THURSDAY, FEBRUARY 27, 1896.

THE CATALOGUE OF SCIENTIFIC PAPERS.

Catalogue of Scientific Papers (1874–1883). Compiled by the Royal Society of London. Vol. xi. [Pet—Zyb]. Pp. 902. (London: Clay and Sons, 1896.)

THIS volume marks the completion of the third series of the Royal Society's contribution to the bibliography of science. With it the "Index Auctorum" for the ten years 1874–83 is completed, as originally planned, but in order to make the list of papers as exhaustive as possible, the Society are, as is known, actively preparing a supplementary volume to contain additional titles and references, taken from serials published not only during that decennium, but also of earlier date, which from one cause or another are not included among those at present indexed. When this supplement is issued, as we hope it may be within the next two or three years, we shall be in possession of a practically complete author-index to the whole vast mass of the serial literature of science, back from the year 1883 to the beginning of the nineteenth century.

Such a register, simple and straightforward, but accurately and systematically compiled, must always form an invaluable and indispensable basis on which to elaborate any further schemes of indexing which may attempt to furnish a guide to the contributions to each of the special departments of science. The whole problem, how best to grapple with the task of recording and indexing the ever-increasing mass of scientific literature, is one of the burning questions of the time for all cultivators of science. This problem the Royal Society have been steadily attacking since the middle of the century, when (in 1858) they commenced work upon their great Catalogue.

In our notice of vol. ix., the first of the present series (NATURE, vol. xlv. p. 338, February 1892), we gave a brief summary of the origin and progress of the Royal Society's bibliographical undertaking, and in the same article we referred to the long-canvassed and still unsettled question of a parallel subject-index. To this we will recur further on. Meantime, a short analysis of the contents of the series now completed may furnish some particulars at once instructive and interesting.

The total number of individual papers entered in the 2900 odd pages of these three volumes we estimate to be between 89,000 and 90,000. The number contained in the two volumes for the preceding decennium (1864-73) we make, by a similar estimate, about 70,000. This shows an increase of about 25 per cent., and such may probably be taken as fairly representing the actual amount of increase in scientific activity during the second ten-year period, on the assumption that the two series comprise a like proportion of the total literature of science. The original series, covering the long period 1800–1863, indexed the remarkably high total of 1500 publications. The exact number indexed for the second series (1864–73) is not quite apparent. The number for the present series is 570, a rather unaccountable decrease when compared with the large number just quoted, and undoubtedly too small to furnish a sufficiently exhaustive record of the scientific work of the world. The Society themselves recognise this, and, as we have said, are making provision for the amplification of the Catalogue by indexing some hundreds of additional serials. The greater part of these must doubtless be of minor importance, but there are also a considerable minority of publications of a high order of merit which, as we pointed out in our notice of vol. x. of the Catalogue (NATURE, vol. l. p. 241, July 1894), were unhappily not included in the list the Society originally worked from.

Of those indexed in this third series we count 192 publications bearing English titles, equal to about 33 per cent. of the whole; 116 French, or about 20 per cent.; and 165, or about 29 per cent., German. These numbers may possibly give a fair idea of the actual proportion obtaining between the contributions to the total literature of science as divided among these three languages; but we need not go further, and attempt to draw conclusions from them as to the relative scientific activity of the peoples speaking them.

The proportions in which the various branches of science contribute to the aggregate of serial literature is not very easy to determine. So far as a somewhat rough estimate may suffice, we should say that nearly 40 per cent. of the entries in the list of publications are devoted to general science, about 35 per cent. to biological, and 25 per cent. to physical and mathematical science. The distinction, however, is not always easy, but there seems a decided preponderance of biological over physical literature.

The printing of the three volumes of this series has occupied some six years, and the supplementary volume will, we imagine, not be issued before another two years at least, making a total interval of fifteen years between the date to which the work extends and the date of complete publication. It is easier to deplore these long intervals than to avoid them, especially while one Society endeavours to cope single-handed with the vast and ever-increasing mass of material. In his address at their last anniversary, Lord Kelvin said that "the continuation of such a work was almost beyond the resources of the Royal Society," and referred to the efforts that were being made to secure effectual international co-operation. As a step towards this, the Society have issued invitations to an International Conference to be held in London during the coming summer, at which the whole question of cataloguing and indexing the literature of science may be discussed from an international point of view, and at which it may be hoped the outlines of a scheme may be agreed upon, the details of which could be filled in later on. As a result co-operative work on a comprehensive and well-considered system might be definitively commenced, say, with the turn of the century, starting as from January 1, 1901.

