THURSDAY, MAY 15, 1902.

THE REPRINT OF STOKES' PAPERS.

Mathematical and Physical Papers, vol. iii. By Sir G. G. Stokes. Pp. viii+451. (Cambridge University Press, 1901.) Price 15*s*.

THE issue of the first volume of this work in the year 1880 was the beginning of the valuable series of reprints of mathematical and physical papers for which we are indebted to the Cambridge Press. It was felt at the time that no more auspicious beginning could have been made, and the publication was widely appreciated; but a gradual and increasing sense of disappointment supervened when, after the second volume, the continuation seemed to be suspended indefinitely. A third instalment has however now appeared, after the lapse of eighteen years, and although the regrets we have referred to cannot be altogether appeased, the contents of the volume will assure it of as hearty a welcome as was accorded to its predecessors.

There is little to be said now by way of comment on papers which have, most of them, long ranked as classics. The volume opens with the memoir on pendulums. The first, or theoretical, part of this contains the germ of almost all that has since been written mathematically on the subject of viscosity. In addition to the main topic, viz. the effect of viscosity of the air on the linear vibrations of a sphere or of a circular cylinder, we find the theory of the oscillating disc employed in Coulomb's experimental method (afterwards greatly improved by Maxwell), the calculation of the terminal velocity of a globule of water descending in air, and the general formula for the dissipation of energy in a viscous fluid, with (as an example) a discussion of the effect of viscosity on water waves. To appreciate fully the originality of this paper we must bear in mind that up to that time the subject had hardly advanced beyond the formulation of general equations; moreover, that a good deal of the analysis here applied to special problems was new, and devised expressly for the occasion; in particular, in the question of the oscillating cylinder an extremely difficult point in the theory of what are now known as Bessel's Functions was resolved with great success and for the first time. The second part of the paper consists of a comparison of the mathematical theory with Baily's experiments on pendulums, and includes the first numerical estimate of the coefficient of viscosity (μ) for air. The value thus obtained, although of the right order of magnitude, is considerably less than that now generally accepted; and, indeed, for the experimental determination of this constant the pendulum method would seem to be not specially appropriate. One source of uncertainty in the present determination is that μ was assumed, on the strength of an experiment of Sabine, to be proportional to the density, whereas Maxwell has since shown that for the same gas μ varies only with the temperature. The author tells us that one reason for the long delay in the appearance of this volume has been a design of revising the calculations from the point of view of Maxwell's result. This design is now abandoned, but an interesting note is inserted, explaining how it comes about that the erroneous assumption had so little effect on the *consistency* of the results. Another note, which also now appears for the first time, deals with the question as to the existence of *two* constants of viscosity for a gas. The usual formal theory, which makes no appeal to molecular hypothesis, leads to stress-formulæ of the types

$$p_{xx} = -p + \lambda\left(\frac{du}{dx} + \frac{dv}{dy} + \frac{dw}{dz}\right) + 2\mu\frac{du}{dx}, \text{ \&c.,}$$

$$p_{yz} = \mu\left(\frac{dw}{dy} + \frac{dv}{dz}\right), \text{ \&c.,}$$

involving the two constants λ, μ. The former of these is eliminated if we denote by p the *mean* normal pressure about the point (x, y, z), viz. we then have $\lambda = -\frac{2}{3}\mu$; but the question remains whether the p thus defined is identical with the "pressure" referred to in the statement of the Boyle-Mariotte law. The identity is assumed by most writers on the subject, and is supported by Maxwell's molecular theory; but it cannot be said that there is as yet any decisive experimental evidence on the point. There is a real physical question involved, viz. as to whether a *uniform* expansion or contraction of a gaseous mass does or does not involve dissipation of energy by viscosity.

The calculations of this memoir are, of course, based on the usual assumption that the terms of the second order in the velocities may be neglected. It has only lately been realised, thanks to a remark of Lord Rayleigh, to what an extremely narrow range of velocities we are sometimes confined by this limitation.

The next paper in the book discusses the effect of radiation of heat on the propagation of sound. It is shown that very slow and very rapid vibrations will alike be propagated without sensible thermal dissipation, the former with the "Newtonian" and the latter with the "Laplacian" velocity, whilst for intermediate frequencies there would be a real degradation. The investigation is reproduced, and extended to include thermal conduction, in Lord Rayleigh's "Theory of Sound."

The memoir on the most general form of the equations of conduction of heat in crystals is remarkable historically, and also on account of the attention paid to the possible occurrence of the "rotatory" coefficients. These are finally dismissed as improbable, but their analogues have in recent times been appealed to to explain certain phenomena of electric conduction under magnetic influence.

The remaining papers deal with optical questions. Those on the colours of thick plates and on the composition and resolution of independent streams of polarised light are important applications of established principles of physical optics; but the most notable in some respects is the great memoir on Fluorescence, with which the volume closes. This masterly analysis of the nature of the phenomenon was more fortunate than some of the author's previous work in the attention which it immediately attracted, not only at home, but abroad.[1] A

[1] Prof. Stokes' work on "Attractions and Hydrodynamics" was long neglected on the continent. I recall a sally of Maxwell's in one of his early lectures at Cambridge. Incidentally he remarked (with, I think, some investigation of Stokes in his mind), "But foreign men of science don't read the Cambridge *Transactions*"; then, guessing from the smiles of some of the audience that his words might be taken ambiguously, he added very emphatically, "It would be a good thing if they did!" One particular instance of erroneous ascription has a curious vitality. In a book dated 1900 we read, "Die Bewegung der Kugel in einer Flüssigkeit ist zuerst von Dirichlet behandelt," and in another dated last year, "Dies ist der von Dirichlet zuerst durchgeführte Fall." Yet both works are written by highly accomplished authors, with a sense of mathematical history.

D

most interesting note is now appended, in which the "Stokes theory of fluorescence," to which references have been made from time to time by Lord Kelvin and others, is expounded for the first time in the author's own words. Apart from the special application, the dynamical problem here employed by way of illustration is remarkable as the first example of the peculiarities of wave-propagation in a medium of "periodic" structure, a question which has been further elucidated by Lord Rayleigh.

The dates attached to the papers in this volume are all included in the interval from 1850 to 1852. The marvellous productiveness of the author, and the massive quality of the work which has left so little opening for subsequent correction or criticism, alike command our admiration. At the same time, we realise how great were the powers which from that period onwards were claimed in an increasing degree by the duties of the Lucasian professorship and by the secretaryship of the Royal Society. The generous and sympathetic manner in which these powers were placed at the service of younger workers now become a tradition of English science.

At the end of the preface we read, "There are other papers which still remain, and I hope, should life and health last, to put these together without delay." The "other papers" here so modestly referred to include such things as the "Communication of Vibrations" and the "Report on Physical Optics"! That the life and health may long continue, and that the promised continuation may speedily appear, will be the earnest desire of every reader of this volume. HORACE LAMB.

ANTHRACITE MINING IN PENNSYLVANIA.

The Anthracite Coal Industry. By Peter Roberts, Ph.D. Pp. xii + 261. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1901.) Price 15*s.* net.

IT is not often that a great industry is discussed in so thorough and useful a manner as has been done by Dr. Roberts in this case. He has brought together information from a large number of sources, and he presents pictures from many points of view; his twelve chapters relate to geology, methods of mining, capitalisation, transport, management and inspection, workmen and wages, incidental profits, accidents, strikes, unionism, reworking old waste heaps and general reflections.

The days of the "mammoth vein," often exceeding 100 feet in thickness, are coming to an end, and we learn that much of the anthracite is obtained from seams only two to four feet thick. It is estimated that, allowing a yearly output of sixty million tons, the stock of anthracite will last for eighty years.

The actual cost of production is reckoned to be $1·25 a ton, to which must be added royalties, insurance, office expenses and taxes amounting to about thirty-one cents, so that the total cost is about $1·56.

Much has been said in this country about the danger of employing a few Poles in our collieries, on account of their imperfect knowledge of English. What should we think of a mining population talking twenty different languages, as happens in parts of the anthracite region? The majority of the alien colliers hail from Russia and Austro-Hungary. The author's ethnology is at fault, however, when he says that the Bohemians do not belong to the Sclav nations.

The chapter upon the incidental profits made by mining companies from running stores is by no means the least interesting; it seems that the truck system still flourishes in Pennsylvania, in spite of legislation against it, and that the workmen have a real grievance.

The accidents follow the usual lines; as in other districts, the proportion of fatalities due to falls of coal and rock approaches one-half of the total. The truth of the assertion that most of the accidents are due to carelessness on the part of the men themselves may be doubted, though the apologists of the owners and managers of mines on this side of the water are too ready to endorse this statement. Recent statistics show that, at all events in Germany, it is incorrect.

The author takes an unnecessarily pessimistic view concerning mining fatalities when he remarks that legislation is impotent to prevent them; the experience of European countries is totally opposed to this conclusion. However, a cursory glance at the statistics for Pennsylvania might lead an outsider to agree with Dr. Roberts, for he shows that after years of law-making the annual mortality-rate from accidents exceeds 3 per 1000. Unfortunately, he fails to make it clear whether this is the death-rate of the underground workers alone or that of all the persons employed both below and above ground. But in either case it is very high and very discreditable, and, what is worse, there are practically no signs of improvement during the last quarter of a century.

One cannot help suspecting that an inefficient method of enforcing the law may be at the root of the evil. Instead of being appointed for life, the inspectors hold office for five years only, and at a salary which in America may fail to secure thoroughly trustworthy and independent persons. It is not surprising, therefore, to find the suggestion that the inspectors are in the hands of the mine-owners. By a law which has come into force recently, the number of inspectors is to be increased, and they are to be elected by popular vote and for three years only. It will be interesting to watch how far this change will remedy the dangers of anthracite mining. Even if the next decade does show an improvement, it will not be necessary to ascribe it to the new inspectorial system. The author points out that a very powerful syndicate has lately acquired the control of four-fifths of the entire anthracite industry, and that with better administration, better discipline, improved methods of mining and increased use of machinery, the present dire waste of human life is likely to be diminished without any further legislative pressure.

While dealing specially with the anthracite industry, the author discusses various social and economic problems, and his book deserves the attention of mining men generally, whether employers or employed. It is a matter for regret that we have not similar works relating to each of our own coalfields, or at all events a general treatise dealing in a like manner with coal-mining in the British Isles.

ORGANOGRAPHY AND ITS RELATIONS TO BIOLOGICAL PROBLEMS.

Organographie der Pflanzen insbesondere der Archegoniaten und Samenpflanzen. Von Dr. K. Goebel, Professor a.d. Universität München. Zweiter theil, Heft 2 (schluss); mit 107 Abbild i. Text. (Jena: Gustav Fischer, 1901.)

THOSE who have read the parts of Prof. Goebel's "Organographie der Pflanzen" which have previously appeared will welcome the volume now before us, although perhaps with mixed feelings, in that it marks the conclusion of an interesting and suggestive work.

The present part is mainly devoted to a consideration of the shoot in relation to the reproductive functions, and the author has succeeded in presenting his subject in an admirable form. Many new observations will be noticed by the reader, and much besides of what is now familiar to botanists represents the outcome of original investigations conducted in the Munich laboratory. Some of the questions touched on are of a rather thorny nature, and Prof. Goebel is to be congratulated on the generally fair and judicious attitude which he preserves in regard to controversial issues thus incidentally raised.

As might have been anticipated, the account of the varied adaptations for the protection of sporangia, as well as for their dehiscence and the dispersal of the spores, is full of interest, and not less so is the treatment of the annulus regarded from a slightly different point of view. The diverse aspects of the same problem, when looked at from the standpoint of phylogeny or of utility, are well exemplified by the discussion based on the structure in question. The physiological stimulus which evokes what may turn out to be an *adapted* structure can only operate on and through the particular mechanism of the organism which can respond to it. And it is just this consideration which gives the clue that may enable us to understand the hereditary nature of a character which at first sight appears to be merely adaptive, and to see also how its importance as a criterion of toxonomic value is determined.

The vexed question as to the homologies of the structures met with in the female cone of the Coniferæ is briefly discussed, especially in relation to the abnormalities which have in the past played an important part in this connection, and the author well indicates the difficulties in correctly appreciating both the value and the cogency of this kind of evidence.

The chief deviations from the primitive character of a simple flower are also dealt with, and provide a good summary of our knowledge of the more salient facts. Some will probably hesitate to fully accept the case of *Pyrus malus* as representing a *real* transition from the perigynous to the epigynous form of gynæcium. The mature structure, as well as the developmental evidence, indicates (it may be argued) that this is a case of true perigyny, only somewhat obscured by the circumstance that the original and widening floor of the carpels has been tilted up instead of forming a horizontal expansion. It may be remarked in passing that the ovary of Primula is regarded as formed of five "paracarpic" carpels, and that the placenta is considered in this plant to represent a new formation, *i.e.* it consists of neither axis nor leaf as morphologically distinguishable. It is also remarked that the evidence which has been derived from a study of the distribution of the vascular strands is apt to prove ambiguous; the strands themselves are extremely variable and depend entirely on the physiological requirements of the ovules.

In dealing with the sporangia, the author makes the interesting suggestion that a feature of great diagnostic importance in separating angiosperms from gymnosperms may be found in the epidermal character of the cells which effect dehiscence in the microsporangia of the latter, whilst they are of hypodermal origin in the angiosperms.

Finally, the volume is brought to a close by an excellent account of many of the recent investigations on the biology of the embryo sac, in the elucidation of which Prof. Goebel's own pupils have taken an active part.

The book, as a whole, is characterised throughout by a freshness and vigour which is the outcome of a first-hand knowledge of the facts upon which it is based. Furthermore, whilst marking a definite advance as containing a large number of new facts, and especially as emphasising new points of view, it is a work which cannot fail to stimulate further research in many new directions.

J. B. FARMER.

OUR BOOK SHELF.

The Hurricanes of the Far East. By Prof. Dr. Paul Bergholz. English Translation, revised by Dr. Robert H. Scott, F.R.S. Pp. xvi + 271. (Bremen: Max Nössler; London: Norie.)

THIS book is a translation of Prof. Bergholz' "Orkane des fernen Ostens," and is intended as a seaman's guide to the typhoons and hurricanes of the China seas, of similar type to Eliot's "Handbook of Cyclonic Storms in the Bay of Bengal." It is, in fact, a digest of the results of the work of Vinez, Eliot, Doberck, Faura, and more especially of the recent papers of Algué, in much the same way as Eliot's "Handbook" is a digest of the elaborate "Cyclone Memoirs."

Prof. Bergholz divides his manual into four sections. The first deals with the general aspects of cyclonic phenomena—the structure of the cyclone itself, and the seasonal and geographical variations in its progressive movements. The typical cyclone is divided into four concentric zones, A, B, C, D; the zones A and B belong to the "outer whirl," C and D to the "inner vortex." Zone A extends from 120 to 500 miles from the centre, and is characterised by a slow fall of the barometer which does not seriously modify the diurnal curve of pressure. In zone B the centre is distant 60 to 120 miles, and the barometer shows a "distinct fall," which does not obliterate the daily curve, but displaces the hours of maximum and minimum. Zone C is a belt of "rapid fall," 10 to 60 miles from the centre; in it the diurnal curve disappears altogether. Zone D is a circle extending to 10 miles from the centre, within which the fall is "very rapid."

The classification of the cyclones runs along two lines, according to either the seasonal distribution or the course of the track followed by the system. The first becomes in effect a basis for subdivision of the main headings of the second, which are four in number:—(1) Cyclones of the Pacific, subdivided into cyclones of Japan and cyclones of the Magalhaes, (2) Cyclones of the China Sea exclusively, (3) Cyclones of the China Sea including the typhoons of Mindanao, Visayas and Luzon, and (4) Cyclones of the Philippines. A further classification, useful for some purposes, is made according to the rate of motion of the cyclone in its path. In connection with this part of the subject, a valuable series of plates gives monthly averages of pressure and temperature, diurnal barometer curves, and a chart of cyclone tracks.

The second part of the book deals with the indications of the approach of cyclones. While the whole section is of immense practical value, two chapters, on the photography of clouds by the photo-theodolite and photographic means of distinguishing true from false cirrus, and on Fournier's rule and the use of Algué's barocyclonometer, are of special scientific interest. The third section describes special characteristic cyclones, with a chapter on anomalies, and the fourth treats of winter or land storms.

Bird Hunting on the White Nile. By H. F. Witherby. Pp. 117; illustrated. (London: *Knowledge* Office, 1902.)

MR. WITHERBY may be congratulated, not only on having made a very successful bird-collecting trip to the White Nile, but also on having presented a narrative of his experiences to the public in an agreeable and well-written form. The several chapters of the book originally appeared as articles in *Knowledge*, from which they have been reprinted with the addition of two appendices and various slight amendments. The illustrations are also somewhat more numerous. The author tells us that he was unfortunate enough to lose all the photographs he took himself, owing to the intense heat and dryness; but he fortunately had with him a taxidermist who met with better luck in this respect, and it is to this gentleman that readers are indebted for the very interesting series of pictures with which the book is illustrated. Khartum is likely to become a popular winter resort, and tourists interested in the natural history and people will find Mr. Witherby's work an excellent and entertaining guide for the trip.

As is indicated by the title of his volume, the author had for his main object the birds of the country visited, and of these he was successful in obtaining a large number of species, of which a list is given in the appendix. Mammals, as is so generally the case, appeared to be excessively rare, and but few specimens were secured; these, however, proved to be of some interest, as they included a bat, a mouse and a hare which have been described as new. Mr. Witherby intersperses his ornithological observations with accounts of shooting and notes on the manners and customs of the natives in a way calculated to attract the attention of readers of all classes. Unfortunately, he was unable to obtain any evidence on the question whether the "crocodile-bird" really enters the mouth of the unwieldy reptile from which it takes its name. R. L.

An Introduction to Chemistry and Physics. By W. H. Perkin, jun., Ph.D., and Bevan Lean, D.Sc. Two volumes. Pp. xviii + 207 and xii + 216. (London: Macmillan and Co., Ltd., 1901.) Price 2*s.* each.

THE special feature of these two small volumes is the treatment of the subject on historical lines, which is certainly a scientific method; for the young mind is asked to travel along the same track which the growth of the ideas has taken. This method lends itself to a more literary style than that of mathematical reasoning; and this, we think, is a gain, as the children in many science schools, where the time is chiefly taken up with science and mathematics, have little opportunity for such training.

Broadly, the first volume deals with physics and the second with chemistry. The metric system is explained at length, but we must confess that we should have preferred to see the gram described as a standard of mass and not of weight. It is certainly not true to say that a gram is *strictly* the weight of a cubic centimetre of water at 4° C., as the authors insist in the footnotes on pp. 18 and 20. It would not have been necessary to call attention to this had not great stress been laid on the fact that a metre is not exactly what it was originally meant to be.

In the experiments an accuracy of 1 per cent. is aimed at, yet in fixing the boiling point graduation on a thermometer, p. 43, the influence of the atmospheric pressure is not stated.

