Suggestions respecting the Institution of Mining Engineers: Prof. R A. S. Redmayne.—Coal-mining in the Faroe Islands: G. A. Greener.—Tin-mining in the Straits Settlements, with a few Notes regarding Chinese Labour: W. T. Saunders.—Underground Temperatures, especially with regard to Coal-mines: Dr. Hoefer.—The Hammer-Fennel Tachymeter-theodolite: A. O. Eoll.—Notes on the Report of the Departmental Committee on the Use of Electricity in Mines: Sydney F. Walker.—A Comparison of Three-phase and Continuous Currents for Mining Purposes: Roslyn Holiday.—Electric and Compressed-air Locomotives: B. S. Randolph.—Work of Conveyors on Longwall Faces: Robert G. Ware.

CHEMICAL SOCIETY, at 8.—*iso*Nitrosocamphor: M. O. Forster.—Imino-Ethers and Allied Compounds corresponding with the Substituted Oxamic Esters: G. D. Lander.—The Action of Heat on α-Hydroxycarboxylic Acids: Part I. α-Hydroxystearic Acid: H. R. Le Sueur.—The Basic Properties of Oxygen. Additive Derivatives of the Halogen Acids and Organic Compounds and the Higher Valencies of Oxygen. Asymmetric Oxygen: E. H. Archibald and D. McIntosh.

FRIDAY, JUNE 3.

ROYAL INSTITUTION, at 9.—The Development of the Theory of Electrolytic Dissociation: Prof. Svante Arrhenius.

INSTITUTION OF MINING ENGINEERS, at 10.30 a.m.—The Firing of Babcock Boilers with Coke-oven Gases: T. Y. Greener.—Explosives and Lamp Testing Station at Frameries: Victor Watteyne.—The Transvaal Kromdraai Conglomerates: A. R. Sawyer.—The Southern Rand Goldfield: A. R. Sawyer.—The Occurrence of Cinnabar in British Columbia: G. F. Monckton.—Prevention of Accidents in Winding: John H. Merivale.—Petroleum and its Use for Illumination, Lubricating and Fuel Purposes: P. Dvorkovitz.—The Analytical Valuation of Gas Coals: G. P. Lishman.—A New Process of Chlorination for Mixed Gold and Silver Ores: H. F. Brown.—Graphite-mining in Ceylon and India—Part I. Ceylon: G. A. Stonier.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology and Prehistoric Anthropology of the Hastings District, with Special Reference to the Excursion of June 11: W. J. Lewis Abbott.

SATURDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—Spitsbergen in the Seventeenth Century: Sir W. Martin Conway.

MONDAY, JUNE 6.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The loss of Nitre in the Chamber Process: J. K. H. Inglis.—Acetone—its Manufacture and Purification: A. Marshall.—A New Method for the Estimation of Tannin: J. Gordon Parker and E. E. M. Payne.

ARISTOTELIAN SOCIETY, at 8.—Primary and Secondary Qualities: Prof. G. F. Stout.

INSTITUTE OF ACTUARIES, at 5.—Annual General Meeting.

TUESDAY, JUNE 7.

MINERALOGICAL SOCIETY, at 8.—On Cobaltiferous Mispickel from Norway: Rev. Mark Fletcher.—On an Improved Form of Refractometer: G. F. Herbert Smith.—Notes on the Development of the Kimberley Diamond Mines, with Lantern Illustrations: Prof. H. A. Miers, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On some New or little-known Butterflies, mainly from High Elevations in the N.E. Himalayas: Lieut.-Col. J. Malcolm Fawcett.—On Seasonal Phases in Butterflies: Dr. A. G. Butler.—Note on an Apparently Abnormal Position of the "Brephos" within the Body of a Skink (*Chalcides lineatus*): F. E. Beddard, F.R.S.—On the Rare Rodent *Dinomys branickii*, Peters: Dr. E. A. Goeldi.—On the Black Wild Cat of Transcaucasia: C. Satunin.—On a Buffalo Skull from East Central Africa: R. Lydekker.—On Two New Labyrinthodont Skulls: Dr. A. Smith Woodward, F.R.S.

WEDNESDAY, JUNE 8.

GEOLOGICAL SOCIETY, at 8.—The Palæontological Sequence in the Carboniferous Limestone of the Bristol Area: A. Vaughan.—The Evidence for a Non-Sequence between the Keuper and Rhætic Series in North-west Gloucestershire and Worcestershire: L. Richardson.—On a Small Plesiosaurus-Skeleton from the White Lias of Westbury-on-Severn: W. F. Gwinnell.

VICTORIA INSTITUTE, at 4.30.—Annual Meeting. The President, the Lord Chancellor, F.R.S., will deliver the annual address.

THURSDAY, JUNE 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Ossiferous Cave-Deposits of Cyprus, with Descriptions of the Remains of *Elephas cypriotes*: Miss D. M. A. Bate.—On the Structure and Affinities of Palæodiscus and Agelacrinus: W. K. Spencer.—On the Physical Relation of Chloroform to Blood: Dr. A. D. Waller, F.R.S.—Contributions to the Study of the Action of Sea-Snake Venoms: Sir Thomas R. Fraser, F.R.S., and Major R. H. Elliot, I.M.S.—On the Action of the Venom of *Bungarus coeruleus* (the Common Krait): Major R. H. Elliot, I.M.S., W. C. Sillar and G. S. Carmichael.—On the Combining Properties of Serum-Complements and on Complementoids: Prof. R. Muir and C. H. Browning.—Notes on the Statolith Theory of Geotropism: F. Darwin, For.Sec.R.S., and D. F. M. Pertz.

MATHEMATICAL SOCIETY, at 5.30.—The Application of Poisson's Formula to Discontinuous Disturbances: Lord Rayleigh.—Some Expansions for the Periods of the Jacobian Elliptic Functions: H. Bateman.—Types of Covariants of any Degree in the Coefficients of Each of Any Number of Binary Quantics: P. W. Wood.

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.—Annual General Meeting.

FRIDAY, JUNE 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—On *Damayantia smithi*, Godwin-Austen and Collinge: Lt.-Col. H. H. Godwin-Austen.—Descriptions of Twenty-nine Species of Gastropoda from the Persian Gulf, Gulf of Oman, and Arabian Sea, dredged by Mr. F. W. Townsend, 1903-4: J. Cosmo Melvill.—*Conus Coromandelicus*, Sin, its Probable Affinities and Systematic place in the family Conidæ: J. Cosmo Melvill.—Descriptions of New Marine Shells from the Collection of the late Admiral Keppel: G. B. Sowerby.—Note on *Voluta brazieri*, Cox: E. A. Smith, I.S.O.—On *Doris planata* of Alder and Hancock: Sir C. Eliot, K.C.M.G.—Description of a Helicoid Land Shell from Central Australia: J. H. Ponsonby.—On Some Semi-fossil Land Shells found in the Hamakua District, Hawaii: C. F. Ancey.

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