If the same research work is often needlessly done twice or thrice over, it is equally certain the same cataloguing and indexing work is done needlessly many times over when once might have sufficed. To save this waste of time and labour, organised collaboration on a large scale seems the one thing needful, and we see no reason to fear that this cannot be successfully arranged. The desideratum of comprehensive and accurate subject-indexes makes itself more acutely felt with every year

that passes, and one of the questions of method which calls loudest for settlement is what particular plan should be adopted for the preparation of such indexes. The feeling of bibliographers now leans strongly towards the general adoption of the ingenious system of decimal notation devised by Mr. Melvil Dewey, the director of the New York State library—a numerical system of indicating and distinguishing the divisional sections and sub-sections of a classification to any desired degree of subdivision, the number affixed to an entry distinguishing not only the particular ultimate subdivision of the general subject, but at the same time indicating all the superior divisions to which the work in question also belongs. The merits of this principle of notation are independent of those of the elaborate classification of all literature which Mr. Dewey has laboriously prepared for use with it. The latter may be open to criticism, but it must be remembered that no classification is likely to satisfy every one. Some sacrifices are inevitable, and we believe that, even as it stands, Mr. Dewey's classification is a workable scheme adequate for most practical purposes. Indeed, American experience has tested this point for some years now. Accordingly, the International Conference of Bibliography, which met at Brussels last autumn, recommende d the entire adoption of Mr. Dewey's system, which has also been approved and adopted, among others, and not to mention its American supporters, by the Association Française, the International Congress of Zoology, the recently-founded Institut International de Bibliographie (Brussels), and our Paris contemporaries, the *Revue Scientifique* and the *Revue Générale des Sciences*.

Other questions which remain to be settled by general agreement are the mode of preparing the material, the extent to which cognisance should be taken of the contents of papers as well as of their titles, the degree of subdivision to which classification should be carried, the terminology, and the language or languages to be employed. These and other associated questions are all ripe for settlement, and it cannot be said that any of them are beyond the reach of general agreement when all are convinced of the urgent need for their practical solution. Meanwhile schemes are formulating and maturing. M. Otlet, of Brussels, and his collaborators of the Institut de Bibliographie have developed and are applying a comprehensive system. The Faculty of Medicine of Harvard University have appointed a special committee to report on the question of a general bibliography of science. The French Ministry of Public Instruction is publishing a "Bibliographie des Travaux Scientifiques publiés par les Sociétés Savantes de la France."

About the last-mentioned work, an undertaking presenting, on a smaller scale, many points of similarity to that of the Royal Society, we may say a word or two. The idea originated with M. Milne-Edwards, and the work is being carried out by Dr. Deniker, the librarian of the Muséum d'Histoire Naturelle. It covers the long period from 1700 to 1888, and is to be divided into three sections. The first section, which is now going through the press, is an enumeration, volume by volume, of all the scientific articles contained in every serial, the serials being taken in alphabetical order of departments, and of the towns in each department, in which the societies are domiciled. The second section is to be the general "Index Auctorum," each title bearing as reference the *numéro d'ordre* prefixed to it in the first section; and the third section is to be the "Index Rerum," each entry again bearing its reference number as before. This plan may be open to criticism, but the bibliography will be a fine piece of work when completed, and, as we said, to some extent parallel to the Royal Society's Catalogue, and indeed duplicating a large fraction of its contents. While admiring the industry and enthusiasm of its compiler, we are bound to feel some degree of regret when skill, labour and time are thus expended upon isolated sporadic and unco-ordinated undertakings, while they might be far more efficiently employed in co-operating upon one well-considered and carefully organised international scheme. This is the direction which future indexing work must inevitably take, and we look forward with impatience to the realisation of this crowning development of the Royal Society's long-sustained labours.

NATURAL SELECTION AND ITS CRITICS.

Nature v. *Natural Selection. An Essay on Organic Evolution.* By Charles Clement Coe. Pp. 591. (London: Swan Sonnenschein and Co., 1895.)

THE author at the outset of this work tells us he "believes that the process of organic evolution has taken place, but he does not believe that natural selection has been the means by which that result has been brought about." The object of his work is the attempt to support the latter contention. He does not profess to speak as an expert, or to bring forward any new observations, but chiefly occupies himself with the quotation and criticism of isolated passages from previous writers. He evidently feels a very sincere disbelief in the adequacy of natural selection, and regards himself as compelled by some sort of inspiration to communicate this disbelief to the world.