The present writer recently examined some 600 candidates in experimental science, and is able to trace many of their answers in these two books. As a rule these candidates seemed to follow the work well, but in some cases the principles of the experiments seemed beyond their power. Of all the quite elementary works of this class, perhaps these before us can be most strongly recommended to the consideration of the teachers in primary and secondary schools. S. S.

The Oil Chemists' Handbook. By Erastus Hopkins, A.M., B.Sc. Pp. viii + 72. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1900.) Price 3 dollars.

AS stated in the introduction, the book has been written with the idea of supplying a want which has been felt for some practical working manual containing methods of examining oils and also data which will assist in the easy detection of adulteration and also give information as to what the adulterant is. The first chapter consists, in the main, of a series of tables of the general properties and uses of the oils and fats met with in commerce and of the solubility of oils, fats and waxes in various solvents. Following this are given the principles of the chief tests—the Maumené, Elaïdin, Warren's sulphur chloride test, &c.—and then, without an excessive amount of detail, the methods of analysis, in all cases references being given to the literature of the processes. The tables of chemical and physical constants which follow form an exceedingly useful collection, though the list might with advantage be a more complete one. In these tables the results of different observers are shown rather than mean figures, and the authors' names are given. In fact, this quotation of sources of information forms a distinct and important feature of the whole book.

Decidedly useful is a series of five tables arranging oils, fats and waxes according to (*a*) saponification value, (*b*) iodine value, (*c*) Reichert Meissl value, (*d*) Hehner value, and (*e*) acetyl value. The final chapters deal with, fatty acids, unsaponifiable matter (such as mineral oils, &c.), lactones, resin and glycerol.

Speaking generally, the book forms a valuable working companion for the oil chemist, without being a mere reference book.

Elements of Botany. By W. J. Browne, M.A. Lond., M.R.I.A. Fifth edition. Pp. viii + 272. (London: John Heywood, 1901.) Price 2*s.* 6*d.*

WHAT is required of the elementary text-book nowadays is that it should furnish suitable directions and sufficient instruction to enable a student to collect, examine and work out the structure of plants for himself. The present work unfortunately follows the old style, being for a great part a mere catalogue of terms, or a series of descriptions, somewhat dry, relating to parts of the plant. In other respects, too, the book is quite unsuited to modern teaching; the appearance of Torula early in the book, presenting a huge nucleus, the idea that anatomical sections may be cut with a knife, the enumeration of the twenty-four classes of the Linnæan system, all suggest that the book has not yet been sufficiently modernised.

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.*]

Mont Pelée Eruption and Dust Falls.

FALLS of dust are caused in two ways; either the dust, as for instance Sahara sand, is transported by means of the lower air-currents over wide areas, or matter is ejected from volcanoes, thrown high up into the air and carried by the upper currents, falling eventually in places at great distances from the seat of disturbance. The eruption of Krakatão is a good example of the latter case, while the dust fall that occurred last year in March and was recorded in northern Africa, southern and northern Europe is a good representation of the former kind of dust fall.

The occurrence of such falls of dust is very interesting meteorologically, because they afford us means of increasing our knowledge of the actual movements of the air-currents, both low down and high up in our atmosphere. Falls of dust originating from volcanic eruptions are perhaps of greater interest, because the dust in such cases is thrown to very great heights, and we are able to deduce the directions of the currents at this elevation, there being no other method of doing so available.

To those interested in the movements of these upper currents, the recent disastrous eruption of Mont Pelée in Martinique may afford us some valuable information on this subject. From the accounts of the eruption already published, it is found that it occurred on May 8, and we gather from the information supplied by the British schooner *Ocean Traveller*, and printed in the *Times*, that when the ship was about a mile off St. Pierre, the volcano on Mont Pelée *exploded*. That the eruption was on a stupendous scale is undoubted from the numerous descriptions already made public, and the report from the British steamer *Esk*, which passed St. Pierre, that "she was covered with ashes although five miles distant from the land, and from on board nothing could be seen owing to the impenetrable darkness," gives some idea of the result of the disturbance. Later reports have indicated a further spreading of the dust, the island of Dominica recording a fall of sand on its southern boundary.

It is interesting for a moment to make a brief survey of the atmospheric circulation in the lower and upper reaches of the atmosphere in the region of the West Indies and to the north and south, and see whether we can trace out the probable path of the fine dust thrown into the air.

An examination of the fine pressure charts published in Bartholomew's "Atlas of Meteorology" tells us that during the month of May the West Indies lie between, but a little to the west of, two high-pressure regions, the more northern one being situated in the Atlantic Ocean and that to the south over the centre of South America, the intervening belt being one of low pressure. We also know that the sun has a declination of about 17° north at this time, and as the island of Martinique is situated in latitude about 15° north, the sun therefore passes daily near the zenith of that place, or, in other words, the sun is exerting its greatest heating power. In consequence of this fact, the low-pressure belt has a maximum in this region, and a low-pressure area means that the air is rising from the earth's surface into the higher regions. The two high-pressure areas already mentioned correspond to downcast shafts of air, *i.e.* air moving from higher to lower regions. With our present knowledge of atmospheric circulation it seems most probable that the heated air, rising into the upper reaches of the atmosphere from the low-pressure region (which includes the West Indies), bifurcates in a north-easterly direction in the northern hemisphere and in a south-easterly direction in the southern hemisphere. Since these currents of air must again reach the earth's surface, where they fall they will give indications of high pressure, *i.e.* indications of descent of air. As the two high-pressure areas already mentioned lie in the correct positions and directions in relation to the West Indies, it seems very probable that these are the downcast shafts corresponding to the upcast shaft or low-pressure area.

If the circulation above mentioned be correct, then, as the region of the volcanic eruption of Mont Pelée lies in this low-pressure area, some of the finest particles ejected to the upper reaches of the atmosphere might possibly be carried in these currents and begin to fall in these high-pressure areas. They may also, if the dust be thrown sufficiently high, reach that elevated current of air travelling from east to west and make a circuit of the earth, as was the case in the eruption of Krakatão.

The most favourable position in the northern hemisphere to observe this fall of dust, should there be such, would be probably in the middle of the Atlantic Ocean, and this could only be recorded by passing ships. Since, however, the descending air moves in a spiral manner and in the direction of the hands of a watch, some of this current reaches Britain as a south-west wind, and it will be interesting to see whether any fall be recorded. There seems little doubt, however, that, just as in the case of Krakatão, a great fall of dust fell to the westward of the volcano, so we shall probably soon hear in this case of such records from Mexico and Central America.

Further, the eruption of Krakatão was responsible for the magnificent coloured sunsets that were observed nearly all over the world, and as these were due to the fine dust particles ejected from the volcano—particles at very great altitudes—so it is quite probable that similar effects will ensue from the eruption of Mont Pelée.

It seems desirable, therefore, that information relating to the present eruption should be collected while facts are still in the memory of those who have observed them, and that a complete account be recorded similar to that published on the Krakatão eruption. It is satisfactory to learn that already expeditions are about to be sent from the United States of America to investigate the scene of the eruption.

WILLIAM J. S. LOCKYER.

Symbol for Partial Differentiation.

IN my college days we used the symbol $\left(\frac{du}{dx}\right)_y$ or $\left(\frac{au}{dx}\right)$ (if there was only one other independent variable y) as the differential coefficient when y was constant. I still keep to this symbol. Thus, if k is a certain kind of thermal capacity, $\left(\frac{dk}{dt}\right)_v$ or $\left(\frac{dk}{dt}\right)_p$ or $\left(\frac{dk}{dt}\right)_\phi$ are in my thermodynamic work perfectly definite. The mathematicians have introduced the convenient symbol for a partial differential coefficient $\frac{\partial u}{\partial x}$, and in much work there is no doubt about the meaning. But even in hydrodynamics there is trouble. In thermodynamics there is so much trouble with this symbol that I venture to ask for help.

The German translator of one of my books uses the same symbol $\frac{\partial k}{\partial t}$ for each of the above quite different things. Baynes in his thermodynamics does the same, and so do all other writers; it seems to me that everybody is doing this without thought. Are they writing for the average examination man who does not need to think, or for the real student? If the letter ∂ is to be retained, would it not be possible to use $\frac{\partial k}{\partial_v t}$ or $\frac{\partial k}{\partial_p t}$ or $\frac{\partial k}{\partial_\phi t}$ in the above three cases? I encourage my own students to use ∂, and I speak in the interest of such men. For myself it does not much matter, as I mean to continue using the symbolism of my youth.

JOHN PERRY.

May 6.

The Pines of Western Asia.

ON p. 15 of NATURE of May 1, it is stated that Herr Hugo Bretzl, in a thesis for his Doctorate at Strassburg, has shown that "the Greeks realised such facts as the absence of the pine in all the countries which intervene between Macedonia and India." That this statement is erroneous is proved by the following facts relating to the distribution of Macedonian and other species of *Pinus* in the countries alluded to. *P. Pinea*, Anatolia and Syria; *P. sylvestris*, Asia Minor, the Caucasus and Tauria; *P. halepensis*, Anatolia, Transcaucasia, Syria; *P. Brutia*, Asia Minor, the Lebanon, N. Persia; *P. Laricio*, Asia Minor. To these should be added various species of *Picea* and *Abies*, which the Greeks may have included under *Pinus*.

J. D. HOOKER.

THE pine referred to is *Pinus excelsa* Wall., which forms a feature of the Macedonian Mountains and also of the Himalayas, but has not been found between Macedonia and Afghanistan. (Brandis, "Forest Flora of North-West and Central India," p. 511). Our thanks are due to Sir Joseph Hooker for pointing out that the statement as it stands suggests a wrong inference.

THE WRITER OF THE NOTE.

The Kinetic Theory of Planetary Atmospheres.

THE much-debated question of the applicability of the kinetic theory to decide what gases can and what gases cannot exist in the atmospheres of planets is necessarily once more raised by a somewhat striking paper by M. E. Rogovsky in the *Astrophysical Journal* for November, 1901. In performing certain calculations contained in this paper which are embodied in Table III. (p. 254), the author bases his work on the assumption (p. 252) that ". . . the equation

$$W = \frac{\sqrt{(2ag)}}{10{\cdot}22}$$

where W is the most probable velocity of the molecules of a gas, gives the minimum most probable velocity in a gas which escapes from the surface of the given celestial body."

This is equivalent to assuming that a gas will escape if the velocity required by a molecule in order to overcome the planet's attraction and fly off to infinity (if it does not collide with other molecules) is not more than 10·22 times the most probable velocity.

Now if we calculate the probability of a molecule attaining a speed of 10 times the most probable velocity (to use round numbers), we find that the expression for this probability involves a factor of the form e^{-100}, that is about 10^{-43}, and this alone is sufficient to show that it is so rare for a molecule to attain a speed of 10 times the most probable velocity that such events cannot possibly have any appreciable effect on the planet's atmosphere.

Let us examine the matter a little closer, and in the first instance let us calculate the average proportion of molecules in any gas which have at any instant speeds of *not less* than 10 times the most probable velocity. The numerical result we obtain is

$$1 \text{ in } 2{\cdot}4 \times 10^{42}.$$

To interpret this result, let us suppose we are dealing with a gas one cubic centimetre of which contains 10^{21} molecules; this figure giving a rough estimate of the number of molecules in a cubic centimetre of air of ordinary temperatures and pressures. Then a volume of this gas equal to 2·4 times a cube the side of which is 100 *kilometres* will have to be taken in order that there may be an average of *one* molecule moving with a speed of 10 times the most probable velocity.

So far our calculations do not involve any considerations of *time*, although this must necessarily enter into the problem of escape of gas from a planet's atmosphere. Let us therefore now suppose the mass of gas under consideration to be bounded by a surface S, and let it further be supposed that every molecule which impinges on S with a speed greater than 10 times the most probable velocity escapes. Let the most probable velocity of the molecules be 1093 metres per second, the number assumed by M. Rogovsky for helium on p. 252 of his paper.

Then in order that the number of molecules removed in this way may be equal to the removal of a layer of the gas 1 millimetre thick all over the surface S, it will be necessary for about $2{\cdot}8 \times 10^{28}$ years to elapse.

Next suppose the surface S to be equal in area to the surface of our earth, namely a sphere 4×10^4 kilometres $= 4 \times 10^9$ centimetres in circumference. How many years would it take for a *cubic centimetre* of gas to escape? The answer comes out to be about $5{\cdot}371 \times 10^{10}$ years.

The only conclusion which can be drawn, not only from the present calculations, but also from others of a similar character [1] which have been made, is that a gas cannot escape from the atmosphere of a planet by the motion of its molecules among themselves without the aid of extraneous causes unless the most probable velocity of the molecules is considerably greater than one-tenth of the velocity required to overcome the planet's attraction.

If helium is actually at the present time escaping from our atmosphere, its escape must be due to entirely different causes, and has to be investigated by entirely different methods from those contained in M. Rogovsky's paper. At all events, a most probable molecular velocity of not more than one-tenth, corresponding to a kinetic energy of not more than one-hundredth of that required to carry a molecule of the gas to infinity cannot have much influence in helping a gas to escape from a planet's atmosphere. And so soon as outside influences are invoked, the ratio of velocities which forms the basis of that portion of M. Rogovsky's work here considered ceases to be the determining factor of the problem.

G. H. BRYAN.

Bangor.

[1] *Phil. Trans.* A, vol. cxcvi., pp. 1–24 (1901); also S. R. Cook, *Astrophysical Journal* January, 1900.

On Prof. Arrhenius' Theory of Cometary Tails and Auroræ.

THE letter of Dr. J. Halm in your number of March 6 is based on two misunderstandings into which the writer could not have fallen if he had seen Arrhenius' original papers (*Physikalische Zeitschrift*, November 1900), or my description of them in the *Popular Science Monthly* (January 1902), instead of the friendly but erroneous notice of my paper in the *Observatory*.

(1) Dr. Halm quotes Prof. Schwarzschild to show that Arrhenius' theory "appears to be incompatible with any assumption which regards the cometary matter as being of a gaseous constituency."

Arrhenius never suggested that gaseous *molecules* could be propelled by the pressure of light. To quote my account of his theory:—"As the comet approaches the sun, the intense heat causes a violent eruption of hydrocarbon vapours on the side towards the sun. The hydrogen boils off, and the vapours condense into small drops of hydrocarbons with higher boiling points, or ultimately solid carbon is thrown out, finely divided as in an ordinary flame. The largest of these particles fall back to the comet, or if they are not condensed till at a great distance from it, they form tails turned towards the sun. The smaller are driven rapidly from the sun by the pressure of its light, with a speed depending on their size, and form the ordinary tails pointing away from it. That particles of different sizes should be formed from the same comet is natural, since the comet is likely to be formed of heterogeneous materials, and there must be great variety in the circumstances of condensation."

Dr. Halm does mention the idea of condensation into drops, and remarks, "Whether such an assumption can be justified appears to me very doubtful." This, of course, is merely his opinion, and receives no authority from the calculations of Prof. Schwarzschild. Indeed, in a recent letter to me, Arrhenius points out that these results fit the theory remarkably well. As Dr. Halm says, Prof. Schwarzschild reckons that "the corpuscles thrown off in the tails of comets should have diameters not smaller than 0·07μ and not exceeding 1·5μ, supposing the specific gravity of the corpuscle to be that of water."

Now Arrhenius, in his original paper (November 1900), taking the specific gravity of the hydrocarbon drops to be 0·8, calculates the size of the particles required by his theory to account for the curvatures observed in the case of four different comets' tails, and finds them to be 0·1μ, 0·59μ, 0·94μ, 1·25μ. These values are distributed almost exactly over the interval within which light could exert a pressure greater than gravitation, according to the "exhaustive mathematical investigation" of Prof. Schwarzschild published a year later.

(2) Dr. Halm says:—"At any rate Prof. Schwarzschild's profound mathematical investigation makes it absolutely clear that the idea of minute electrically-charged corpuscles—about one-thousandth the size of a hydrogen atom (see *Observatory*)—being propelled by the sun's light towards the earth and causing the various phenomena of auroræ, Gegenschein, &c., receives no support from the mathematical point of view."

A reference to Arrhenius' paper and to my article will show that it is carefully explained in both that the charged (negative) particles are known to form excellent nuclei for condensation. It is the small drops so formed, and not the corpuscles, which, according to Arrhenius, are supposed to be driven off as far as the earth, and beyond it, giving rise to the auroræ, &c. As was seen above, Prof. Schwarzschild's results support such a view.

JOHN COX.

McGill University, Montreal, March 19.

THE object of my letter to which Prof. Cox refers was to draw attention to certain statements made in recent accounts of Arrhenius' theory which were disproved by Prof. Schwarzschild's computations. I was fully aware at the time that Arrhenius himself had already arrived at the conclusion that, to accord with his theory, the particles in the tails must be assumed to be liquid or solid. This was the necessary result of his computations, which had convinced him that the diameters of the particles must be between 0·1 and 6μ in order to satisfy Prof. Bredichin's values for the repulsive forces observed in comets. But how does Arrhenius' theory account for the presence of luminous vapours in the tail? In some recent comets the typical spectrum of the hydrocarbons was traced by Prof. Vogel to the farthest end of their tails. The emission of Comet 1881 iv. (Schaeberle) was almost entirely gaseous, and in Comet 1882 ii. even the sodium vapour was observed in the brighter parts of its luminous appendage. How are these vapours carried into the extreme parts of the tail, since the analysis of Prof. Schwarzschild shows that the pressure of light is far too insignificant to exert a repulsion upon the molecules of a gas or vapour?

Prof. Cox assumes the evaporation on the side facing the sun to be caused by the "intense heat" to which the comet is exposed on its approach towards our luminary. He thus attempts the revival of an hypothesis now abandoned by astrophysicists. Astronomers will find it somewhat difficult to comprehend how, for instance, the famous comet of 1811—one of the most remarkable phenomena of last century—which never approached the sun to the distance of our planet, could have received so intense a heat-supply that the "hydrogen of the hydrocarbons would boil off." But apart from this, the spectroscope has now clearly demonstrated the luminosity of the cometary substance to be due to disruptive electric discharges at a low temperature. The assumption of an "intense heat" causing the evaporation on the side towards the sun receives no support from the spectroscopic evidence. Moreover, the misty film surrounding the nucleus, the so-called atmosphere or coma, is certainly of extreme tenuity, and the mass of the comet cannot but be immeasurably small. Hence the hydrostatic pressure opposed to the outpouring vapours must be extremely insignificant. This necessarily involves low boiling points, so that condensation can only take place at very low temperatures. Hence we require at the same time an intense heat to boil off the hydrogen and an extremely low temperature to allow the condensation of the hydrocarbons into drops.