It is evident that the criticisms are intended to be fair, and they are conceived in no unfriendly spirit, and expressed with no want of respect to the great writers on the subject; but the method of minute verbal criticism of single sentences and short passages is one which almost invariably leads to unfairness, however unintentional, and the work before us has certainly not escaped from this very natural tendency.

A few instances, upon all of which comment is superfluous, will sufficiently indicate the competence of the author to deal with his subject, and the spirit in which he approaches it.

In speaking (p. 23) of the two phrases (he unaccountably calls them "two contradictory theories"), "Natural Selection" and "Survival of the Fittest," he says: "It seems almost incredible that a great writer should have rejected the more accurate in favour of the sometimes more convenient phrase." He seems to forget that it was too late to withdraw a phrase which was already world-wide, and, furthermore, that convenience in such matters is of very high importance. As the author inquires why natural selection is more convenient, he may be referred to Darwin's "Life and Letters," in which the subject is

discussed in detail. His own remarks on this point afford a clear example of the means by which the unnecessary size of the volume has been attained.

In Book i., Chapter v., numerous examples of co-operation in nature are quoted from various writers, and it seems to the author "to be quite impossible to harmonise the demands of the theory of natural selection . . . with the co-operation which is constantly found in nature."

In attempting to account for the extermination of the black rat by the brown, on other grounds than those of natural selection pure and simple, we meet with the suggestion (pp. 107, 108) that the proportion of brown females was increased in consequence of the proteid diet of black rats!

Upon the destruction of the watercress in the New Zealand streams by means of the willow, he remarks—"There is no abstract survival of the fittest: both are equally fit apart from one another."

The work is divided into three books, each of which contains seven chapters. The first book discusses the possibility, the third the evidences of natural selection, while the second compares it with other attempts to explain evolution.

It would have been far better if the author could have found "peace"—to use his own phraseology—by performing a task of less herculean proportions. In these days of hurry and hard work the world will find it difficult, if not impossible, to absorb a message which requires 591 pages to deliver. E. B. P.

OUR BOOK SHELF.

Minerals, and how to Study them: a Book for Beginners in Mineralogy. By Edward Salisbury Dana. 8vo, 380 pp.; 319 figs. (New York: Wiley and Sons. London: Chapman and Hall, 1895.)

A GLANCE at this volume is sufficient to show that we have here a book of the sort which is wanted for quite elementary students. A sentence chosen at random from the introductory chapter will indicate at once how it differs from the ordinary text-books, both in style and method. Speaking of the trial of hardness, the author says: "It is necessary to be sure and distinguish between a real scratch on a smooth surface and the crushing of a rough surface by the knife-edge; a very hard mineral may often be scratched in this way. The danger of making a mistake of this kind is made less if, besides the useful knife-point, the mineral be rubbed on a piece of glass; better have a piece at hand (not disfigure a window-pane). Only do not make the opposite mistake and call a white ridge left by a soft mineral on the glass, which can be easily rubbed off, a scratch." Here is a real attempt to guide the beginner through the pitfalls which beset an unwary student; how different from the usual bald statement of facts, in which the possibility of any difficulty which may occur is not even mentioned. The same is true of the excellent chapter on blowpipe-testing; thus: "Another trial may be made with sphalerite or zinc blende, but to succeed now the mineral should be pulverised first, since it is infusible before the blowpipe, and the compound is only with difficulty decomposed on charcoal," &c.

It is of course difficult to maintain this style of writing when the author comes to the description of the various mineral species, but in that portion of the book also he has contrived to present the facts in attractive language and make them interesting to an elementary student, and he is content to describe only the most important minerals; the smaller text-books at present available, excellent though they may be in other respects, are usually condensed epitomes of the larger treatises; they contain too much, and are not written in simple language calculated to engage the attention of beginners.

The book closes with an excellent chapter on the determination of minerals, full of useful and suggestive hints.

As might be expected from the author, or joint-author, of the best and most exhaustive treatise on minerals which exists, Prof. Dana's book, though elementary, maintains throughout a high standard of scientific method.

From the educational point of view, we note some striking defects due to the use of language which, though picturesque, may be misunderstood by a beginner. For example, the statement that "the reflecting goniometer demands polished faces if good results are to be obtained," will inevitably suggest the need of artificial polish to the student who takes all things literally; a similar misunderstanding will be produced by the description of Chalcotrichite as a variety of Cuprite, in which "the cubes are spun out into long threads."