But even suppose that in spite of the intense heat and the low hydrostatic pressure condensation does take place on the side towards the sun, and that drops of hydrocarbons with less than the "critical" diameter are driven from the sun by the pressure of light. Can Prof. Cox demonstrate the possibility of these drops preserving their liquid state after having been launched into the vacuum of space? The permanent existence of drops of hydrocarbons in the tail is possible only under the condition that the space between the drops is saturated with hydrocarbon vapours. Here, then, we are again confronted with the question, How are these vapours carried into the tail, since the pressure of light has practically no repulsive power on the molecules of a gaseous substance? But if only drops, and no vapours, of hydrocarbon are repelled by the light-pressure, as Arrhenius assumes, what force prevents these drops from being instantaneously evaporated after once having departed from the outskirts of the comet's atmosphere and having started on their journey through the vacuum of space? Obviously the assumed drops ought to retain their initial bulk throughout the whole length of the tail, *i.e.* through a distance of hundreds of thousands of miles, all the time unsurrounded by any vapour, the tension of which might counteract the inherent tendency of the liquid to assume the gaseous state. Such an hypothesis is plainly impossible.

Prof. Cox mentions the possibility of solid particles being repelled by the light-pressure. He remarks that "ultimately solid carbon is thrown out, finely divided as in an ordinary flame." There is no objection to this assumption from the physical point of view. But is it sufficient to explain the characteristic forms of the tails and their classification into several distinct types? What reason can be adduced for particles of dust assuming only such dimensions as would lead in all the comets to only three or four particular repulsive forces out of an infinite number of possible varieties? Why have, for instance, in the forty comets investigated by Prof. Bredichin, the particles never assumed such dimensions as would correspond to types intermediate between Bredichin's first and second? The explanation of Prof. Arrhenius is very unsatisfactory. He says:—"Wenn nun zufolge gewisser Umstände einige Tropfengrössen die gewöhnlichsten sind, so können die wohlbekannten, relativ scharf begrenzten Schweife von verschiedener Krümmung entstehen." No attempt is made in his paper to show what these "certain circumstances" are, nor why they should lead to the same types of tails in comets with widely different conditions of evaporation and condensation. The results of Bredichin seem to me indeed to be irreconcilable with the present version of Arrhenius' theory, which in no way explains the remarkable selection of repulsive forces discovered by the distinguished Russian astronomer.

Another difficulty has been pointed out in my previous letter. It relates to the peculiar behaviour of the coma. In some comets a contraction of the coma has been observed on the approach of the comet towards perihelion, succeeded by an expansion after the perihelion had been passed. Thus the diameter of the coma of Encke's comet in 1838 was found by Valz to have shrunk from 280,000 miles at the solar distance 1·42 to only 3000 miles at perihelion. How is this phenomenon to be explained by the pressure of sunlight? In many instances (Comet 1862 ii., Respighi's and Henry's comet among others) the coma retained its globular form while the tail spread out and assumed enormous dimensions. But the spectroscope has now demonstrated that no difference exists between the coma and the tail with regard to the physical and chemical constitution of their materials. Hence the question remains still open why the pressure of light should repel the materials of the tail and yet at the same time leave the same materials in the coma entirely unaffected.

My objection to the theory of Arrhenius refers to those parts where he introduces Maxwell's pressure of light. I am perfectly at one with the Swedish physicist and with Prof. J. J. Thomson regarding the important part probably played by the negative electrons emitted by the celestial bodies. But I fail to understand why the pressure of light should be required to account for the discharge of negative electrons into space. Physicists tell us that a hot body like our sun is most probably the source for an energetic emission of free electric atoms. We are, moreover, acquainted with the fact that these free electrons possess enormous velocities. The measurements of Wiechert have shown the velocity to be between one-fifth and one-third of that of light. Now if the heat of the sun is capable of splitting off the negative electron from its atom, a great number of these free electric atoms must be flung into space simply on account of their enormous kinetic energy. For no form of matter leaving the upper strata of the solar atmosphere with a velocity exceeding 600 kilometres per second can possibly return to the sun. Why, then, should the free negative electron, with more than one hundred times this critical velocity, still require a force such as the pressure of light to be propelled into the universe? If we adopt Arrhenius' idea, according to which the free electrons first condense ordinary matter around themselves near the solar surface and are afterwards driven off by the pressure of light on this bulk of matter, we must find it difficult to understand how in some authenticated cases the action of a solar outburst on the magnetic instruments could have been instantaneous (see Young, "The Sun"). Granting the highest possible repulsive action of light-pressure on small particles, the solar electrons would require at least sixteen hours to reach the surface of our planet.

In my opinion, if we adopt the suggestion of Prof. J. J. Thomson that free negative electrons are probably emitted by the sun, a copious propagation of these infinitesimal corpuscles into space would be the obvious and necessary result of such an emission, even without the assumption of light-pressure.

The train of reasoning ensuing from this hypothesis would lead in a most natural way to Zöllner's celebrated theory of comets. By the abundant presence of electrons, space has then to be considered as a negatively charged electric field acting upon the *ionised* cometary matter. From this point of view, Zöllner's theory—according to Newcomb, the one "which on the whole most completely explains all the phenomena"—would no longer "lack the one thing needful to accept its reception," namely, "the evidence that the sun acts as an electrified body."

The main conclusion I have arrived at after a careful study of the theory of Arrhenius amounts to this: that by abandoning the assumption of the pressure of light and by assuming the propagation of free negative electrons from the sun into space simply as a consequence of their great inherent velocity, the theory becomes admirably fitted to strengthen the views of Olbers, Zöllner and Bredichin with regard to the nature and the origin of the repulsive force acting upon the cometary matter. But the introduction of Maxwell's pressure of light gives rise to a number of difficulties which, as Prof. Arrhenius abundantly shows, can only be overcome by arbitrary and unwarranted assumptions.

I shall take an early opportunity of demonstrating the superiority of Zöllner's theory over the one which now claims to "sweep the astronomical horizon of so many mysteries."

Royal Observatory, Edinburgh. J. HALM.

Stopping down the Lens of the Human Eye.

MAY I be permitted to direct Mr. Wm. Andrews' attention to the fact that his experiment in "stopping down" the lens of the eye involves exactly the same principle as "orthoptics," of which every rifle-shot will have had experience.

The "orthoptic" consists of a round hole in a black disc, which replaces the lens of a pair of spectacles. The hole is generally adjustable in size, to suit varying conditions of light. The purpose of the orthoptic is to increase the *depth* of focus, enabling both back and fore sights and the target to be in sharp focus together. Persons with naturally large pupils will, as a rule, notice the effect more strongly. H. BLISS.

May 9.

IT may interest your readers to know that the principle referred to, under the above heading, in your issue of May 8 was adopted, a great many years ago, by the late Lord Sherbrooke, whose sight I believe was very defective. I remember seeing, about the middle of the seventies of the last century, at an exhibition of physical apparatus at South Kensington, a pair of spectacles which were said to have been invented by him for his own use. They consisted of two convex metal cups, closely resembling in shape and size the bowl of an ordinary tea-spoon. In the centre of each cup was a small pin-hole, which was the only aperture through which light could enter; and the two cups were fastened together by an elastic string, evidently intended to go over the head. The invention impressed me at the time as a remarkable example of scientific skill combined with great simplicity of contrivance.

GERALD MOLLOY.

The Evolution of Snails in the Bahama Islands.

IT seems desirable to call the attention of evolutionists to Dr. H. A. Pilsbry's monograph of the genus Cerion (or Strophia), just published in the "Manual of Conchology." The facts presented are most of them not new, but all that is known is set forth in great detail, with an abundance of excellent figures. Cerion is a genus of rather large cylindrical land-shells, for the most part inhabiting the Bahamas and Cuba. It has split up into innumerable local species and races, 134 of which are recognised as sufficiently distinct to bear names. Not only do even the smallest islands or "keys" produce distinct species, but frequently one small island will have two or more different forms inhabiting different parts, and sometimes a distinct race will occupy a very small area, surrounded on all sides by another type. The problem of the differentiation of the Achatinellidæ in the Hawaiian Islands is complicated by the complexity of their environment; but here in the Bahamas we have differentiation just as marked, with an environment—small sandy islands with palms and low bushes—as simple as we are likely to find anywhere. It would therefore seem that an excellent opportunity lies before some student of evolution to investigate exhaustively the local species and races of these Bahama snails, and determine what causes have brought about the known results. Colonies could be taken to new localities, and watched from year to year to see whether they became modified. The food and moisture conditions might be altered, and the results observed. The exact conditions surrounding each distinct form might be studied and described. Thus it might be determined whether the differentiation was the result of natural selection or has taken place independently of it. Such an investigation would be delightful work for some enthusiastic naturalist, especially with such an excellent guide in hand as Dr. Pilsbry has supplied. T. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A., April 26.

Retention of Leaves by Deciduous Trees.

THE retention of leaves by beechen hedges referred to by your correspondent in NATURE, April 10, is by no means confined to those on elevated ground. It may commonly be observed in hedges of this tree whatever their situation. In Northumberland the beech is not infrequently used as a hedge, and always retains its leaves throughout the winter. Young beech trees also frequently retain their leaves, and by no means always in exposed situations. Indeed, the examples I have myself seen have been much more frequently in sheltered spots, as in plantations of older trees.

Nor is this phenomenon of deciduous trees retaining their leaves under certain conditions confined to the beech. It is, perhaps, equally common in the oak. Young oak trees in plantations may often be seen in the spring covered with brown and withered leaves. Larger trees may also sometimes be seen retaining the leaves on some of the *lower* branches, while the *upper* ones are bare. Travelling from Eastbourne to Victoria, soon after reading the above communication in NATURE, I noticed hundreds of young oaks covered with withered leaves. None of these were in elevated or exposed situations. Indeed, I am inclined to suggest, as an inference from the above facts, that it is rather the *protection* enjoyed by the trees which *enables* them to retain their leaves. In the one case the lesser height of the tree, and in the other the close intergrowth of the hedge, gives the wind less power to strip off the leaves. We can hardly consider that there is here a "protective device," unless on the part of the gardener who sets a beechen hedge to shelter his plants. G. W. BULMAN.

13 Vicarage Drive, Eastbourne, May 3.

WITH regard to the interesting communications concerning the retention of their leaves by young beeches, I beg to forward another possible solution. The beech is a "frost-tender" species, and early frosts, which would not rise high enough to affect large trees, would freeze the leaves of "small young" trees, thus preventing the formation of the abscission layer of cork at the base of the petiole. In such a case there is no reason why the leaves should fall off for a considerable time.

Leaves killed before the formation of this layer remain on the branch for an indefinite time, of which phenomenon pea-sticks cut in full leaf may serve as an example. P. T.

May 10.

THE RECENT VOLCANIC ERUPTIONS IN THE WEST INDIES.

NEWS of the terrible volcanic eruption in Martinique reached this country on Thursday last, and the details which have since become known have shown that an appalling disaster has occurred. St. Pierre, the chief commercial centre of the island, has been totally destroyed, and about thirty thousand people have perished. The eruption of Mont Pelée began on the night of Saturday, May 3, when large quantities of scoriæ and volcanic ash were thrown into the surrounding country. On Monday, May 5, a stream of lava is reported to have rushed down the side of Mont Pelée, following the dry bed of a torrent, and reaching the sea, five miles from the mountain, in three minutes. When the stream met the sea the water receded 300 feet on the west coast, returning with greater strength in a large wave.

Two days later, on May 8, a similar torrent of incandescent lava engulfed the town of St. Pierre. The following telegram describing the calamity was received at Paris from Fort de France on May 11, and was published in Monday's *Times*.

"The town of St. Pierre was destroyed on the 8th about 8 a.m. A terrible torrent of incandescent lava, from Mont Pelée, a volcano a few kilometres from the town, accompanied by a shower of fire, in a few seconds covered the town, and an immense furnace extended over the neighbouring coast, thus forming a line of fire from the village of Carbet to the town of Prêcheur. The effects of this volcanic torrent were felt as far as

Fort de France, and we received a shower of cinders and stones weighing seven to ten grammes. The whole island was covered three millimetres thick with cinders. The panic was general, yet relief was soon organised. The French cruiser *Suchet* went to the spot, as also other vessels towing boats, which soon returned, bringing terrifying news. The shore is unapproachable. The vessels in St. Pierre roads are on fire. The heat is extreme."

A later message from Fort de France, published in Wednesday's *Times*, says:—

"Access to the ruined town of St. Pierre has become more easy since the day before yesterday. At the Mouillage no signs of fire are now visible. Everything appears to have been rent and scattered as by a tornado. The iron gate of the Custom House remains standing. In the hospital the iron bedsteads are twisted, but bear no other traces of fire. The bed clothes and all other textile fabrics have completely disappeared. About 2000 corpses have been found in the streets. The central quarters of the town and the fort are buried under cinders to a depth of several yards. In the neighbourhood of the creek several houses remain intact, but the inhabitants were killed as if they had been struck by lightning, the bodies lying, sitting, or reclining in curiously diverse attitudes.

"Smoke is issuing from the crater of the volcano. Over the northern slope, as well as Basse Pointe, hover clouds of hot cinders, and flashes and rumblings are still distinguishable from time to time."

The Soufrière volcano in the neighbouring island of St. Vincent has also broken out in eruption. According to a *Times* telegram from St. Lucia, the northern district of St. Vincent, from Chateau Belair to Georgetown, has been devastated by an enormous flow of lava, destroying everything in its path. It is reported that both the large craters on St. Vincent are emitting enormous volumes of vapour, lava and hot ashes, and that small craters are bursting out everywhere. No vessel can approach the northern shore of the island on account of the intense heat and steam from the craters. Heavy ashes fell in great quantities on a steamer 250 miles from St. Vincent, and many masses of rock have fallen at Kingston. It is stated that sixteen hundred deaths have been caused in St. Vincent by the eruption.

This brief statement of the eruptions and their consequences contains the chief points of the news yet available. We are fortunate in being able to supplement the reports with an article by Prof. Milne upon the subject, and a summary in which he gives the sequence of events.

Sequence of Events.

April 19.—A very heavy earthquake occurred in Guatemala. It was recorded in the Isle of Wight, and might have been recorded anywhere in the world. It probably indicated a sudden adjustment in the orogenic fold of Central America, and a change in this fold possibly resulted in movements in the neighbouring fold represented by the West Indies, and hence the recent volcanic eruptions and earthquakes in that region.

April 23.—Mont Pelée showed a plume of "smoke."

May 3.—Mont Pelée not only "smoked," but at night was lighted up by the incandescent lava within its crater.

May 4.—Mont Pelée covered the surrounding district with ash.

May 5.—A stream of mud and lava were erupted and engulfed a sugar factory, twenty-three persons being buried. The sea receded 300 feet.

May 6.—A Government Commission issued a reassuring report.

May 7.—About 11 p.m. (Martinique time) a small earthquake from a very distant origin was recorded in the Isle of Wight, Edinburgh, and at other stations.

May 8.—At 8 a.m. "the rain of fire" destroyed St. Pierre. Ships were burned and sunk by a shower of rocks and heated materials, which poured down for about fifteen minutes. At Fort de France, twelve miles distant, these stones were the size of walnuts.

This eruption still continues, but on the 10th it had so far decreased that the site of St. Pierre was explored, but no living beings were seen.

The eruption of La Soufrière in St. Vincent commenced on Monday, May 5, and on May 7 the eruption was violent.

It would therefore seem that these two eruptions were simultaneous, and may have been brought about by a common cause.

Martinique, which, the *West India Pilot* tells us, is 35 miles in length and 7 to 16 miles in breadth, "is very lofty and irregular in height, and may be readily distinguished by three remarkable mountains of different forms, rising far above the general chain which runs through the whole of the island from N.W. to S.E., and may be seen about 45 miles off. The most northern of these is Mont Pelée, 4428 feet above the sea, rising nearly 4 miles to the south of Cape St. Martin, and its summit, when seen from a distance, appears rounded, and presents nothing remarkable."

It seems to be an irony of Nature that the most dangerous creations should so frequently simulate the appearance of that which is quite ordinary.

Prior to A.D. 79, Vesuvius was in its appearance even more innocent than Pelée. Spartacus and his gladiators camped within its crater, which, Plutarch tell us, was to a great extent covered with wild vines. On its flanks were cultivated fields, at its base the wealthy and populous cities of Pompeii and Herculaneum. If we except a few slight shocks which preceded the burial of these two towns, there was nothing to indicate the terrific outburst by which this was accomplished. The mountain, which was "nothing remarkable" in its appearance, suddenly exploded, there was a rain of ash, and the surrounding country became a desert.

Another illustration of the awakening of a slumbering Titan was Krakatoa. After a rest of 200 years, this mountain, on Sunday, May 20, 1883, gave symptoms of unrest by an eruption accompanied by shakings and roarings, which were loud enough to be heard even at a distance of 100 miles. Then for a few months there was comparative quiescence until August 26, when a crater opened near sea level and the challenged ocean poured in upon internal fires. The story of the battle which ensued, with its fearful detonations, which were heard at Rodriquez, 3000 miles distant, the appalling darkness created by black ash suspended in the atmosphere, the finer particles of which belted our globe and gave rise to brilliant and peculiar sunsets, the great sea waves which were formed to devastate surrounding coasts and destroy 36,000 lives, forms a well-known chapter in the history of vulcanology.

Pelée, the Hawaiian goddess who from her well of fire serves out molten rock for the consumption of those with whom she is angered, gives as spin drift from her molten fountains tresses of her glassy hair. Possibly the Pelée of the Antilles, although she has not sought an encounter with the oceans, may give to our atmosphere exhalations and glassy particles, the evidence of which will be seen in meteorological observations.

A third illustration of a mountain which to all who knew it was in its appearance as innocent as Primrose Hill, but without any premonitory warnings suddenly blew itself to pieces and changed the topography of the surrounding district, was Bandaisan, in central Japan. When, in 1878, the writer visited this mountain, to clamber through woods and vines with which its sides were covered and pass over a grass-covered depression at its summit where deer were browsing, the only indications that this round-headed hill might be included in the list of active volcanoes were that at its base there were some hot springs, whilst on its flanks a few pieces of scoria were seen. Ten years later, this apparently peaceful mountain drove sixteen hundred million cubic yards of itself to such a height that many of the falling fragments struck the ground with such velocity that they were buried out of sight.

To know the extent to which the phenomena accompanying the eruption of Pelée find a parallel in those exhibited by her predecessors will be determined in the future. The probable loss of life, which it is to be hoped has been over-estimated, is given at 40,000. Whatever this number may be, it has been suggested that the same might have been reduced had the inhabitants of the stricken district taken warning from the slight earthquakes by which the great eruption was preceded. But may we not ask whether small earthquakes are not so frequent in the Windward Islands that were the inhabitants to fly with every tremor the Antilles would be depopulated?

Although the last great eruption of Pelée, which was one of frightful violence, occurred in 1851, statistics which do not take account of mere tremors credit the Island of Martinique, in an interval of twenty-six years, with 148 disturbances, whilst the Lesser Antilles generally are, during the same interval, credited with nearly 1200.