The illustrations are mostly new, and among them are many good pictures of typical minerals; it is only unfortunate that the figures of the simple forms and combinations in the third chapter are so shaded that the faces appear concave. These defects can be easily corrected in a second edition, and do not detract from the merits of the book as a really useful and attractive introduction to mineralogy, which can be safely recommended to beginners. H. A. M.

Heating and Ventilating Buildings. By Rolla C. Carpenter, Professor of Experimental Engineering, Cornell University. Pp. 400. (New York: John Wiley and Sons. London: Chapman and Hall, Limited, 1895.)

THE subject of heating and ventilating buildings has of late years been more and more considered by engineers in this country. In the United States, on the other hand, the question has received satisfactory treatment, and we have therefore much to learn from the systems in vogue there. The object of this volume is to present to the reader a general idea of the principles which apply, and of the methods of construction usually adopted in various systems of heating and ventilating. The author deals with the subject in a clear and concise manner, the information given being the result of extensive practice in designing and operating heating apparatus. Taken as a whole, the volume is of much value; it is well printed and nicely bound.

The author divides the matter into sixteen chapters, commencing with a description of the "nature and properties of heat"; he very fully enumerates the many laws pertaining thereto. On the general principles of ventilation we find much useful information. Some experiments made by Mr. Warren R. Briggs, of Bridgeport, Conn., on the subject of the proper method of introducing pure air into rooms, and the best location for the inlet and outlet, are described. The illustrations showing graphically the results are highly interesting, the best being obtained by placing the air inlet on the side of the room near the top, and the outlet in the bottom and near the centre of the room. The outlet, of course, must be connected with a flue of ample size, and maintained at a temperature higher than that of the surrounding air. Many authorities are quoted, and extracts from technical papers are given. The loss of heat through walls of various thicknesses is pointed out, and Mr. Alfred R. Wolff's lecture before the Franklin

Institute on this subject is referred to. As the majority of systems make use of heat supplied by radiating surfaces, the author, in chapter iv., very fully explains what is meant by the various terms, and then proceeds to describe the methods of testing radiators at Sibley College to measure the heat discharged. The results obtained are brought together in a table; further tests being given from radiators with extended surface so as to form air-flues.

The remaining portion of the book deals with the practical details and metallic parts of design, and architectural considerations. Much sensible advice is imparted as to the care of steam-heating boilers, and how to avoid boiler explosions, of which statistics are given. We notice many useful rules and formulæ for various purposes when designing a hot-water or steam-heating system. The volume lifts the subject out of the hands of the "plumber," and leaves it in the hands of the "engineer." Prof. Carpenter is to be congratulated on producing a really good book on a subject seldom treated scientifically.

Lessons in Elementary Botany for Secondary Schools. By Thomas H. Macbride. Pp. 233. (Boston: Allyn and Bacon, 1896.)

IN his far-reaching essay on "Education," Mr. Herbert Spencer remarks: "In education the process of self-development should be encouraged to the uttermost. Children should be led to make their own investigations, and to draw their own inferences. They should be *told* as little as possible, and induced to *discover* as much as possible." It is satisfactory to all who are concerned in the progress of science, to know that these sound principles of scientific instruction are being brought more within the region of practical education every day. The present volume is an addition to the steadily growing literature in which the principles referred to are applied. The young students, for whom the book is intended, are led to make their own observations; they are induced to study plants, rather than printed books, and thus to derive their knowledge at first hand from nature. The opening lesson in the book is typical of the fifty-three which follow it. The pupils are told to collect the twigs of various trees or shrubs and to compare them, noting various peculiarities. A single twig is then examined, and attention is directed to the arrangement of the buds and leaf-scars upon it. In the second lesson, twigs are compared with particular reference to buds and their relations to branches, and are grouped according to bud-arrangement. The structure of stems afterwards forms the subject of several lessons, and then the root, leaf, flower, fruit and seed are studied in succession, after which come lessons having for their object the elucidation of the structure and history of individual plants and trees. Much more attention is given to trees than is usual in books on botany. The book is hardly suitable for class use on this side of the Atlantic, but an English edition of it would be welcomed by many teachers of botany.

Vegetable Culture. By Alexander Dean, F.R.H.S. Pp. 136. (London: Macmillan and Co., 1896.)