That volcanic outbursts are usually preceded by slight earthquakes is well known. How very slight these may be is testified by the tall and not too substantial buildings in Naples near the base of the almost continually erupting Vesuvius. Unfortunately, the occurrence of slight earthquakes is very much more frequent without, rather than with, volcanic outbursts. Many of the 1000 earthquakes which are annually recorded in Japan, two or three of which would shatter a London, are felt round the base of volcanoes, but it is only on rare occasions that they have been followed by disaster. Could science devise a means by which increasing pressure beneath a volcanic area could be measured, or could the crust of the same be rendered transparent, until familiarity ended in contempt, such areas would in all likelihood be sparsely populated; but so long as we cannot distinguish between the shakings which announce the abortive attempts of volcanoes to establish an opening and those tremblings and gurgitations which precede attempts that are successful, people will go on living as before.

One writer predicts great storms to follow the eruption. In August, 1891, a hurricane passed over Martinique, to be *followed* by an earthquake. The hurricane months for Martinique are July, August, September and October, when no doubt we shall have records of hurricanes both before and after earthquakes.

In considering the probable cause of this West Indian disaster, attention is drawn to the fact that the Lesser Antilles as seen on a chart are a group of islands running approximately from south to north, forming the outcrops of a suboceanic ridge. The western side of this ridge is steeper than the eastern, with the result that off Martinique, for example, at a distance of 5 or 6 miles there are soundings of 1200 fathoms, whilst on the opposite side such depths are not even found at distances of 50 miles off shore.

The steepness of this fold is such that earthquakes might be expected to originate along its western frontier, whilst volcanoes would occur along its ridge. Now it is chiefly along this western frontier that the cables pass. Those of Martinique, of which there are six, radiate from Fort de France. One goes northwards 12 miles, to end at the ill-fated St. Pierre. Three others also pass northwards to Guadeloupe, Dominica and St. Thomas. Another goes southwards to Paramaribo, and the last to St. Lucia, St. Vincent and other places.

Notwithstanding the existence of so many cables, communication with Martinique, and later with St. Vincent, was interrupted. At St. Pierre the cause of this was no doubt due to the avalanche of mud and lava which overwhelmed the town and roadstead. The cause of interruptions out at sea would be sought for in seismic convulsions, but of such disturbances of any magnitude there is no evidence. Since 8 a.m. (Martinique time) on the 8th, when St. Pierre was overwhelmed, until the 11th, seismographs in Great Britain have been at rest. That *small* earthquakes occurred is known, and it is just possible that some of these caused landslides sufficient to bury and damage the cables running along and across the steep suboceanic slopes described.

The cause of these earthquakes and the volcanic outbreak of Mont Pelée and of the Soufrière in St. Vincent—at which the last great eruption took place in 1812—probably results from some widespread rearrangement in the fold, the ridge of which is represented by these islands. The geological evidences pointing to elevations and depressions amounting to as much as 12,000 feet, and all within late Tertiary times, are found in the Barbados and other parts of the West Indies. If we assume that earthquakes are accelerations in these orogenic processes, and volcanic outbursts indicate that pressure has been relieved along the foldings they create, one inference is that the terrible disasters in the West Indies announce that a change has taken place in the configuration of the ridge which above the surface of the water is known as the Lesser Antilles.

Whatever may be the scientific inferences in connection with the great catastrophe, the situation it has created, which Byron might describe as one in which

> "Sires have lost their children, wives
> Their lords, and valiant men their lives,"

commands the heartfelt sympathy of the civilised world.

J. Milne.

DOES CHEMICAL TRANSFORMATION INFLUENCE WEIGHT?

In Nature (vol. lxiv. p. 181, 1901) I directed attention to experiments by Heydweiller (*Drude Ann.*, vol. v. p. 394) from which he inferred that some chemical transformations, such as the solution of copper sulphate in water, were attended by real, though minute, changes of weight, and I pointed out certain difficulties involved in the acceptance of this statement. In connection with another subject, it has lately occurred to me that such changes of weight would really be in opposition to the laws of thermodynamics, and I propose now briefly to sketch the argument from which this opposition appears.

It is known[1] that by suitable arrangements the dissolution of salt may be effected reversibly at a given temperature. During the process, a certain amount of work is gained and a certain amount of heat at the given temperature has to be supplied. In the reverse process, of course, an equal amount of work has to be performed and an equal amount of heat is recovered. The temperature being given, these operations are not affected (it is assumed) by the height above the earth's surface at which they may be supposed to take place.

Conceive now that the temperature is uniform throughout and that the materials are initially at a low level and in one state (A). Let them be raised to a high level and there be transformed into the other state (B). Subsequently let them be brought down to the low level and transformed back into state A. The reverse transformations above and below compensate one another thermodynamically, and *if the weights are the same in the two states*, so do the operations of raising and lowering. But if the weights in states A and B are different, the cycle of operations may be so executed that *work is gained.*

1 "On the Dissipation of Energy," Nature, xi. p. 454, 1875; "Scientific Papers," vol. i. p. 238.

Such a difference of weight is therefore excluded, unless, indeed, hitherto unsuspected thermal effects accompany a rising or falling against or with gravity. It is scarcely necessary to say that we are not here concerned with the differences of temperature and pressure which may actually be met with at different levels over the earth's surface.

There are many chemical transformations which cannot easily be supposed to take place reversibly. But this, though it might complicate the statement, does not affect the essence of the argument; and the conclusion appears to be general.

If the reasoning here put forward be accepted, it increases the difficulty of admitting the reality of such changes of weight as have been suspected, and it justifies a severe criticism of experimental arrangements. In my former letter I pointed out a possible source of error.

It is to be hoped that the matter may soon be cleared up, for it is scarcely creditable to science that doubt should hang over such a fundamental question. But for my own part I would wish to say that I fully recognise how much easier it is to criticise than to experiment.

RAYLEIGH.

UNIVERSITY COLLEGE AND THE UNIVERSITY OF LONDON.

AN influential meeting was held at the Mansion House on Friday last in support of the fund for higher University education and research in London, with special reference to the incorporation of University College in the University. The Lord Mayor presided, and the company present included many who have contributed to national progress in various ways and are anxious that adequate provision shall be established for future advance.

The appeal made by University College was described in our issue of May 1 (p. 10), and at the same time a brief statement was made of the needs of the University and its Colleges. The University can only become a living organism when the Colleges connected with it are actually part of its being. The incorporation of University College would be the commencement of this desirable development, and the ultimate structure would be on a scale worthy of the greatness of our great metropolis.

We are glad to see that the Duke of Devonshire, in his speech at the Mansion House, made special reference to some of the points to which attention was directed in our article. He explained that though the University of London has statutory powers to teach, it has not the material means of teaching, and cannot take part in the extension and advancement of knowledge until placed in possession of buildings and resources for carrying on the work of higher education. The provision of funds for University College thus means the strengthening of the University itself, for by incorporation the senate would acquire complete control over the whole resources of the College, and would be able to carry on the work of the various departments under better conditions than at present are possible.

The urgent need for liberal endowments for higher education in London was stated in our recent article and has often been put forward in these columns at other times. The educational wants of London are, indeed, almost a discredit to the rich citizens, and the inadequate provision made for higher education generally shows that the State does not realise the importance of such studies as factors in national progress. But though the State does little or nothing for those who are making knowledge, the Duke of Devonshire expressed himself as aware of the value of extending the resources of education and research, and other speakers at the Mansion House (including the Lord Mayor) took the same view. Referring to the necessity of giving greater consideration than has hitherto been done to the requirements of the country in this respect, the Duke of Devonshire said:—

"Within the last half-century the gigantic strides which have been made in the discoveries of science have brought about great changes in our requirements as to higher education. It is now recognised that in all professions and industries success must be dependent on a knowledge of scientific principles and on the trained capacity to apply those principles. The Universities are no longer a necessity for one class alone, but the welfare of the whole nation demands that we should seek through all classes men of high intelligence, and, having found those men, that we should equip them with the highest training. These changes in the requirements of higher education found us in this country to a certain extent unprepared. As a nation we cannot be said to have been quick to recognise the necessity of corresponding changes in our higher University training. The older Universities of Oxford and Cambridge have recognised the necessity and have made great efforts to equip themselves with the necessary machinery, but they have found themselves hampered by a want of the necessary resources.

"But, even if complete satisfaction could be given to the claims of the older Universities, still that would not suffice for our national necessities or meet the requirements of present conditions. Our success as a nation depends upon the possession of trained brains, and these we cannot get in sufficient number from any one class, and the older Universities cannot supply the number of trained men we require for our national industries. In all the great towns and industrial centres, University institutions properly equipped and properly endowed are now a necessity, and this need has already received a considerable amount of local expression. I need only give you the instance of the University of Birmingham and the movement which is now taking place in Liverpool for the establishment of a separate University there. But in London, owing to its size and the absence of what may be called local patriotism, the University movement has up to the present time failed to receive that support which might be expected from the wealthiest city in the world. But now, to-day, an opportunity is afforded to the citizens to repair any past neglect, and to create for London a University which shall be worthy of the capital of the Empire and adapted to the special needs of the metropolis of the Empire."

Resolutions were afterwards carried in support of the scheme of incorporation, and urging citizens of London to make a generous response to the appeal for one million pounds to endow and equip University College with a view to its incorporation. It remains to be seen whether London is sufficiently jealous of its honour and supremacy to make the University bearing its name rank with those of Europe and America.

THE CULTURE OF GREENHOUSE ORCHIDS.[1]

BEFORE passing judgment on a work of this kind it is only fair to the author to attempt to ascertain his object in writing it, so that a fair conclusion may be arrived at as to how his object has been attained and the use of the resultant work to those who consult it, for that is the main consideration.

In the first few lines of the preface, Mr. Boyle very definitely gives his reason for writing the book. He says: "The literature of orchidology is voluminous in these days. But a book written 'by an amateur for amateurs' is still needed." That was a very good reason. Every new work on orchids, or on any other special subject, tends to increase the knowledge and growth of the subject dealt with, and as the devotees to orchid culture are mainly recruited from the amateurs commencing in a small way, a work written by an amateur, and especially by such a pleasant and entertaining writer as Mr. Boyle, who has the art of conveying instruction with amusement, must be of the highest value.

1 "The Culture of Greenhouse Orchids." By Frederick Boyle. Pp. xii + 231. (London: Chapman and Hall, Ltd., 1902.) Price 8s. net.

The handy little volume, extending over two hundred and thirty pages, has three excellent coloured plates and fifty illustrations of single flowers of cool-house orchids,

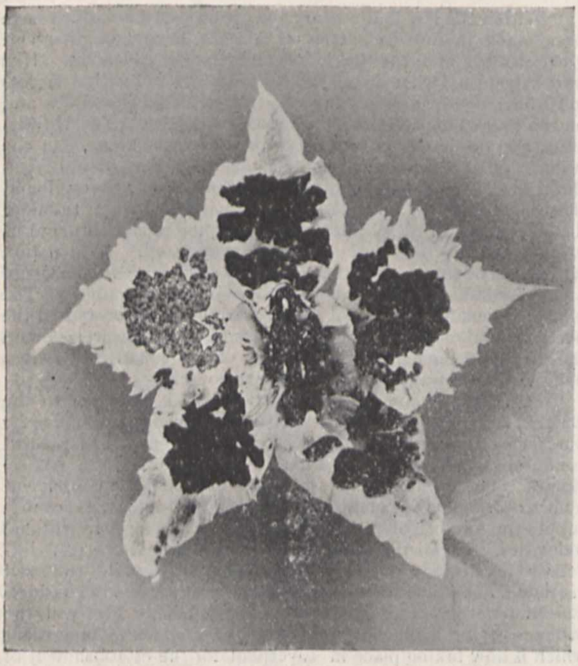

FIG. 1.—Odontoglossum Crispum Pittianum, showing the widest departure from the normal white form. The sum of 750*l*. was offered for this plant.

reproduced from photographs by Colonel F. C. Taylor. The book, though useful as a work of reference, will be found to give the best results to the amateur just beginning orchid culture, or who has been pursuing it with indifferent results, if he repeatedly peruse it from beginning to end. Thus he will have a sound basis on which to continue his work, freed from the struggles and failures which the unaided amateur must expect, and the sorrows the past experience of which Mr. Boyle justly advances as a reason why he should be able to write a book which would be useful to those who contemplate following him as amateur orchid cultivators—a pastime of the greatest interest and pleasure if reasonably followed.

The work opens with six lengthy and instructively written articles, setting forth the general principles of orchid culture and matters relating to it, after which throughout the remainder of the work follow the enumeration of the genera and species suitable for culture in the greenhouse, together with cultural remarks and much information relating to each, all of which, having passed the scrutiny of that well-known and clever expert, Mr. Joseph Godseff, have a sufficient guarantee of excellence.

On testing the question ample proof is obtained. If but for the articles on *Coelogyne cristata* and on Oncidiums for the cool-house, the perusal of the work might well be recommended. In the case of *Coelogyne cristata*, one of the most beautiful and easily grown orchids when treated as Mr. Boyle advises, there are few species which give more unsatisfactory results to the budding amateur growing it by his own judgment. Even experienced growers in large establishments often have their plants with the shrivelled bulbs which are cited as to be avoided by the method prescribed. In the matter of the Oncidiums enumerated, the mere direction that they are to be grown in a cool-house is almost sufficient to ensure success, for they are more often than not grown in too high a temperature and killed in consequence. And so on throughout the book; even the enumeration together of the species which can be successfully grown in a greenhouse, to say nothing of the excellent cultural details, makes it of great value, for it saves the amateur from attempting things which require more heat than he can give—a mistake which causes many small amateur collections to look shabby and annoy and disgust the owner, who has probably taken more pains to bring about that undesirable state of things by working on unsuitable subjects than he need take to ensure a delightful success on the lines set forth in Mr. Boyle's book.

But from the critic the book calls for some remarks on points which luckily do not much interfere with its general usefulness. In the preface and following articles, Mr. Boyle makes much of his desire to advance the new Belgian culture of orchids in oak-leaf mould, or terre de bruyère, but in the progress of the work he only places it as an alternative method, wisely placing the well-tried British method of potting in peat fibre and sphagnum moss in the first place. It should be remembered that there is a vast difference between the Belgian collections, with large numbers of a few species only, and many of the British collections, which include a few of each of a large number of species. Then there are climatic and other differences; and above all it should be said that one of the largest and oldest and some of the smaller Belgian orchid growers, after experiment, will have nothing to do with it. In Great Britain the question is on trial, and while in some places there are excellent specimens grown in leaf-soil, in others it has been tried and abandoned.

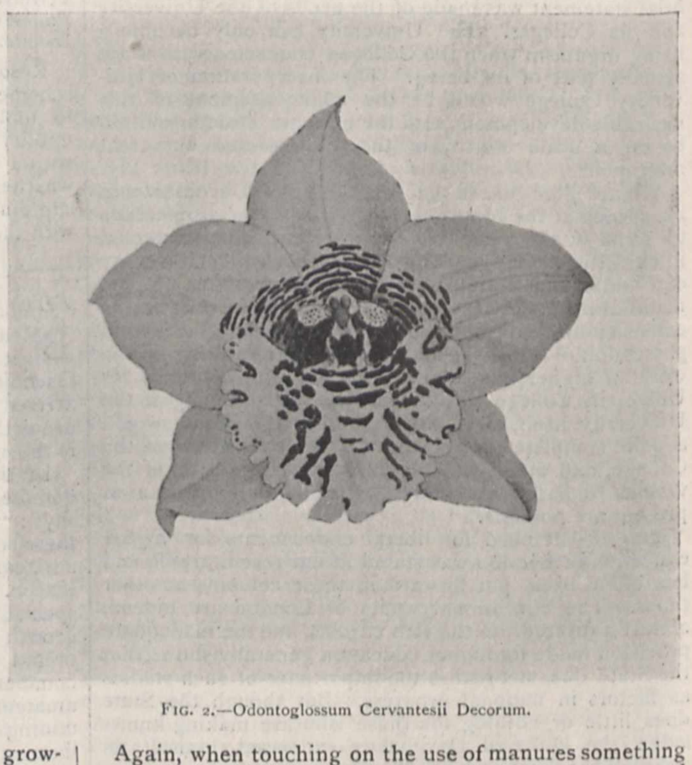

FIG. 2.—Odontoglossum Cervantesii Decorum.

Again, when touching on the use of manures something more definite than general remarks might have been used —the "yea or nay" promised in the preamble—or the small amateur who is induced to experiment will surely find himself in trouble.

In the chapter "Orchid Names," the author follows the popular lead by finding fault with the existing orchid nomenclature, and with the inevitable result that he is unable even to hint at a better method than that for which we have to thank a long line of patient and clever men who have been working on the subject in all ages since the classification of plants began. It should be remembered that the question is not as to whether the name is good or bad Latin or Greek, expressive or not expressive, but that it is intended as a means of identifying the plant in every civilised quarter of the globe, an end which no system of popular names could accomplish, but which has worked under the present system of scientific names in a marvellously satisfactory manner. To apply it to his own case. Deprived of the scientific names he finds fault with, Mr. Boyle's book would have been impossible in its present useful form.

Orchid culture cannot be reduced to an exact science. Each operator has to adapt his methods to his convenience, but in order to know how to meet his difficulties and to overcome them, Mr. Boyle's book will be found invaluable. In some cases the prices at which the plants may be obtained are also given.

THE ROYAL VISIT TO THE UNIVERSITY OF WALES.

THE installation of the Prince of Wales as the second Royal Chancellor of the University of Wales is associated with an important epoch in the development of university education in North Wales. When the University College of North Wales was founded in 1884, it would have been difficult to find a more ideal situation for a centre of university education than the Penrhyn Arms Hotel at Bangor, which possessed ample accommodation for existing requirements. But eighteen years ago, Hertz's realisations of Maxwell's theory of electric oscillations, culminating in wireless telegraphy, did not exist; the existence of Röntgen and other rays had not been anticipated; no argon was known to exist in our atmosphere, no helium in our earth; the liquefaction of the more permanent gases was regarded as a mere classical experiment, impossible on a large scale; even in mathematics, the fertile theory of groups was almost untrodden ground. Taking also into account the increase in the number of students in the eighteen years from 55 to 320, it is small wonder that new buildings with more modern equipments have now become indispensable for the further progress of the College. These needs bid fair to be soon met by the recent generous gift on the part of the City of Bangor of a new plot of ground 10·6 acres in extent, about 6·6 acres of which are available for building purposes, on a site which, in the opinion expressed by Principal Reichel, "any university College in the kingdom might well envy." This gift represents, for the City of Bangor, the equivalent of a gift of one million pounds from the citizens of a wealthy town comparable with Liverpool.

The smallness of the population of Bangor and the absence of the large wealth-producing industries of our midland towns are a sufficient guarantee that the new College need never fear the disturbing influences of electric trams and the smoke and din of factories which have afforded such an obstacle to scientific research in wealthy and thickly populated manufacturing centres.

The University congregation was held, not at Bangor, but at Carnarvon, where the large pavilion had been transformed into a senate house. The lavish display of bunting at Carnarvon and subsequently at Bangor; the gowns and hoods of graduates, extending over the whole range of colours from violet to red, and the presence of large contingents of students from Aberystwyth, Bangor and Cardiff, including a considerable proportion of "sweet girl undergraduates" in caps and gowns, all contributed to the festivity of the scene. Even the mountain ranges of Snowdonia were clad in white hoods of snow rarely seen in May. The actual installation ceremony having been completed by the presentation of the key of the University seal and a copy of the statutes to the Prince as Chancellor, addresses were read by Dr. Isambard Owen and Principal Roberts on behalf of the University court and senate, and addresses were also presented or read on behalf of several other bodies, including the guild of graduates. The Prince in reply, after referring to the work done by teachers and students of the Welsh University, laid special stress on the encouragement given to post-graduate and scientific work, and the fact that it is by the work done in after life by its graduates that the reputation of a university is really made. The Chancellor then admitted the Princess of Wales to an honorary degree in music and proceeded to the conferment of honorary degrees, in which science was represented by the Earl of Rosse, the recipients being presented by Vice-Chancellor Roberts, of Aberystwyth. The intervals in the proceedings were filled by part songs sung by a well-trained choir, and at the conclusion the problem of transporting the guests to Bangor was solved with remarkable success. Here luncheon was laid for six hundred and fifty in a marquee pitched close to the new site, under the chairmanship of Lord Kenyon. In his speech, the Prince of Wales once more struck a chord which he had already sounded at the National Physical Laboratory in referring to his recent tour and his experience of the work done in universities across the seas in bringing intellectual ability to the front and rendering it available for the public service. This line of thought was ably echoed by Principal Reichel in his remarks that "The idea, which at one time was not uncommon, that intellectual training is unfavourable to action is now happily becoming discredited at home; on the Continent it has long ago perished. . . . The function of provincial university colleges is, in short, to train up a more vigorous and efficient race, fitted to meet the heavy demands which the course of world events is making on the inhabitants of these islands, a race of more efficient thinkers, of more efficient workers, and if the necessity should arise, of more efficient fighters." Principal Reichel further announced the receipt of an offer of twelve scholarships of 30*l*. for three years from Sir Alfred L. Jones, of Liverpool. It was also announced that the town of Cardiff, like Bangor, has presented its University College with a new site.

The next item was the visit of the Prince and Princess to the present College, where a guard of honour was formed by the College volunteer corps. Interest naturally centred round the museums and laboratories. The College possesses a very fair zoological museum, and it is proposed to establish in connection with the same department a marine station where problems connected with the fisheries of the North Wales coast can be studied systematically. Already efforts have been made to arouse interest in the fishing industry by popular lectures. Most of the work of the College in agriculture has been hitherto carried on at a farm right away near Llangefni, but the College is now indebted to Colonel Platt for an experimental farm in a much more accessible situation near Llanfairfechan. Of other recent developments on the science side, we note the Drapers' Company's temporary endowment of a school of electrical engineering, a school which is bound to develop when a university training is, as it should be, insisted on in this country as an indispensable qualification for every electric engineer. The organisation of a department of mining is also, thank to the support of local bodies, approaching completio A recent gift from Mr. George Rae for the purpose providing teaching in banking and finance affords evidence that the commercial side of modern university education has not been overlooked, and a further gift from the trustees of the late Sir Henry Tate has been announced.

The last item in the Royal visit to Bangor was the visit of the Princess of Wales to the University Hall, where an enthusiastic reception from the women students, assembled in cap and gown under Miss Fowle, was awaiting the Royal party.

If there is one function on which the University of Wales, in common with other universities, will have to lay ever-increasing stress, that function is the dissemination in the less accessible parts of the Principality of those internationalising influences which are now bringing all parts of the civilised globe into closer touch with each other. The deliberations of English-, French- and German-speaking science workers are daily becoming more and more international in character, and this influence is spreading gradually down the educational ladder. The late Mr. Cecil Rhodes's scheme for fostering the international spirit in Oxford is still in our minds, and it may be confidently hoped that modern and well-equipped University College buildings both in North and South Wales will do much to promote that educational influence which may so well be summed up in the word "internationalisation."

G. H. BRYAN.

THE IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held on May 7 and 8, and a short report of the proceedings is subjoined. At the annual dinner of the Institute, on Wednesday of last week, Mr. Arnold-Forster made a few remarks upon the duties of the State towards science, and the necessity for the introduction of scientific organisation and method in all departments and works of a progressive character. We give his speech as reported by the *Times*:—

Mr. Arnold-Forster said that however little he might contribute to the Government in any other matter, he did contribute in full measure great respect, great admiration and great reverence for science and scientific organisation. By scientific organisation he meant the application to the ordinary work of everyday life, the work which had been thought out and coordinated by students of science. In this country we were probably behind almost every other great country in the recognition of the great truth that science had a lesson for everyone in producing economy and efficiency by the application of a scientific method. There was a time when the duty of the State to take its part in ordering the work of the nation was more clearly recognised and acted upon than it was now. The enormous attention which was given to regulating our coinage and to giving us a system of weights and measures formed a considerable part of the earlier economic history of this country. But when we had accomplished those one or two rudimentary duties, the State appeared to think that nothing more could be accomplished or was to be expected from it as the administrator and as the instrument to apply in the teaching of science. But the time had gone by when we could afford any longer to fail to recognise the direct duty of the State to the country in the matter of organising on some scientific principle many of the most important departments of our scientific life. Governments were now so enlightened that they could interfere in scientific matters with certainty of producing the results which they desired. It should be insisted upon that in every department which came within the purview of the Government there should be scientific coordination and organisation. He would not speak of weights and measures—though there, indeed, a wise Government might step in—but there was the kindred branch of scientific application about which he would say a word—namely, standardisation and the uniformity of tests. In that regard we were behind the Continental nations. He had been studying the publications of the great Continental nations for the coordination of tests of materials and the institution of standard dimensions, and the conviction had been forced upon him that we had already allowed opportunities of cooperation to go by which we ought to have seized. He was glad that at the eleventh hour the Iron and Steel Institute, the Institution of Civil Engineers and the Institute of Naval Architects had taken up the work. He wished every success to it. The French Government were standardising their railway material, but nothing corresponding to that existed in the records of our Governmental arrangements. In inspecting a steel works recently he found that in the matter of tensile strength for steel there was one test for the Admiralty, another for the War Office, another for the Board of Trade, another for one set of railway companies, and another for another set (the Board of Trade recognising neither), another for the Egyptian Government, another for the Indian Government, and another for the whole of the Continent of Europe. That was absolutely crazy. It was like measuring pints by fourteen different kinds of pint pots. They were all sinners in that respect—all the departments—because it ought not to be allowed. He urged that scientific societies should forward the work of standardisation as forcibly as possible. Already in the Admiralty great strides were being made, thanks to Sir William White, and already they had succeeded to some extent in the standardisation of electrical appliances. They had also standardised in the whole of the gunnery branch, and were now endeavouring to do so to a much larger extent in the whole of the fittings of the ships. When the Iron and Steel Institute and kindred associations had made up their minds as to what was the true method of standardisation they should go boldly to the Government and ask them to undertake that within a definite time all Government specifications should be within the terms of that standardisation. He was not unaware that there was a danger in standardisation, that one must not stereotype too closely, and must not interfere with improvement by solidifying all patterns; and therefore he trusted that they would insist upon it that the Government should be the cooperators in the work in which the Iron and Steel Institute and kindred societies must be the kindred spirits. In conclusion, he said that we had been too modest in this country of advancing the claims of science. What was done for applied science in every other civilised country should make us ashamed of the pittances doled out in England, which were supplemented to the extent of 99 per cent. by private charity, for the purpose of performing those elementary duties of coordinating the scientific part of this country's life. He believed that if the scientific associations took a high line in the matter the country would support them right through.

Other speakers at the dinner were Sir Alfred Hickman, Admiral Sir N. Bowden-Smith, Sir Bernhard Samuelson, Lord Raglan, Lord Blythswood, Sir Christopher Furness, Sir W. C. Roberts-Austen, General Sir John Maurice, Sir Norman Lockyer and the president.

At the annual meeting of the Institute the chair was occupied by the president, Mr. W. Whitwell. The Bessemer gold medal was presented to His Excellency F. A. Krupp, of Essen. The Andrew Carnegie medal was awarded to Dr. J. A. Mathews for the research described in his report; and Andrew Carnegie research scholarships, each of 100*l*., were awarded to Messrs. O. Boudouard (Paris), W. Campbell (New York), A. Campion (Coopers Hill), P. Longmuir (Manchester), E. Schott (Berlin) and F. H. Wigham (Wakefield). The following are the chief points of the papers read:—

In the first paper, Mr. J. H. Darby embodied the results of experiments made with the object of improving the quality of coke by compressing the fuel before coking. The net gain in production of coke per oven was found to be between 10 and 12 per cent. in favour of the compressed charge.

Mr. J. Thiry read a paper on the recovery of by-products in coke-making. He gave some striking figures showing the profit and economy derived from this method of coke manufacture, and described the most recent form of the Otto-Hilgenstock coke oven. These two papers gave rise to an interesting discussion, in which Sir Lowthian Bell, Sir Bernhard Samuelson, Dr. Ludwig Mond and other members took part.

Mr. A. McWilliam and Mr. W. H. Hatfield described an exhaustive research dealing with the control of the silicon in the acid open-hearth bath. The experiments were made in a 25-ton furnace at Sheffield. The results detailed, showing the influence of the composition of the slag on the elimination of impurities from metal under an oxidising influence, seem to point to the necessarily very acid slag produced being beyond the point at which silicon can be oxidised, for it would appear that not only can phosphorus and sulphur not be oxidised in an acid-lined vessel in the presence of an acid slag, but that silicon is not oxidised to below a certain percentage when the acidity of the slag is beyond a certain point. The authors have thrown light on a subject still requiring further elucidation, namely, the relation between the composition of the slags and the type of oxidation or even reduction taking place, and they in particular have not seen recorded this exact balancing of the composition of the slag, so as at will to eliminate or reinstate small amounts of silicon and manganese while the carbon continues steadily to fall. A well-sustained discussion followed, in which the value of the paper was generally recognised.

Mr. H. Allen described a new system of cooling blast-furnace tuyeres in such a manner as to prevent the leakage of water into the furnace crucible. The meeting then adjourned until May 8, when the secretary, Mr. Bennett Brough, presented the report of the committee appointed to ascertain whether it would be possible to make the terminology of metallography less complicated and more precise. This comprises a glossary of the more important terms used by authors of memoirs dealing with the subject, with the exact equivalents in French and German. Care has been taken to exclude all controversial matter, and, in cases where a definition is not quite universally accepted, to quote the definition given by its respective author.

The next paper, by Prof. J. O. Arnold and Mr. McWilliam, was of a highly controversial nature. The conclusions arrived at in the paper were as follows:—The clear and definite constituents of hardened steel are (*a*) hardenite, $Fe_{24}C$, of which the whole mass consists, only in the case of 0·89 per cent. carbon steel; (*b*) ferrite, Fe, which segregates more or less in unsaturated carbon steels in spite of the rapid action of quenching; and (*c*) cementite, Fe_3C, which segregates more or less in supersaturated steels in spite of the rapid action of quenching. The indefinite portions of hardened steels consist in unsaturated carbon steels of hardenite containing more or less unsegregated ferrite, or in supersaturated carbon steels of hardenite containing more or less unsegregated cementite. Martensite is not a constituent, but a crystalline structure developed at high temperatures. It is marked in saturated carbon steels by preferential etching lines, in unsaturated carbon steels by striæ of ferrite, and in supersaturated carbon steels by striæ of cementite. The existence of the constituents sorbite, troosite and austentite is extremely doubtful. Students of micrographic analysis should guard against apparent or false constituents really due to optical causes or to obscure polishing or etching effects. The authors' investigations detailed in this paper have been strictly confined to pure iron and carbon steels such as are produced in the best crucible practice. The views expressed by the authors were opposed by Sir W. C. Roberts-Austen, Mr. J. E. Stead and other members.

Dr. J. A. Mathews' paper on a comparative study of some low carbon alloys, which was next read, contained the results of a research undertaken in New York by the author as Andrew Carnegie research scholar to ascertain the effects of various elements upon iron. The elements studied were nickel, chromium and molybdenum. Prof. Arnold took exception to this paper on the ground that no reference was made to his own work on the same subject.

Mr. H. Kilburn Scott presented an elaborate description of the iron ores of Brazil. The quality of the mineral and the great size of the deposits will, the author is convinced, enable Brazilian iron to take a leading position in the market. Some valuable additional details were furnished by Mr. H. Bauerman.

Mr. P. Eyermann, of Benrath, near Düsseldorf, submitted a paper describing a proposed method of combining the blast furnace and the open-hearth furnace. The novel feature consisted in the employment of blast-furnace gas in the open-hearth furnace, in arrangements for improving the quality of the gas and in the application of air nozzles to one of the hearths.

Mr. Axel Wahlberg, of Stockholm, communicated an important paper on Brinell's researches on the influence of chemical composition on the soundness of steel ingots. The percentage of carbon and the casting temperature, which have hitherto been regarded as the agents responsible for the presence and position of blow-holes, are to be regarded as exercising a secondary influence. The principal cause is the percentage of silicon and manganese, and in some cases of aluminium, contained in the ingot metal at the moment of casting. In the discussion, Mr. C. P. Sandberg pointed out that some of the results given by Brinell had been anticipated by himself in a paper read ten years ago.

From the investigations recorded in Baron Jüptner's paper on the sulphur contents of slags, the following conclusions are drawn:—If during metallurgical processes a state of equilibrium is established between the slag and the contiguous metallurgical product under treatment, the sulphur distributes itself between the two in a constant ratio (the coefficient of distribution), the value of which is dependent on the composition of the two phases under consideration and on the temperature. In general the value of these coefficients of distribution increases with the basicity of the slags. It increases also apparently with the proportion of lime and manganous oxide (probably also with that of ferrous oxide and zinc oxide) in the slag. In the case of alloys of iron, the value of the coefficient of distribution increases, and very considerably, with increasing percentages of carbon and manganese and with diminishing percentages of phosphorus. The influence of the composition of iron alloys on the coefficient of distribution increases and diminishes with the increase or decrease of the basicity of the slag. The same law holds good with respect to the influence of a higher percentage of lime and manganous oxide in the slag. The conclusion contained regarding the effect of the composition of iron alloys may be explained by the supposition that the capacity of manganese, and perhaps also that of iron carbide, or at least of iron rich in carbon, to absorb sulphur is very low, while, on the other hand, that of pure iron and phosphide of iron is very high. These facts show that in metallurgical operations in general it is impossible to eliminate entirely from the product the whole of the sulphur contained in the charge. The extent to which desulphurisation can be carried depends upon the coefficient of distribution—that is, upon the composition of the two phases occurring during the process in question. On this account the desulphurisation of irons rich in carbon and manganese (ferromanganese and pig iron) is more complete than with irons low in carbon and manganese, such as those produced by the open-hearth and Bessemer processes. In the Bessemer process, the phosphorus exercises an additional counter-influence to the desulphurisation; but this appears only to be possible when the phosphorus has largely decreased, in which case, however, the carbon and manganese have also almost entirely disappeared. In order, therefore, to keep down the sulphur to the lowest possible margin in iron, which is very low in carbon and manganese, there remain only two courses open (since the basicity of the slag cannot be increased beyond a certain limit), viz. (*a*) either in the selection of a charge that contains the least possible sulphur, consisting of pure iron or of iron that has been desulphurised in the mixer; or (*b*) by repeated removal of the old slag and the formation of new slag. In this connection a mixer could be employed with good effect, since this not only supplies a raw material lower in sulphur, but its use necessitates the removal of the mixer-slag and the formation of new slag. It is by no means impossible, especially with a falling temperature, that a third phase, a mixture of oxides and sulphides, may occur in conjunction with the slag and metal. This phenomenon seems to occur during certain segregations.

In a paper on the chemical and physical properties of carbon in the hearth of the blast furnace, Mr. W. J. Foster showed that by increasing the temperature and diameter of the hearth, more carbon would be exposed to the oxides, with proportionally less interruption by the gases that are decomposed in the neighbourhood of the tuyeres; hence more carbon would be converted into carbon monoxide in the hearth per unit of air introduced at the tuyeres, and consequently an increased rate of driving and economy would be the result.

The making of a fixed gas from wood for service in the gas engine or in the manufacture of steel is in some localities desirable. Mr. James Douglas, of New York, was induced, therefore, to give a detailed account of the use of a fixed gas, made in a modification of the Loomis gas producer in Mexico. The meeting terminated with the usual votes of thanks. The autumn meeting of the Institute will be held at Düsseldorf on September 2 to 5.

GEORGE GRIFFITH.

THE news of the sudden death of Mr. George Griffith, Assistant General Secretary to the British Association, came as a shock to all who were acquainted with his vigorous personality. On the afternoon of May 7 he left the office of the British Association apparently in his usual health, and took his place in the train from Baker Street Station for Harrow. Scarcely had the train started when he was seized with an attack which ended fatally in a few minutes.

Griffith's career was divided into three periods—his Oxford life, his long tenure of an assistant mastership at Harrow School, and the last twelve years of his life occupied with his duties as assistant general secretary of the British Association.

His career at Jesus College, Oxford, was a brilliant one. After taking honours both in classical and mathematical moderations, his name appears, alone, in the first class in the final school of natural science in 1856. For the next eleven years he resided at Oxford, where he married a daughter of Mr. A. H. D. Acland Troyte. Toward the latter end of this period he was appointed deputy for the professor of natural philosophy, from which position he was summoned in 1867 by Dr. Butler to inaugurate the teaching of natural science at Harrow.

The task before the new-comer was by no means easy. The teaching of science, which had been forced on the attention of reluctant governing bodies by the recommendations of the Endowed Schools Commission, was regarded with scant favour by the majority of schoolmasters, while among the boys it was frankly disliked. At Harrow there was at that time neither laboratory nor special class-room; Griffith was allowed the use of a room when it was not being used by another master, but all apparatus had to be cleared away after each lecture before the entrance of the legitimate tenant. This state of things continued until about 1874, when properly equipped laboratories were erected. For twenty-six years (1867–93) Griffith taught at Harrow, in his earlier years taking physics, chemistry, geology and biology, according to the demand; latterly he confined himself almost exclusively to physics. In 1871 he entered into possession of a "Small House" (a boarding-house for nine boys), which he held until, in 1887, he succeeded Mr. Holmes as the master of "Druries," a larger and more responsible charge. In 1893 he retired from his mastership, having already been appointed (in 1890) assistant general secretary to the British Association for the second time.

His active connection with the British Association began at a much earlier date. We find him acting as local secretary at the Oxford meeting of 1860, memorable for the Huxley-Wilberforce battle over Darwin's works, while in 1862 he entered on his first term of office as assistant general secretary. Having resigned in 1878, he was prevailed upon to take charge of the work for the year 1881, during a temporary vacancy. In 1890 he was re-appointed, and carried on the work of his office with full vigour until an hour before his death.

During his latter years he threw himself with characteristic energy into the Royal Society's scheme for an international catalogue of scientific literature, a task for which he was singularly well fitted by wide learning, both scientific and linguistic, his unfailing memory and his fastidious accuracy of thought and expression.