METHODS and results are what amateur gardeners, cottagers, and allotment-holders want, and this is the book to supply their need in regard to the culture of vegetables. Theirs not the ambition to ask the reason why, but merely to know exactly what to do in order to reap rich fruits of their industry. Very admirably does the author impart this kind of information. In concise language he describes the best methods to be followed in the preparation and after-treatment of the soil, the best varieties of the various classes of vegetables, and the best systems of cultivation. Both the text and the illustrations are instructive, and together they make up a sound and serviceable primer for gardeners.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Röntgen Rays.

IT may interest your readers to hear that, with the assistance of Mr. J. C. M. Stanton, I have succeeded by means of the Röntgen rays in actually seeing the coins inside a leather purse, the metal instruments inside a closed wood and leather case, a coin through a piece of wood half an inch in thickness, and also through a sheet of aluminium.

Photography was not employed, but the shadows of the enclosed objects were made directly visible to the eye by means of a fluorescent screen.

The precise arrangement was similar to that recently described by Prof. Salvioni, of Perugia, whose results, though in accordance with certain experiments of Prof. Röntgen, confirmed, I understand, by Mr. Porter, of University College, have so far been received in this country with a certain amount of scepticism.

The apparatus consisted of a tube of opaque paste-board with a simple aperture at one end, to which the eye was applied. The other end was provided with an opaque diaphragm of double black paper, upon which, on the inner side, was laid a piece of blotting-paper impregnated with platino-cyanide of barium in a crystalline state.

The purse or other object was held against the diaphragm with the Crookes' tube beyond it, so that the rays from the latter cast a shadow of the coins through the leather and black paper upon the inner impregnated screen. The platino-cyanide fluoresced brightly under the stimulus of the rays on those portions of the blotting-paper where no shadow was cast, and consequently the form of the metallic objects was made clearly visible. Non-metallic objects were also clearly seen, though more faintly, owing to their greater transparency to the rays.

Besides being exceedingly interesting in itself, and possibly capable of sufficient improvement to render it of service in medicine and surgery, the appliance will be very useful for the purpose of ascertaining, without the tedious process of exposing and developing a plate, whether any given Crookes' tube is suitable as regards exhaustion and form for photographic purposes.

It can be seen at once whether the tube is working to the best advantage, and is giving clearly defined shadows.

The place on the glass of the tube from which the maximum radiation is proceeding, can also be easily determined, and I may mention as confirming a point previously noticed by myself—*i.e.* that a tube with a well-marked fatigue spot on the glass will not answer satisfactorily for photography—that with the above-described instrument the fatigue spot is visible to the eye through the black paper, thus showing that the glass when fatigued does not transmit the Röntgen rays. A. A. C. SWINTON.

66 Victoria-street, Westminster, February 25.

P.S.—Since writing the above, I have been able to see distinctly the bones in the thick portion of my own hand.

As the hand appears to feel a cold sensation when exposed to the X-rays, an experiment was made with the thermopile to put the matter to the test. This showed that heat was being radiated from the phosphorescent patch in the Crookes' tube; if the current be reversed so as to make the opposite pole the anode, then heat was again radiated, but in a very much smaller amount. The phosphorescent patch becomes very markedly warmed in some tubes. On replacing the thermopile by a lighted candle, the flame exhibited a flickering motion, and was slightly drawn towards the phosphorescent patch; this could be observed at a distance of six inches. The phenomenon was also observed when the candle was placed on the side of the tube opposite the anode, but less markedly. A flame is almost transparent to the X-rays; on taking a shadowgraph of a lighted candle or gas jet, the shadow of the flame is just visible as an exceedingly faint impression, the internal core in the case of the gas flame being slightly more marked than the external.

Edinburgh. DAWSON TURNER.

The Cause of an Ice Age.

THOUGH I have no wish to prolong this discussion, yet I will ask you to spare me space for a few lines.

In his last letter, Sir Henry Howorth expresses his belief that, as a consequence of the recent correspondence, I have been led to change the opinions I previously held as to the cause of an Ice Age. May I assure Sir Henry Howorth that he must have quite mistaken the purport of my letter.

With all due courtesy to Sir Henry Howorth, as well as to any others who may have differed from me, I may say that I have seen no reason to swerve from the belief that the position taken in my book on "The Cause of an Ice Age" is the sound position. My opinions are, therefore, unchanged.