He was laid to rest, on May 13, in the old churchyard of Harrow-on-the-Hill, above the little town that had been his home for thirty-five years, and the old school into which he had been the first to introduce the systematic teaching of science. B. P. L.

NOTES.

M. T. MOUREAUX, who has for twenty years been connected with the magnetic work of the Parc Saint-Maur Observatory, has been appointed to succeed the late M. Renou as director of the Observatory.

PROF. T. C. CHAMBERLIN, of Chicago, Dr. T. Thoroddsen, of Reykjavik (Iceland), and Prof. S. W. Williston, of the University of Kansas, have been elected foreign correspondents of the Geological Society.

THE Prince of Wales has consented to become an honorary member of the Linnean Society. The following gentlemen have been elected foreign members of the Society:—MM. A. Giard, H. J. Hansen, C. S. Sargent, F. E. Schulze and J. Wiesner.

ON Tuesday next, May 20, Prof. Karl Pearson will deliver the first of three lectures at the Royal Institution on "The Laws of Heredity, with Special Reference to Man." The Friday evening discourse on May 30 will be delivered by Mr. G. Marconi, on "Electric Space Telegraphy," and that on June 6 by Sir Benjamin Baker, on "The Nile Reservoirs and Dams."

THE new botanical laboratories, presented to University College, Liverpool, by Mr. W. P. Hartley, were opened by Sir William Thiselton-Dyer, K.C.M.G., F.R.S., on Saturday last. The new Institute is an imposing building and the accommodation it affords will facilitate the advancement of the science of botany in Liverpool. The teaching of large classes of University students of botany is now not only possible, but easy; and in view of the probable early realisation of a University for Liverpool, this is a matter of some importance. Not only does Mr. Hartley's gift provide ample room for all probable increase in number of students, but the laboratories are equipped with the necessary appliances, both for elementary and advanced work. A special laboratory is set apart for investigations in plant physiology and another for anatomical research. The laboratories will thus not only become centres of teaching, but of work carried on with the view of contributing knowledge which will assist the progress of botanical science. We hope to give a description of the new Institute in a later issue.

LIVERPOOL has often given evidence of its appreciation of the men of light and leading whose activities bring honour to the city. The return of Prof. Herdman from Ceylon, where he has recently spent several months in the investigation of the Pearl Oyster Fisheries, on behalf of the Government, provided Liverpool biologists and others with an opportunity of expressing their esteem for his work. A large company, including the Lord Mayor and Lady Mayoress, assembled at a complimentary dinner given to Prof. and Mrs. Herdman last week under the auspices of the Liverpool Biological Society. In responding to the toast proposed by Sir William M. Banks, Prof. Herdman was prevented from speaking on the principal object of the expedition, namely, his work on the pearl oyster, because the Government report had not been presented, but he gave an interesting account of other sections of his work and of visits to places of interest in and about Ceylon.

THE annual conversazione of the Society of Arts will be held on June 24 at the Royal Botanic Gardens, Regent's Park.

A MEETING of delegates representing a number of natural history and photographic societies was held at Croydon on Friday, May 9, Mr. W. W. Whitaker, F.R.S., being in the chair, to consider and set in motion a photographic survey of Surrey. It was resolved that a society be formed to be called "The Photographic Survey of Surrey," and that its object be to preserve a record in permanent photographs of buildings of interest, antiquities, scenery, geology, natural history, anthropology, and of portraits of notable persons, representations of passing events of local or historical importance, and of old records, rare books, prints, maps, so as to give a comprehensive survey of what is valuable and representative in the county of Surrey.

IN the death of Mr. John Clavell Mansel-Pleydell, of Whatcombe, near Blandford, Dorsetshire loses a man of wide influence and learning, a naturalist of the old school, distinguished for his labours on the botany, zoology and geology of his native county, and one who as magistrate and councillor had rendered great local services. He was born in 1817, educated at St. John's College, Cambridge, and succeeded to the family estates on the death of his father in 1863. He was a fellow of the Linnean and Geological societies, and one of the founders of the Dorset Natural History and Antiquarian Field Club, to the *Proceedings* of which he contributed many articles. He was author also of separate works on the flora, the mollusca and the birds of Dorsetshire. He died on May 3, 1902, aged eighty-four.

MR. J. MACFARLANE, honorary secretary of the Asiatic Society of Bengal, informs us that Sir Frank Athelstane Swettenham, K.C.M.G., the Governor of the Straits Settlements, has made the Society a grant of 2800 dollars, or Rs. 8750, for the purpose of completing the publication of the "Materials for a Flora of the Malayan Peninsula," by Sir George King, K.C.I.E., formerly superintendent of the Botanic Garden near Calcutta. The series of papers bearing this title is really a monograph, modelled on the lines of Hooker's well-known "Flora of India," of the flowering plants of the Malay Peninsula and the adjacent smaller islands, and it is as useful to the student as it is to the systematic botanist. The series was commenced in the *Journal of the Asiatic Society* for 1899, and up to last year nearly 1400 pages, including fifty-two natural orders, or rather more than half the work, had been published. One order, Leguminosæ, has been contributed by Major Prain, and Dr. O. Stapf, of Kew, has collaborated in the preparation of the suborder Melastomeæ. The Society's financial position would, however, scarcely permit the publication of the Malayan flora without support. At this juncture the Government of the Straits Settlements, which was naturally interested in the completion of the work, held out the prospects of financial aid being afforded, and has now sanctioned the liberal donation of Rs. 8750. This assistance places the Society in a position to complete without delay the publication of Sir George King's important contribution to the advancement of botanical research.

DURING a trial of M. Severo's air-ship at Vaugirard on Monday, an explosion occurred, causing the total destruction of the balloon and the death of M. Severo and his assistant, who were thrown to the ground from a height of more than one thousand feet. It is not known whether the accident was caused by an escape from the motors setting fire to the hydrogen in the balloon, or whether part of the machinery became heated and ignited the envelope, but the former appears to be the more probable cause of the calamity. The balloon shot up suddenly when it was released, and the expansion which must have occurred on account of the diminished pressure seems to have caused an escape of gas, which becoming ignited, resulted in the explosion. As the petroleum motor was little more than a metre from the envelope of the balloon, there was great danger that an accident of this kind would occur. In M. Santos Dumont's airship the motor was sixteen or eighteen metres from the balloon and far to the rear, so that the possible chance of gas ignition was much less. M. Severo designed his balloon with the object of avoiding the danger of pitching to which M. Santos Dumont's machine was liable. This feature must necessarily exist in the greatest degree in a machine in which the screw propellers are so placed that their resultant thrust has a considerable moment about the centre of the balloon. If the thrust acts nearly along the axis of the balloon and the car of the balloon is as close up to the balloon as possible, the pitching may be expected to be small. This was the essential feature of the Severo airship. The propulsion was effected by two screws attached to the balloon itself, and placed at either end of an axis that bisected the balloon longitudinally from end to end, while the car was drawn up close to the balloon. Another feature was the method of securing rigidity by means of a light rod running through the balloon from end to end and preventing it from crumpling in even if it should become somewhat deflated.

IN a letter to the *Times*, Earl Grey has directed attention to the important influence which the United States Fish Commission claim to have exerted upon the fish supply of their western coasts by means of the fish-hatching operations carried out by the Commission. The new illustration cited by the acting commissioner in his letter to Earl Grey has reference to salmon. It is stated that, of one lot of 5000 fingerlings released at the Clackamas (Oregon) hatchery in 1896, after having the adipose dorsal fin removed with a razor, 375 fish, averaging 27·7 lb., were captured in 1898 in the Columbia River basin and five in the Sacramento River (California); in the following year between forty and fifty others were taken, and in 1900 a number of others were reported, the fish caught in 1899 averaging 10 lb. heavier than those in 1898. It appears that not less than 450 marked fish, with an aggregate minimum weight of 10,000 lb., were secured in the second, third and fourth years following their release. "The foregoing figures mean that for every 1000 fingerling salmon liberated by this Commission on the Columbia River, 2000 lb. of adult fish were caught for market two to four years later. Reducing this to a financial basis, it appears that the cost of producing and planting young salmon is under 1 dollar per 1000 (including compensation of permanent employés), while the minimum value of the fish caught for market is 5 c. per pound, or 100 dollars for the 2000 lb. actually taken." The acting commissioner adds that it is the intention "to verify these results by additional and more conclusive marking experiments, which are already under way," and concludes his letter with a reference to the Commission's well-known success in introducing the Atlantic shad and striped bass into the waters of their west coast, where these fish now yield profitable fisheries. Everyone recognises the zeal and enterprise which the Americans have shown in the matter of fish-culture, as well as the success of their acclimatisation experiments cited above; and there will be general satisfaction, even among the Commission's critics, if they should ultimately be in a position to prove the commercial utility of their extensive salmon-hatching operations. The moral, however, which Earl Grey deduces for the behoof of our Fisheries Department, *i.e.* to go and do likewise, is more questionable. There is scarcely any need to introduce good fish into any of our British waters, and there are many who think that the salmon has already monopolised too much of the attention of our administrative authorities. On the other hand, a Fish Commission for Great Britain, on which science and practice were fitly represented, and which was provided with adequate means both for investigations and practical experiments, would fulfil a serious deficiency in our industrial organisation.

IN a small pamphlet of 21 pages which we have received, Father J. Fényi, S.J., describes a most ingenious apparatus for registering thunderstorms. The instrument seems to be due chiefly to the ingenuity of Father Johann Schreiber, S.J., an assistant at the Haynald Observatory in Kalocsa, who constructed it. The apparatus consists mainly of three portions; the first consists of a horizontal magnetic needle mounted on a vertical support between a small and sensitive coil of wire, the needle and its stop being connected with a battery, a bell and a registering apparatus, the needle when in contact with its stop completing the circuit. The registering apparatus is a small electromagnet which actuates a pen in contact with a disc, and the latter is connected with a clock and moves with regular velocity. The third and very important portion of the arrangement is the coherer, which is composed of two delicately suspended needles nearly in contact; these are connected in a circuit, which includes the coil in which the horizontal needle is placed, a cell, and the long intercepting wire, corresponding to the tall post with wire of the Marconi telegraph system. The apparatus works in the following manner. A distant flash of lightning starts a wave-impulse, and this is led to the coherer by the intercepting wire; the needles move and touch each other, thus completing the circuit, and allow a current to pass through the coil. This coil immediately causes the needle inside it to be deflected to the stop. The second circuit is thus completed, the needle on the registering apparatus marks a deflection on the disc, the bell is rung, and the vibration caused by the latter separates the needles of the coherer. According to the account here given, the instrument is very efficient and has been found to record storms as many as twenty miles away, while on another occasion the instrument during very fine weather was working "apparently rebelliously," but was really recording a great storm raging at Budapest (as shown by the time of occurrence and record at each place), a distance of 110 kilometres from the apparatus.

IN the *Scientific Transactions* of the Royal Dublin Society for April, Prof. F. T. Trouton discusses the remarkable experiment suggested by the late Prof. Fitzgerald for testing the relative motion of the earth and the æther. The idea of the experiment is that a charged electrical condenser, when moving through the æther with its plates edgeways to the direction of motion, possesses a magnetic field between the plates in consequence of its motion in accordance with the generally held view that a moving charge is equal to an electric current. As Prof. Trouton points out in the second part, the experimental realisation of the results anticipated opens up the possibility of utilising the earth's energy of motion through space, but it appears, so far as the observations go, that the effects sought are masked by some countervailing phenomena. In examining the paper at the present time, the recent discussions of Cremieu, Righi and other physicists on the question whether moving charges do actually generate a magnetic field, and allied points in the theory of electromagnetism, must not be overlooked.

WE have received a copy of a paper, by Mr. R. S. Hutton, on the fusion of quartz in the electric furnace. Mr. Hutton found that quartz can be readily fused in a Moissan arc furnace taking 300 amperes at 50 volts, and if air is supplied during the process reduction can be prevented. A modified form of furnace was built with a trough cut at right angles to the carbons, so that a carbon mould filled with broken-up quartz can be pushed under the arc. For making tubes, a carbon core is used, which is easily withdrawn afterwards, as it does not stick to the quartz. The tubes thus prepared are not quite free from bubbles, but can be improved in appearance by reheating under the arc, and, being thick-walled, can be used for drawing down and blowing. Mr. Hutton expresses the hope that this process may be extended by those having large supplies of power at their disposal, and may prove cheaper and more easily worked than the present method of fusion in the oxyhydrogen flame. Fused quartz apparatus might then be easily available, and its valuable properties would ensure its use for many purposes. Chief among these may be noted its low coefficient of expansion, its high melting point, and its power of withstanding sudden changes of temperature without cracking.

THE last number of the *Journal* of the Russian Physical and Chemical Society (vol. xxxiv. 2) contains a paper by Prof. Bohuslav Brauner on the position of the rare earths in Mendeléeff's periodical system of elements, which led to a very interesting discussion when it was read at the last Congress of Russian Naturalists. After having mentioned his experimental and theoretical work concerning the elements lanthanum, cerium, praseodymium, neodymium, thorium, &c., the author discussed the position of these elements in the periodic system, and the four different ways in which it may be attempted to place them in it. With Mr. Steele, of Melbourne, he comes to the conclusion that this group of elements represents a sort of node in the periodic system, between cerium and an unknown element which has the atomic weight of 180. This inter-periodic group is a continuation of the eighth series, which ends with the platinum elements; gold appears in such case as the first member of the ninth series, and not of the eleventh. In the twelfth series the first members are, probably, radium, thorium and uranium. This addition seems, in Mendeléeff's opinion, to deserve serious attention.

IN the latest *Bollettino* of the Italian Seismological Society, Dr. Cancani reconsiders the periodicity of the great earthquakes which have visited the coasts of the Marches and Romagna. By the discovery of some missing records, he has been able to fill up two gaps in the series, which now extends from 268 B.C. to 1874 A.D. The intervals between successive great earthquakes vary from 93 to 114½ years, the average interval being 101·9 years.

SOON after the Riviera earthquake of February 23, 1887, the geodynamic section of the Central Meteorological Office of Rome commenced the systematic record of all Italian earthquakes. During the first three or four years, the new section was getting into working order, but from 1891 onwards it attained that uniformity and regularity which now characterise it. The results of the first ten-year period (1891–1900) are summarised by Dr. A. Cancani in a paper published in the last *Bollettino* (vol. vii. No. 6) of the Italian Seismological Society. Taking into account only those shocks that were perceptible without instrumental aid, he finds that no less than 3361 earthquakes were observed in Italy during the ten years. The maximum monthly numbers occur in July and August, but this distribution is accidental and due to the very numerous shocks which followed the Monte Saraceno (Foggia) earthquake in July and August, 1893. During the last five years, the maximum numbers are found in January and March. The hourly distribution of earthquakes shows a minimum between 5 and 8 p.m. and a maximum in the first hour after midnight. Seismologists usually consider the midnight maximum as apparent and due to the condition of the observers, but Dr. Cancani remarks that the ratio of night earthquakes to day earthquakes is the same, namely 1·5, both for weak shocks (of intensities 2 to 4) and for strong ones (intensities 5 to 8). This is in direct contradiction to results previously obtained by de Montessus.

DR. HERGESELL, president of the International Aëronautical Committee, has communicated the following preliminary results of the balloon ascents which took place on the morning of February 6:—Strassburg, (1) temperature on ground $-0^{\circ}·9$ C., $-39^{\circ}·7$ at 8290 metres; (2) temperature at starting $-0^{\circ}·1$, $-6^{\circ}·8$ at 3600 metres. Berlin, temperature $-4^{\circ}·4$, and $-12^{\circ}·9$ at 3635 metres. Vienna, (1) temperature $-8^{\circ}·6$, and $-12^{\circ}·0$ at 3760 metres; (2) with Archduke Leopold Salvator and Archduchess Blanca in the car, temperature $-9^{\circ}·0$ at 3000 metres (temperature at starting not stated). Ascents were also made at Trappes (Paris) and Pavlovsk (St. Petersburg), but the results are not yet known. Mr. Rotch sent up a kite from Blue Hill Observatory, U.S. The lowest temperature, corresponding to the time of the European ascents, was $-16°·0$ at a height of 1242 metres. During the period in question there was an area of low barometric pressure over western Europe, which extended from Spain to Scandinavia, while over the eastern part of the continent there was an area of high pressure; the ascents from Vienna were made under the influence of the latter atmospheric conditions.

RESEARCHES carried on by Prof. F. E. Weiss on a Carboniferous plant-remain found at Halifax, and named *Xenophyton radiculosum* by Mr. Thomas Hick, show that the specimen may with little hesitation be regarded as the "root" of *Lepiaophloios fuliginosus*—a view which supports the contention of the late Prof. W. C. Williamson that the plant was of stigmarian character. (*Manchester Memoirs*, vol. xlvi., 1902, No 9.)

THE *Annuaire* of the Royal Academy of Belgium for 1902 contains a biography, with portrait, of the late Baron de Selys Longchamps, who died at Liege in 1900. It appears that the family of Selys has been intimately connected with Liege since the seventeenth century. Full justice is done in the memoir to his work on the natural history of his own country, as well as to that on ornithology, ichthyology, and other branches of biology in general.

THE movements of gregarines are discussed by Mr. H. Crawley in the first part of the *Proceedings* of the Philadelphia Academy for 1902. The theory that these tiny organisms possess a kind of passive locomotion by means of the gelatinous threads they exude from the hinder part of the body is rejected—for one reason because such a mode of motion is unparalleled in the animal kingdom. Instead of this, the author believes that locomotion is effected by transverse muscular movements in the body, although the exact nature of the action and its results can only be surmised.

IN the *Proceedings* of the U.S. Museum (vol. xxiv.), Mr. Jordan, assisted in one case by Mr. M. Sindo and in another by Mr. J. O. Snyder, continues his valuable illustrated review of the fishes of Japan. Four parts are now before us, the first dealing with the surf-fishes (Embiotocidæ), the second with the angler-fishes, the third with the "trachinoids," and the fourth with the salmonoids. With regard to the lack of sharply defined specific or subspecific characters between the numerous forms of the latter, the authors are inclined to adopt the view that this is in part at least due to the modern origin of the group.

PROF. H. F. OSBORN, in the April number of the *American Naturalist*, urges the importance of "homoplasmy" as a law of latent or potential homology, taking for his text the independent origin of certain cusps in the cheek-teeth of the Primates which are clearly homologous. Assuming that all teeth started from the tritubercular type, we are forced to the conclusion that there is some principle in the constitution of these teeth which unifies up to a certain point the subsequent variation and evolution.

AN explanation of the survival of the brachiopod genus Lingula from Cambrian times is offered by Mr. N. Yatsu in *Annotationes Zoologicae Japonensis* (vol. iv. part ii.). A part of the Japanese coast where this brachiopod flourishes was a few seasons ago coated with a deposit of muddy sediment from a flooded brook. All the burrowing molluscs were immediately killed, but the Lingula were unharmed. As it is also known that Lingula will live in an aquarium after the water has become unfitted for other organisms, it is inferred that its survival is due to its power of withstanding unfavourable conditions. In the same journal, Mr. H. Kuwano describes a new Japanese Balanoglossus.

THE presidential address delivered by Dr. Erwin F. Smith before the Society for Plant Morphology and Physiology is published in full in a recent number of *Science*. Taking "Plant Pathology" as the subject of his discourse, comparisons are instituted between the conditions under which the pathologist worked twenty years ago and the improved modern-day methods. At that time pure cultures were almost unknown, and precise fixing and staining methods had not been devised. Then follows a considerable list of important researches from the time of De Bary down to the present day. Finally, looking forward, Dr. Smith suggests that the pathologist of the future will require to consult or, better still, train himself as a chemist and physicist. A preparation of eight years is considered to be none too long to fit the future pathologist for his life's work.

WE have received a copy of a syllabus of a special course in natural history for training college and King's students, issued, under the supervision of Prof. J. A. Thomson, by Marischal College, University of Aberdeen, for their summer session. The book, which is beautifully illustrated, appears in every way admirably adapted to the purpose for which it is intended. It commences with an examination of a series of types of British vertebrates, followed by a selection of invertebrates. Then comes a discussion of the principles of classification, with brief definitions of varieties, species, genera, &c. The structure of the cockroach is then exemplified, after which we have a brief table of the animal kingdom with appropriate illustrations. Another lesson deals with living animals, this being followed by a discussion on adaptation to surroundings and mode of life. The pupil is then introduced to the leading features in the structure of limbs, after which development claims his attention. Finally, there are illustrated studies of various types of common animals from four different points of view.

THE first number of the fortnightly *Agricultural News* (16 pages, one penny) was published by the Imperial Department of Agriculture for the West Indies on April 25, and has been very well received by the colonials. Its contents are of a most varied character, appealing to all classes of cultivators in the islands, dealing, not only with the staple industry, sugar, but also with bats, beetles, tarpon fishing, grape cultivation, market reports, notices of books, &c. It is proposed to make a special feature of reports on the work which is being carried on at chemical laboratories, botanic institutions, agricultural shows, &c., and of the promotion of agricultural education in the colleges and schools of the West Indies. In future the *West Indian Bulletin* will be the quarterly journal of the Department for scientific and technical readers, while the *Agricultural News* will be the publication for the masses and the classes. Although the Department has only been in existence a little more than three years, it is evidently already widely appreciated, for its publications have now an extensive circulation in all parts of the tropics, the income from the sales disclosing a steady increase.

DR. HERBERT J. WEBBER has published a complete account of his investigations on the germination of the pollen grain and the series of events leading to fertilisation in two species of Zamia (U.S. Department of Agriculture, Bureau of Plant Industry, *Bull.* 2, 1901). The paper is a valuable addition to our knowledge of a most important race of plants, and the author's treatment is critical as well as descriptive. He shows that the male prothallium consists at first of two (or possibly three) cells, of which the terminal one divides into a stalk and "central" cell (the latter = antheridial cell of other authors). From the central cell the two antherozoids are formed, and the entire mass is used in their formation. The blepharoplasts, which ultimately serve as the starting place for the coil of cilia in each antherozoid, are regarded as organs *sui generis*; and although their possible relation to centrosomes is also considered, the arguments against their identity with the latter are cogent. In fertilisation, the entire antherozoid enters the egg, and the cytoplasm and nuclei of the male and female cells respectively become fused. No centrosomes were observed during the cleavage of the fertilised egg during the formation of the embryo.

WE have received from the publishers (Messrs. Cassell, Ltd.) a copy of the first part of an illustrated quarto work on "European Butterflies and Moths," by Mr. W. F. Kirby, the well-known lepidopterist. The plates are excellent examples of modern colour-printing, and the work, so far as it has yet gone, may be described as an attractive subject attractively treated. Perhaps it would have been better if a little more prominence had been given in the text to the English names. The work is to be issued in fortnightly parts.

A VOLUME containing the physical papers of the late Prof. H. A. Rowland is now in preparation. It will be issued under the editorial direction of a committee appointed for that purpose, consisting of President Remsen, Prof. Welch and Prof. Ames. The book will contain Prof. Rowland's articles and memoirs on physical subjects, together with his popular writings and addresses, numbering sixty in all. It will occupy between six and seven hundred pages, and will be published at the price of one guinea net per copy. Orders may be sent to Prof. Joseph S. Ames, secretary of the committee of publication, Johns Hopkins University, Baltimore, Maryland.

THE industry of chemical perfumes is one of recent development and is rapidly assuming an importance second only to the colour industry in the field of commercial organic chemistry. The current number of the *Moniteur Scientifique* contains an account by MM. Marc Tiffenau, R. Bernard and A. Gloess of the exhibits in this field at the Paris Exhibition of 1900, preceded by a short sketch of the general methods employed in the preparation of chemical perfumes. It is interesting to note that practically the whole of this branch of applied science is divided between two nations, France and Germany.

THE conclusion of Maxwell from the electromagnetic theory of light that the dielectric capacity should be equal to the square of the refractive index has led to a mass of experimental work not always in accord with the law. In the current number of the *Comptes rendus*, M. Edm. van Aubel collects the experimental data for these two constants for four classes of nitrogen compounds, amines, alkyl nitrates, fatty nitro-derivatives and nitriles, and shows that in all cases the dielectric constant diminishes as the molecular weight increases, whilst the refractive index increases, a result obviously incompatible with Maxwell's law.

THE additions to the Zoological Society's Gardens during the past week include two Lesser Kestrels (*Tinnunculus cenchris*), a Short-eared Owl (*Asio brachyotus*) captured in the Red Sea, presented by Capt. E. W. Burnett; a Red-footed Falcon (*Tinnunculus vespertinus*), South European, presented by Miss E. Leeke; a Virginian Eagle Owl (*Bubo virginianus*) from the West Indies, presented by Mr. B. C. Storey; a Common Mynah (*Acridotheres tristis*) from India, presented by Mr. F. G. Miéville; two Syrian Bears (*Ursus syriacus*) from Western Asia, twenty-two Moorish Toads (*Bufo mauritanica*) rom North-west Africa, five Amphiumas (*Amphiuma means*), ten Punctated Newts (*Amblystoma punctatum*) from North America, an Upland Goose (*Chloephaga magellanica*) from the Falkland Islands, received in exchange; a Japanese Deer (*Cervus sika*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

NEW VARIABLE STARS.—The following variable stars have been detected on plates taken with the astrographic telescope at Greenwich Observatory:—

Star.		R.A. h. m. s.		Decl. ° ′		Variation. m. m.
6. 1902. Draconis	...	18 5 9	...	+65 56·9	...	9·0 – <14
7. 1902. Draconis	...	18 6 54	...	+66 8·9	...	9·5 – 14
8. 1902. Camelopardalis		5 49 22	...	+74 30·8	...	8·9 – <14

ELEMENTS OF COMET 1902 *a* (BROOKS).—The following elements computed for this comet are given in *Astronomische Nachrichten*, Bd. 158, No. 3790:—

T = 1902 May 7·159, Berlin M.T.

$$\left.\begin{aligned} \omega &= 228^\circ\ 22'\cdot7 \\ \Omega &= 52\ \ 15\cdot4 \\ i &= 66\ \ 30\cdot4 \end{aligned}\right\} 1902\cdot0.$$

$$\log q = 9\cdot65436.$$

COLABA OBSERVATORY.—The Report of the Director of the Government Observatory at Colaba, Bombay, has been issued, and contains the results of magnetic and meteorological observations made during the year 1901.

The magnetic observations have been on regular record since 1842, but there is now reason to believe that disturbances will occur from the proximity of the electric tramways in Bombay. It is hoped, however, that a new site will be granted early enough to permit of a fresh series of determinations running parallel with the present, so that the value of such a long continuous record may not be seriously affected.

ATOMS AND VALENCIES.

AN offprint has come to hand of a thoughtful essay by Mr. J. Fraser, of the Scottish Ordnance Survey, entitled "A Theoretical Representation leading to Suggestions bearing on the Ultimate Constitution of Matter and Ether," which appeared recently in *Proc.* Roy. Soc. Edin. xxiv., i., 1902, pp. 1–64. Under this guarded title the writer discourses, in a manner often stimulating and suggestive, on the bearing on the facts of chemistry and chemical physics of a notion he has formed of the constitution of the æther, and of matter which he considers as constructed out of that medium. He begins by quoting Sir J. Herschel's opinion that the æther is "an adamantine solid," far denser, in fact, than the densest metal. The other alternative, that of inertia or density insensibly minute, has been more commonly in evidence in recent times, especially since Lord Kelvin showed that it was adequate for the transmission of radiant energy across space. It is something to know that the more unfamiliar view, which has recently again been broached in illustration of the laws of general æther-theory, presented no intrinsic difficulty to the mind of so competent an authority as Herschel. Enormous density implies still more enormous elastic resistance, which Mr. Fraser ascribes in a way to a kinetic origin, like Kelvin's and FitzGerald's turbulent motion. How is an atom of matter to be represented? Briefly and bluntly, in the words of the writer, as "a veritable ethereal bubble"—walled in by a single layer of æther-particles, in very rapid rotation, the centrifugal force of which prevents the bubble from collapsing under the enormous ambient pressure. How is its permanence assured? Astronomical analogies are invoked in favour of its possibility; but the sceptical critic had better refrain from too close scrutiny in order to pass on to see whether any light on atomic behaviour is shed by a somewhat loose representation of this sort. After all, a hollow vortex-ring atom is a ring-shaped bubble kept open much in this way; and representations dynamically vaguer than this have turned out in chemical science to contain the germ of fruitful and far-reaching progress. A sort of Le Sage corpuscular theory of gravity is set forth with considerable freshness and some plausibility. But the most interesting sections relate to chemical suggestion, with regard to which the writer modestly confesses to little knowledge except what has been acquired with a view to the present attempt. It may be remarked on his behalf that knowledge of speculative scientific theory, when acquired with some constructive intention of this sort, even if it be visionary, is apt to be a much more real possession than when the aim is merely to become well-informed in a colourless way about the opinions that chemists have held and have at different times put into their treatises. Time and reflection, to an extent that can hardly be spared by most people, would be required to come to a definite judgment as to how far the notions put forward are allowable or should be at once put aside, whether the "resemblance to the ways of nature" on which the writer insists involves any germ of general ideas beyond those already recognised. But in any case there can be no question as to the acuteness of the writer; and the Royal Society of Edinburgh has been well advised in making his ideas accessible to others who are attracted by the same range of theoretical speculation, in subjects which are only now coming to the threshold of the dynamical stage.

J. L.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject of the Rede lecture, to be given by Prof. Osborne Reynolds, F.R.S., on June 10, at 11.30 a.m., is "On an Inversion of Ideas as to the Structure of the Universe."

Prof. Forsyth, F.R.S., will represent the University at the celebration of Abel's centenary, to be held at Christiania in September, 1902.

The museums syndicate propose to assign the greater portion of the buildings about to be vacated by the botanical department to the engineering laboratory. The number of the students engaged in the latter is now more than 200, and extension of the accommodation now provided is urgently necessary. The syndicate regret that they are unable to make arrangements for additional accommodation for the departments of human anatomy and physiology, or for the museum of zoology, which are also in need of considerable expansion.

The Graces authorising the recently proposed changes in the natural sciences tripos will be voted on in the senate on May 22. It is understood that some of them will be opposed.

Mr. W. Bateson, F.R.S., is again to be deputed to lecture in zoology for Prof. Newton during the ensuing academical year.

The Frank Smart studentship in botany will be vacant at midsummer. The studentship is of the annual value of 100*l*. and is intended to further the scientific study of botany by supplying students with some means of pursuing original investigations in this subject after they have taken the degree of Bachelor of Arts. It is open to all students of the University who have taken honours in the first part of the natural sciences tripos, provided that not more than fourteen terms have elapsed since their first term of residence. The studentship is not awarded by a competitive examination. Candidates should send in their names to the master of Gonville and Caius College on or before June 10, with a statement of their University standing.

THE second reading of the Education Bill was passed by the House of Commons on Thursday, May 8, after a debate which extended over three days. The majority in favour of the second reading was 237, the numbers being 402 votes for the Bill and 165 against.

To assist the scholarship scheme founded by the late Mr. Rhodes, Sir Alfred Jones, head of the shipping firm of Elder, Dempster and Co., announces that he will agree to give a free passage backwards and forwards from any colonial port served by his firm's steamers to both Jamaican and Canadian scholars once a year during the tenure of their scholarships. He adds:—"I trust that my example will be followed by shipowners trading to other colonies, and I hope that it may thereby be made universal, so as to put all the Rhodes scholarships from the colonies on an equal footing."

THE announcement is made that Prof. Karl B. Lehmann, of Würzburg, has been appointed to the chair of hygiene at the University of Munich, which recently became vacant by the death of Prof. Hans Buchner on March 30. He was formerly connected with the University, having been trained there as a medical student, and subsequently acted as assistant to Prof. Pettenkofer and as privat-docent for many years. Prof. Lehmann, who is a Swiss by birth, is still in the prime of life, but has already made a high reputation as a hygienist. His first special scientific work was the study of the physiology of the sense-organs, his contributions to this department of science being of great and practical value. He has also studied and written upon the action and influence of various gases upon the animal organism, and more recently has given much attention to the study of physiological chemistry in connection with general metabolic processes.

IN connection with the subject of State aid for secondary education, it is of interest to read in *Science* that the General Assembly of the State of Iowa has passed a mill tax for the building support of the three educational institutions of Iowa, as follows:—State University at Iowa City, one-fifth of a mill to run for five years. This will realise 550,000 dollars. The Iowa State College of Agriculture and Mechanic Arts at Ames, one-fifth of a mill for a similar period, which will realise 550,000 dollars. The State Normal School at Cedar Falls, one-tenth of a mill for five years, which will realise 225,000 dollars. The State educational institutions receive in addition 434,269 dollars for the biennial period, distributed as follows:—State University, 215,000 dollars; Iowa State College of Agriculture and Mechanic Arts, 135,000 dollars—of this 35,000 dollars are for additional general support annually, and 10,000 dollars annually for the experiment station, 5,000 dollars for live stock, 5,000 dollars to begin the building of a barn, and 35,000 dollars to start a main central building; the Iowa State Normal School, 84,269 dollars.

THE general scope of the new matriculation examination for all students of the University of London are published in the official gazette. The full text of the regulations will be published at the beginning of June, and the first examination under them will commence on September 15 next. An examination under the old regulations will be held in January, 1903, and under both sets of regulations in June, 1903. Matriculation candidates will be expected to show a competent knowledge in each of the following subjects, according to the details specified under the several heads:—(1) English, one paper of three hours. (2) Elementary mathematics, two papers of three hours each. (3) Latin, or elementary mechanics, or elementary physics (heat, light and sound), or elementary chemistry, or elementary botany, one paper of three hours in each subject. (4) Two of the following subjects, neither of which has already been taken under (3). One paper of three hours in each subject. If Latin be not taken, one of the other subjects selected must be another language from the list, either ancient or modern:—Latin, Greek, French, German, Arabic, Sanskrit, Spanish, Portuguese, Italian, Hebrew, history (ancient or modern), logic, physical and general geography, geometrical and mechanical drawing, mathematics (more advanced), elementary mechanics, elementary chemistry, elementary physics—(*a*) heat, light and sound, or (*b*) electricity and magnetism; elementary biology—(*a*) botany, or (*b*) zoology.

DR. D. C. GILMAN contributes to the May number of *Scribner's Magazine* some further reminiscences of noteworthy scholars with whom he has been brought in contact as president of the Johns Hopkins University. An English mathematician remarked to him one day that he had heard of Baltimore as a place which exported corn and imported mathematics, and this epigram was founded upon fact. Cayley and Sylvester both went to the new University from England. Cayley spent a winter at Baltimore, and profoundly impressed his hearers; Sylvester spent the seven years there which preceded his seventieth birthday, and left to become Savilian professor at Oxford. Many stories are told of Sylvester's eccentricities, but most of them are apocryphal. He became possessed of a sort of monomania for rhyme, and one of his most extraordinary compositions was a long series of lines, every one of which ended with a syllable that he pronounced as *ind*. This *tour de force* reached four or five hundred verses. Sometimes he was very absent-minded. For example, he arrived from Philadelphia in a late train one night and walked bareheaded to his hotel. The next morning he demanded his hat, and insisted that it was in the house, and he would not be persuaded that it had not been stolen until a telegram revealed the fact that the hat had been found in the train at Washington. In 1884, Lord Kelvin gave a course of lectures at the University. "The lectures," says Dr. Gilman, "went on from day to day upon the topics that occurred to the lecturer, or that were suggested by the questions of his hearers. Everyone who was capable of following him was enchanted. 'How long will these lectures continue?' asked one of the audience. 'I do not know,' replied Lord Rayleigh, who was one of the followers, 'I suppose they will end some time, but I confess I see no reason why they should.'" Dr. Gilman concludes his article with the following wise words:—"In the conduct of a university, secure the ablest men as professors, regardless of all other qualifications excepting those of personal merit and adaptation to the chairs that are to be filled. Borrow if you cannot enlist. Give them freedom, give them auxiliaries, give them liberal support. Encourage them to come before the world of science and of letters with their publications. Bright students, soon to be men of distinction, will be their oyal followers, and the world will sing a loud Amen."

SCIENTIFIC SERIAL.