I would like to take this opportunity to thank Dr. A. R. Wallace for his letter on this subject in your columns, and to express the satisfaction with which I found that he had been led to the same conclusion, with respect to Mr. Culverwell's argument, as that at which I had myself arrived by an independent method. I note that Mr. Culverwell dissents; but, even at the risk of being thought very obstinate, I must say that I still believe Dr. Wallace and I are right. ROBERT S. BALL.

So far as I know, it has not been suggested that a comparatively small elevation of the crust of the earth would cause a glacial state in the elevated part. The roughness of an ordinary terrestrial globe, representing an elevation that might be compared with the thickness of letter-paper, would correspond with an elevation of the crust of the earth that even in the tropics would cause perpetual snow. A few thousand years would be sufficient to cause a sufficient elevation without any catastrophic hypothesis. THEODORE RYLAND.

The Measurement of High Temperatures.

IN a valuable paper on the "Determination of High Temperatures" (*Wied. Ann.* 1895, No. 10), Messrs. Holborn and Wien give the results of their observations on the changes in the resistance of platinum wire over a range of 0° to 1600° C. The authors come to the conclusion that the relation between temperature and resistance "cannot be accurately represented by the Callendar and Griffiths formula"; although, on the other hand, they admit that by means of that formula Heycock and Neville have determined a number of melting points which are in good agreement ("die sich in guter Uebereinstimmung mit unsern Werthen befinden") with the values found by Holborn and Wien when using a thermo-couple standardised by direct comparison with the air-thermometer.

Platinum thermometers are now so generally used for high temperature measurements that an adverse conclusion of this kind is a matter of importance, especially when associated with the names of accurate observers such as Holborn and Wien.

I trust, therefore, that a brief criticism will not be regarded as out of place.

I would first remark that my delay in commenting on this paper is not due to any want of respect for the authors, but from a sense of the importance of the matter. Before attempting any reply, I wished to ascertain the views of Prof. Callendar, and I accordingly wrote to Montreal calling his attention to the paper, but I have not as yet received his answer. I feel, however, that further delay is undesirable.

Neither Prof. Callendar nor I have at any time claimed that the relation between t and pt, as given by the empirical formula, has been *rigorously* verified at temperatures exceeding 600° C.

In NATURE, November 1895, p. 40, I wrote as follows:—"Results of this kind prove that even if the reduction does not express the temperature accurately in the air-scale, it at all events gives us a *constant* scale in which all high temperatures can be expressed, and it is further evident that this constant scale differs but little (even at these high temperatures) from the true air-scale."

The context shows that the "high temperatures" referred to were those in the neighbourhood of 1100° C.

The above quotation defines my own position with sufficient accuracy, and I will therefore pass on to consider the work of Messrs. Holborn and Wien.

(1). The authors state that the platinum wires (in experiments up to 1200° C.) were placed in an externally glazed porcelain tube, and isolated from each other by means of special porcelain capillaries ("die Drähte wurden durch besondere Porzellan Capillaren von einander isolirt"); and at higher temperatures "in externally glazed tubes of a very infusible substance, and isolated from each other by capillaries of the same material."

From this description it appears evident that the wire was in contact with the porcelain, or the other material, probably throughout the greater portion of its length; otherwise it must have been subjected to some strain. Now, contact with porcelain or any similar substance has been found by us to be absolutely fatal: if by any chance the wire has come into contact with the walls of the surrounding tube at high temperatures, the coil has had to be replaced by a new one. This is probably caused by the action of the silica; but whatever the reason may be, the effect has long been known, and care has been taken to avoid this source of error.

It is true that in the present form of the platinum thermometer the wire comes into contact with mica, and I have little doubt that some similar action (although in a lesser degree) takes place between the platinum and the mica. The method of constructing the framework and coil, however, causes the length of platinum in actual contact with the mica to be but an exceedingly small fraction of the length of the wire (probably less than $\frac{1}{100}$th), and thus any such effect is diminished. I think it possible that the small changes at high temperatures to which I have called attention in NATURE, (November 1895, p. 40), are in some measure due to action at the points of contact.

Unless Holborn and Wien took greater precautions in regard to this matter of contact between case and wire than they indicate in their paper, there is no need to seek for further explanation of the somewhat erratic behaviour of the two platinum wires examined by them; in fact, other experiments by the same observers show how materially the resistance of platinum is affected by exposure to the action of silica or hydrogen.

(2). No adverse conclusion should be drawn from the changes in their Wire No. I., for the authors state that "at the termination of the observations the protecting tube was found to have broken in the oven, and the wire had been exposed to the gases of the oven."

The necessity of complete protection from the furnace gases has from the first been insisted upon by those accustomed to the use of platinum thermometers. It was want of attention to this essential matter which led the B. A. Committee of 1874 to a false conclusion. The behaviour of Holborn and Wien's Wire I. has no significance or value, except in so far as it emphasises the importance of complete protection. It appears doubtful if sufficient precautions were taken in this matter with regard to their series of experiments with the platinum Wire II. The infusible tubes which they used for the air-thermometer bulbs at high temperatures were covered externally with a glaze. The authors say: "As the glaze in this case and also in the porcelain becomes liquid much sooner than the softening point of the material, we made use of our method by which there must always be a smaller pressure inside the vessel than outside. Under these conditions the glaze is pressed into the pores of the tubes, otherwise it would immediately come off."

Now I do not find any mention of a similar precaution when heating the platinum wire in what appear to have been similar tubes; it is possible, therefore, that the changes observed in Wire II. were also in some degree due to contamination by furnace gases.

(3). The authors speak of Wire II. as formed from "pure platinum" ("*Aus reinem Platin*"). They give the value of its temperature coefficient as—

Before heating	·003801
After ,, ...	·003783

As a general rule, the purer the platinum the higher its coefficient. The samples used by us (as, for example, in the Kew Observatory thermometers) have coefficients which vary from ·003860 to ·003880. It would hardly appear, therefore, that the wire used by Holborn and Wien merits the term "pure." The purity is, however, not of great consequence, as (see NATURE, November 1895, p. 40) we have found that although the coefficient depends on the purity, the deduced temperatures are unaffected provided that the coefficient is not reduced by the impurities to lower than about ·0032. The fall in the coefficient (above indicated) is, however, of great significance, and in itself is evidence that the wire had become contaminated during the experiments. Assuming (as was doubtless the case) that the wire had been previously annealed, the above change sufficiently establishes inadequate protection of the wire.

I have carefully investigated the numbers in Table II., where the authors give the results of their observations on this second specimen of "pure platinum." I am unable to draw any con-

clusion from the figures there given, except that this wire, either from its quality or its situation, behaved in a different manner from any one of the many specimens I have examined during the past five years. The value of $\delta R/\delta t$ decreases with increase of temperature in a most phenomenal manner.[1] In cases in which I have observed this phenomenon in a lesser degree it has indicated a breaking down in the insulation, consequent on rise in temperature. I am unable to find any evidence that the insulation was tested at high temperature during these experiments.

(4). Any expression of opinion by Messrs. Holborn and Wien necessarily carries weight; nevertheless, I would venture to suggest that (considering the amount of experimental work previously performed by those who advocate the methods of platinum thermometry) the examination of only two wires, one of which was admittedly exposed to the action of furnace gases, affords insufficient grounds for the adverse conclusions arrived at by the authors.

(5). Heycock and Neville's determinations of the freezing points of copper, gold, and silver are admitted by Holborn and Wien to be in "good agreement" with their own. The nature of this agreement is shown in the following table.

	Heycock and Neville.	Holborn and Wien.
Copper ...	1080·5	1082
Gold ...	1061·7	1072
Silver ...	960·7	971

It is worthy of notice that copper is the only metal of which Holborn and Wien used large quantities, comparable with the masses experimented on by Heycock and Neville. Also in this case Holborn and Wein determined both melting and freezing points. Their results (using practically the same thermometer throughout) range from 1076° to 1093°, whereas Heycock and Neville's values, when using six distinct platinum coils possessing very dissimilar constants, range from 1079°·0 to 1081°·7, a very different order of agreement.

In the case of gold and silver, Holborn and Wien used small quantities, determining their results by observations of the *melting* points, and thus the method of experiment adopted renders it probable that the temperatures observed would err on the side of excess. The close agreement in the case of copper, and the higher values found by Holborn and Wien in the experiments on gold and silver, are therefore significant.

Thus, when the conditions are similar (as in the case of copper), we may regard the results obtained by the different observers as practically identical. Such agreement would be impossible if platinum resistance thermometers ordinarily underwent, at high temperatures, changes of the nature of those observed in the wires studied by Holborn and Wien. The differences would then be measurable not by units, but by tens and hundreds! and these discrepancies would be found not only when different methods were used, but also when the same observations were repeated with different platinum thermometers.