Memoirs of the Kazan Society of Naturalists, vol. xxxv.—Researches into the Protozoa of the Black Sea, by R. Minkiewicz. The organisation, the multiplication and the systematical position of Euplotes (Ehrbg.) are discussed.—Materials for the knowledge of the soil and vegetation of western Siberia, by A. Gordyaghin. This is the second and last part of a very valuable work which was began in a previous issue of the same periodical (vol. xxxiv.). The fir, Scotch fir and birch forests, the mutual relations between the chief arborescent species, and the Steppe vegetation are discussed in this part, which contains also a large-scale botanical map of the western portion of the basin of the Irtysh and a full index.—The physicochemical structure of the chlorophyll grain, by M. S. Tsvett. Experimental researches and critical review of the work hitherto done.—Botanic-geographical researches in the province of Saratov, by B. Keller. An interesting general review of the vegetation (summary in German) and a list of 987 plants belonging to the flora of Saratov are given.—On the soils of south-eastern Russia, by A. Ostriakoff, being descriptions and chemical analyses of salt-bearing soils of southern Samara.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, May 9.—Prof. S. P. Thompson, president, in the chair.—Dr. P. E. Shaw exhibited a simple electric micrometer. Two years ago, Dr. Shaw described an instrument with which he measured very small lengths by the application of electric contacts, and the micrometer shown was a simple form of the original apparatus. A screw, fitted with a milled head, turns in a fixed nut, and its lower end presses upon the extremity of the long arm of a lever. A metal point is attached to the short arm, and the distance through which it moves, on turning the milled head, can be deduced from a knowledge of the pitch of the screw and the ratio between the arms of the lever. In using the instrument, this point is always brought up to a metal surface, and the contact is accurately determined by the telephonic arrangement described in connection with the original micrometer. Dr. Shaw illustrated the use of the instrument for measuring small lengths by describing the following eight applications to ordinary laboratory measurements:—(1) The measurement of the thickness of plates, films or fibres. The object is placed between two metal plates. The point of the micrometer is adjusted to touch the top plate and the reading taken. The object is removed, the point is again brought into contact with the top plate, and the difference between the readings in the two cases gives the thickness of the film. (2) The determination of Young's modulus by the elongation of a wire. Dr. Shaw described experiments on two wires, each 2½ metres long, hanging side by side, one of copper and the other of steel. The wires terminated in horizontal platforms to which the stretching weights were attached. The base of the instrument rested on one platform, while depressions of the other, due to loading, were measured. In this way any error, on account of the bending of the beam from which the wires were hung, was eliminated. (3) The determination of Young's modulus by the bending of a beam. (4) The determination of simple rigidity by a static method. Observations were made upon a rod held horizontally by rigid wall brackets. One end of the rod was fixed and the other held in position by a pin pressed into a hole in the end of the rod. From this end an arm projected outwards. Weights were applied to the extremity of this arm, and the twist measured by observing with the micrometer the movement of the end of the arm. (5) Application to the extensometer. (6) Measurement of thermal expansion. (7) Microscopic measurements. In measuring the diameter of a capillary tube, the cross wire of the microscope is made to touch one side of the tube, and the point of the micrometer is brought into contact with the metal stage. The stage is then moved by a screw until the cross wire comes to the other side of the tube. The micrometer point is moved into contact again, and the difference in the readings gives the diameter of the tube. In this measurement the full magnifying power of the microscope is utilised, and the work of moving the stage is performed by a rough screw. (8) The direct measurement of the wave-length of light. Newton's rings are formed by a convex lens and a piece of plate glass. The convex lens is fixed to the short arm of the lever, and the distance through which it must be moved to cause a certain number of bands to appear at the centre gives a means of calculating the wave-length of the light employed.—Papers on the conservation of entropy, by Mr. J. A. Erskine, and rational units of electromagnetism, by Sig. G. Giorgi, were postponed.

Chemical Society, April 30.—Prof. Emerson Reynolds, V.P.R.S., in the chair.—The preparation of absolute alcohol from strong spirit, by Dr. Young, F.R.S. The 4 or 5 per cent. of water remaining in the strongest rectified spirit procurable by distillation can be removed by adding to it a volatile liquid capable of forming with alcohol and water a ternary mixture boiling below 78°·3 C. and distilling. Benzene is a suitable substance for this purpose, the ternary mixture so formed boiling at 64°.85. The alcohol thus obtained contains a trace of benzene, which in turn can be removed by a redistillation with pure hexane.—On the properties of mixtures of the lower alcohols with water, by Dr. Young, F.R.S., and Miss E. C. Fortey. Methyl alcohol can be prepared in an absolute condition by simple distillation through an efficient still-head. The higher homologues, such as isopropyl, propyl and tertiary butyl alcohols, can be dehydrated by addition of benzene and redistillation. The constant boiling mixtures of these alcohols with water are not definite hydrates.—On the properties of mixtures of the lower alcohols with benzene and with benzene and water, by Dr. Young, F.R.S., and Miss E. C. Fortey. Among the lower alcohols of the paraffinic series, all except isoamyl alcohol form constant boiling mixtures with benzene, but beyond the amyl alcohols this phenomenon no longer occurs; ethyl, propyl, isopropyl and tertiary butyl alcohols alone form constant boiling ternary compounds with benzene and water.—Fractional distillation as a method of quantitative analysis, by Dr. Young, F.R.S., and Miss E. C. Fortey. When a mixture which tends to separate into two components is distilled, the portion of the distillate obtained below the temperature midway between the boiling points of the two constituents is almost exactly equal to the weight of the more volatile component of the mixture. This principle can also be extended to ternary mixtures.—On the vapour pressures and boiling points of mixed liquids, by Dr. Young, F.R.S. Mixtures of bromo- and chloro-benzene exhibit a close agreement with van der Waals's law, which states that "the relation between vapour pressure and molecular composition of mixtures of liquids having equal critical points and in which $a_{1 \cdot 2} = \sqrt{a_1 a_2}$ (where $a_{1 \cdot 2}$ represents attraction of unlike molecules and a_1 and a_2 the attractions of like molecules) is represented by a straight line."—The correction of the boiling points of liquids from observed to normal pressure, by Dr. Young, F.R.S. An extension and improvement of Craft's table of constants of correction.—Vapour pressures and specific volumes of isopropyl isobutyrate, by Dr. Young, F.R.S., and Miss E. C. Fortey. These constants have been determined on a pure specimen of this ester prepared by electrolysis of potassium isobutyrate.—The preparation of highly substituted nitroaminobenzenes, by Dr. Orton. The author has devised a method of preparing aromatic nitroamines by the action of nitric acid on amines dissolved in acetic anhydride, and has by this method isolated and characterised a number of these substances.—The atomic weight of tellurium, by Dr. Scott, F.R.S. When tellurium is treated with methyl iodide, it forms a trimethyl tellurium iodide which crystallises well and affords a convenient method of comparing the combining weight of tellurium with that of iodine which is accurately known from Stas's determination. The ratio thus found indicates that the atomic weight of tellurium is about 127·75.—Nitrogen bromides containing the propionyl group, by Dr. Chattaway. A continuation of the author's researches on nitrogen halides in which propionyl is a substituent. A number of these derivatives are described.

Mathematical Society, May 8.—Dr. E. W. Hobson, president, in the chair.—Dr. Ganesh Prasad read a paper on the use of Fourier's series in the theory of conduction of heat. It is pointed out that the received theory may break down through discontinuity in the initial conditions; and a method is described for forming an equation which shall, at the discontinuities, take the place of the usual partial differential equation of conduction. The modified theory thus deduced is equivalent to the ordinary theory at all places and times at which there is no discontinuity in initial or boundary conditions.—Mr. A. E. Western pointed out an exception to a theorem of Fermat's on binary powers.—Dr. F. S. Macaulay read a paper on some formulæ of elimination. The resultant of any number of equations, which are homogeneous in an equal number of variables, is proved to be expressible as the quotient of a certain determinant by a certain minor of the same; certain formulæ are also given connecting the determinants with the roots of the equations which, for this purpose, are made non-homogeneous by equating one variable to unity.—The following papers were communicated from the chair.—Prof. Burnside, on groups in which every two conjugate operations are permutable. The general character of the operations of a group which satisfy this condition of permutability is determined, and it is shown that the sufficient and necessary conditions that the group may be of finite order are that the generating operations are of finite order. In general for such a group, the commutator of any two operations is a self-conjugate operation. The case in which the order is a power of three is exceptional.—Mr. H. S. Carslaw, the application of contour integration to the solution of general problems in the conduction of heat and to the expansion of an arbitrary function in series. The solutions of certain special problems are transformed so that they are expressed in terms of integrals taken along certain paths in the plane of an auxiliary complex variable. The solutions of more general problems, built up by synthesis, are then transformed so that they are expressed by means of infinite series. The methods are applied to problems of conduction of heat in a finite rod and in a cylinder, and it is pointed out that they admit of extension to other branches of mathematical physics.

Geological Society, April 16.—Prof. Charles Lapworth, F.R.S., president, in the chair.—The Carlisle Earthquakes of July 9 and 11, 1901, by Dr. C. Davison. The shocks were at least four in number, and there are single records of four other shocks. The isoseismal 5 of the first and principal shock is very nearly a circle 29 miles in diameter, with its centre 7 miles south-south-west of Carlisle, and is excentric with regard to the isoseismal 4. The continuity of the shock over a band extending from Carlisle to Coniston implies a corresponding continuity in the focus. The investigation of the earthquakes has led to the recognition of a deep-seated fault, the average direction of which is N. 5° E. and S. 5° W. and the hade throughout is to the east. In the surface-rocks there is no sign whatever of such a structure. The movements along the fault were somewhat peculiar. In the first shock the focus was of considerable length, and consisted of two principal portions, the centres of which were about 23 miles apart, connected by a region wherein the slipping was continuous throughout, and much less in amount. The northern part of the focus was smaller than the other, but was marked by a much stronger impulse. The third slip was complementary to the first, for it appears to have occupied the whole of the region between the two principal portions of the first focus, and to have been greatest near the centre of that region and to have gradually diminished towards both ends.—The Inverness Earthquake of September 18, 1901, and its accessory shocks, by Dr. C. Davison. Since the Comrie earthquake of 1839, which was followed by 330 tremors and earth-sounds within little more than two years, no British earthquake has been attended by so many accessory shocks as this one. The unusual intensity of the earthquake, its apparent connection with the great northern boundary-fault of the Highlands, and the possibility of tracing oscillations in successive centres of disturbance along the fault-surface, combined in rendering a detailed investigation desirable. With a few exceptions, the earthquakes originated beneath the district lying between Inverness and the north-eastern end of Loch Ness. The mean direction of the fault, which follows the line of the Great Glen, is N. 35° E. and S. 35 W. and its hade is to the south-east. The isoseismal 8 contains 67 square miles, and its centre is about one-and-a-half miles east-north-east of Dochgarroch and three-quarters of a mile south-east of the fault-line. The correspondence between the position of the great boundary-fault and of the fault inferred from the seismic evidence is so close that there can be little doubt that the earthquake was due to a slip along this fault. The nature of the shock, the sound phenomena, time-relations and after-shocks are described in detail, and some account is added of the earthquakes of 1890 and of sympathetic earthquakes in the valley of the Findhorn. There were two distinct slips in rapid succession, with continuous slight motion between them, the second being greater in amount and extending over an area which probably overlapped, even if it did not entirely include, that within which the first took place. The great slip reached nearly from Loch Ness to Inverness, and was greatest at a point about half-way between. The three chief after-slips resulted in an extension of this area in both directions along the fault-surface, the extension to the north-east being small, while that to the south-west amounted to 6 miles or more. In addition to this migration of the focus, there was also a continuous decrease in the depth of the focus. The earthquakes provide no evidence with regard to the direction of displacement along the boundary-fault. There can be little doubt, however, that Loch Ness is still growing; but it can hardly be determined whether the lake is now contracting in area, or whether it is gradually pushing its way outward to the sea.—The Wood's Point Dyke, Victoria (Australia), by Mr. F. P. Mennell.

Zoological Society, May 6.—Prof. G. B. Howes, F.R.S., vice-president, in the chair.—A note was read by Mr. Roland Trimen, F.R.S., upon a moth of the genus Cossus, which had been reared in the Society's insect-house from a chrysalis sent home from South Africa. The specimen was apparently referable to the common goat-moth of Europe (*Cossus ligniperda*), which had probably been introduced in logs of wood into South Africa.—Mr. Oldfield Thomas, F.R.S., read a paper on the mammals obtained during the Whitaker Expedition to Tripoli. At Mr. J. I. S. Whitaker's expense, Mr. E. Dodson had made a successful collecting expedition into Tripoli, and the specimens of mammals obtained had been presented to the National Museum. Twenty-one species were referred to, and, among others, a hare (*Lepus whitakeri*), allied to *L. aethiopicus*, but of a bright pinkish buffy colour, and a gundi (*Ctenodactylus vali*) like *C. gundi*, but with much larger bullæ, were described as new.—A communication from Mr. G. A. Boulenger, F.R.S., contained lists of four species of fishes, eight species of batrachians and thirty-five species of reptiles, of which specimens had been collected by Mr. J. ffolliott Darling in Mashonaland. Amongst these were described as new two species of fishes (*Labeo darlingi* and *Barbus rhodesianus*), one of batrachians (*Rana darlingi*) and two of reptiles (*Homopus darlingi* and *Ichnotropis longipes*).—A communication was read from Hans Graf von Berlepsch and M. Jean Stolzmann containing a second part of their memoir on the ornithological researches of M. Jean Kalinowski in Central Peru. It gave an account of 188 species and subspecies, of which twelve were described as new.—A paper contributed by Sir Charles Eliot contained notes on the nudibranchs of the eastern and western coasts of Zanzibar. *Zatteria brownii*, *Dunga nodulosa* and *Crosslandia viridis* were described as new genera and species, and remarks were made upon the little-known species *Melibe fimbriata* and *Marrella ferruginosa*.—Prof. G. B. Howes, F.R.S., communicated a paper by Prof. G. Elliot Smith on a case of abnormal dentition in a lemur. The author recorded the occurrence in an individual of *Lemur fulvus* of a fourth lower molar, present on both sides, in its characters a diminutive counterpart of the normal third molar as regards its postero-external cusp. Reverting to the fact that certain fossil lemurs, marsupial-like, possess four molar teeth, and to the presence in Otocyon of four molars, and in the insectivore Centetes of a fourth upper molar, the author asserted a belief in a four-molared ancestry for the Primates.

PARIS.

Academy of Sciences, May 3.—M. Bouquet de la Grye in the chair.—The permanent secretary announced to the Academy the death of M. L. Fuchs, correspondant for the Section of Geometry.—Studies of batteries founded on the use of saline solutions with the reciprocal action of oxidising and reducing liquids, by M. Berthelot.—On the functions of the sphæridia of the sea-urchin, by M. Yves Delage. Various views have been put forward at different times as to the functions of the sphæridia in sea-urchins. An experimental study has been made with Echinocyamus, and it was found that the sphæridia are not the exclusive organs of the sensation of orientation, since sea-urchins deprived of these organs can turn over as certainly, although less rapidly, than before.—On a class of transformations of Buckland, by M. E. Goursat.—On the deformation of conoids, by M. A. Demoulin.—The problem of surfaces loaded on end. Solution in the case of the cylinder of revolution, by M. Alban Gros.—On the function of self-induction in electric discharges through gases, by M. B. Eginitis.—The action of an intense magnetic field upon the anodic flux, by M. H. Pellat.—The action of self-induction on the spectrum of dissociation of compounds, by M. A. de Gramont. It was found that by altering the self-induction of the spark circuit the spectrum of air could be very easily eliminated without altering that of other bodies. By still further increasing the self-induction of the circuit, the lines due to various metalloids, such as sulphur, selenium, tellurium and phosphorus, could be made to disappear, a result which has obvious applications in the spectroscopic analysis of minerals.—On the law of Maxwell $n^2 = K$ for some compounds containing nitrogen, by M. Edm. van Aubel (see p. 68).—Glucose and the carbonates of cerium. On a new mechanism of oxidation, by M. Andre Job. Cerous carbonate in the presence of air is capable of oxidising arsenites and also glucose. In the latter case the cerous salt behaves like an oxydase.—On the alloys of cadmium with barium and calcium, by M. Henri Gautier.—On an oxycarbide of cerium, by M. Jean Sterba. By the action of carbon upon cerium oxide in the electric furnace, a well-defined crystallised oxycarbide can be obtained of the formula $CeC_2.2CeO_2$. This oxycarbide is relatively stable in water and air, and when decomposed with dilute acids furnishes unsaturated hydrocarbons. No other carbides except this and cerium carbide, CeC_2, can be obtained in the electric furnace.—On arsenic anhydride and its hydrates, by M. V. Auger. The only hydrates which could be obtained were $(H_3AsO_4)_2$, H_2O and $H_6As_4O_{13}$. The three hydrates $HAsO_3$, $H_4As_2O_7$ and H_3AsO_4 described by Kopp could not be prepared.—The preparation and properties of the chloro-, bromo- and iodo-sulphobismuthites of lead, by M. Fernand Ducatte.—On some derivatives of pyruvylpyruvic ester, by M. L. J. Simon. An unsuccessful attempt was made to prepare this ester, $CH_3—CO—CO—CH_2—CO—CO_2C_2H_5$. The product of the action of aniline upon ethyl pyruvate appears to be this triketone condensed with two molecules of aniline. Only one of the aniline groups could be split off by hydrolysis with sulphuric acid.—On the mutual action of acid chlorides and methanal, by M. Marcel Descudé.—On the combinations of sodium tetrazoditolylsulphite with aromatic amines and phenols, and their transformation into azo colouring matters, by MM. A. Seyewetz and Biot.—On the addition of hypochlorous acid to propylene, by M. Louis Henry. A reply to a note of M. Tiffenau on the constitution of the chlorhydrins. The constitution of the addition product of hypochlorous acid to propylene has usually been determined by oxidation. The author points out that the apparently contradictory results obtained are due to the fact that the same compound gives different oxidation products according to the oxidising agent used. It is possible that two addition products are simultaneously formed, but the principal one is undoubtedly that in which the -OH group attaches itself to the group $=CH_2$.—The development of black rot, by M. A. Prunet.—The Carboniferous eruptive rocks of Creuse, by M. L. de Launay. The results of this investigation are in accord with the theory of M. Michel Lévy on the differentiation of magmas.—Study of specimens of water and sea floor from the North Atlantic, by M. J. Thoulet.

DIARY OF SOCIETIES.

THURSDAY, MAY 15.

ROYAL SOCIETY, at 4.30.—On some Phenomena affecting the Transmission of Electric Waves over the Surface of the Sea and Earth: Capt. H. B. Jackson, R.N., F.R.S.—Microscopic Effects of Stress on Platinum: T. Andrews, F.R.S., and C. R. Andrews.—A Note on the Recrystallisation of Platinum: W. Rosenhain.—Cyanogenesis in Plants. Part II. The Great Millet, *Sorghum vulgare*: Prof. W. R. Dunstan, F.R.S., and Dr. T. A. Henry.—On Electro-motive Wave accompanying Mechanical Disturbance in Metal immersed in Electrolyte: Prof. J. C. Bose.

INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.—Electrical Traction on Steam Railways in Italy: Prof. C. A. Carus-Wilson.

CHEMICAL SOCIETY, at 8.—The Radioactivity of Thorium Compounds. II. The Cause and Nature of Radioactivity: E. Rutherford and F. Soddy.—The Radioactivity of Uranium: F. Soddy.—The Variation with Temperature of the Surface Tensions and Densities of Liquid Oxygen, Nitrogen, Argon and Carbon Monoxide: E. C. C. Baly and F. G. Donnan.—Comparison of Bromonitrocamphane with Bromonitrocamphor: M. O. Forster.—*aa*-Benzoylnitrocamphor and *aa*-Benzoyliodocamphor: M. O. Forster and E. A. Jenkinson.

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 9.—The Nebular Theory: Sir Robert Ball, F.R.S.

TUESDAY, MAY 20.

ROYAL INSTITUTION, at 3.—The Laws of Heredity with Special Reference to Man: Prof. Karl Pearson, F.R.S.

WEDNESDAY, MAY 21.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Exhibition of Freshwater Entomostraca: D. J. Scourfield.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Report on the Wind Force Experiments on H.M.S. *Worcester* and at Stoneness Lighthouse: W. H. Dines and Capt. D. Wilson-Barker.—The Cornish Dust Fall of January, 1902: Dr. H. R. Mill.

THURSDAY, MAY 22.

INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.—Annual General Meeting.

FRIDAY, MAY 23.

ROYAL INSTITUTION, at 9.—The Ethical Element in Shakespeare: Rev. Canon Ainger.

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