If Tables XI., XII., and XIII. of Heycock and Neville's paper[2] are examined, it will be found that although in each case from 6 to 8 different platinum thermometers were used in which, for example, the value of δ varied from 1·495 to 2·04, the extreme resulting temperatures differ by a smaller quantity than the differences obtained by Holborn and Wien when repeating an observation without change in the conditions, by means of the same thermo-couple.

Finally, I assert that Holborn and Wien have produced no evidence sufficient to support the somewhat sweeping conclusions given by them on p. 394 of their paper. I have shown that in their experiments on only two samples of wire, they have neglected the precautions insisted upon by those who have devoted years of study and experiment to the investigation of the platinum thermometer, and this portion of their work is only useful in so far as it emphasises the validity of the conclusions arrived at by those who preceded them.

I fully appreciate the great value of Holborn and Wien's direct determinations of high temperatures by means of the thermo-couple and the air thermometer, and I admit it is probable that for temperatures exceeding 1400° C. or so, the thermo-couple is the more convenient, and possibly the more accurate instrument. Below such temperatures, however, I consider that the weight of evidence is in favour of the accuracy of the platinum thermometer. In any case, such evidence is in no way weakened by the experiments of Holborn and Wien.

E. H. GRIFFITHS.

[1] This extraordinary behaviour of Holborn and Wien's Sample II. (for reasons previously given the behaviour of Sample I. is of no significance) is noticeable in the numbers attained by them at *low*, as well as at high, emperatures.

[2] *Chem. Soc. Trans.*, 1895, pp. 188–190.

Earth Tremors.

IN Prof. Milne's article in NATURE of December 26, he states that earth tremors are more frequent during the winter than during the summer, that they are frequent with a low barometer, and still more frequent when the locality of observation is crossed by steep barometrical gradients. In the North-West Himalayas, throughout the winter months, slight earth tremors are exceedingly frequent, and occur, so far as can be judged without instrumental records, more frequently by night than by day. This may be in part due to the fact that during the day most people would be moving about in downstairs rooms, while at night the same people would be in upstairs rooms, and both they and their surroundings perfectly quiet; but, whatever may be the day and night relation, there can be no doubt that during the winter months in Simla peculiar little earth tremors are remarkably frequent. My experience has been that these tremors are not so much connected with areas of low barometer as with the *commencement* of a sudden and large change in atmospheric pressure from a high to a low, a reduction of pressure which need not necessarily be accompanied with steep barometric gradients or high winds at or near the earth's surface. In the case of earthquakes, also, I have noticed subsequent large changes in atmospheric pressure. Thus at about midnight on January 15–16, 1896, a (for these regions) rather severe earthquake occurred, which lasted from 1m. 20s. to 4m. in different localities. On the plains the most severe shocks were felt at midnight, 15th, at Simla, at 0h. 30s. a.m. on the 16th, and at Srinagar at 1 a.m. on the 16th. Times for other places in the Punjab were published in the newspapers, but I have omitted to keep them. The above, however, show that the shock was felt at Lahore at midnight, at Simla half an hour later, and at Srinagar an hour later. The barometric records show that for the forty-eight hours from 8 a.m. on the 16th to 8 a.m. on the 18th, pressure changed as follows:—

Srinagar (Kashmir)	−0·187
Astor ,, ...	−0·062
Murree	−0·165
Lahore	−0·144
Simla	−0·140
Quetta	+0·022

From the above figures, it appears that a considerable decrease of barometric pressure occurred between the morning of the 16th and the morning of the 18th, and that this fall was central over Srinagar; while the times of occurrence of the earthquake show that the movement of terrestrial disturbance was directed towards this central area of diminishing pressure. It has always appeared that the atmospheric changes which ordinarily occur in tropical and subtropical countries would be a wholly inadequate cause to account for the considerable earthquakes which at times occur; but I have undoubtedly noticed that very slight earth tremors constantly take place when a sudden and large decrease in atmospheric pressure *commences* after a considerable period of high pressure.

W. L. DALLAS.

Simla, January 29

"Roches moutonnées."

SOME ten years ago, I came across in an old memoir a rational explanation of the term *roches moutonnées;* but I made no note at the time, and have been unable to trace the reference. However, my scepticism was fortified, and I proceeded to search French dictionaries, which made it clear that *moutonné* meant "frizzled like sheep's wool," and not "sheep-like." Yet M de Lapparent tells us ("Traité de Géologie," 3me ed., p. 281) that these glaciated rocks "produisent une impression analogue à celle d'un troupeau de moutons endormis, d'où le nom de *roches moutonnées*"; and who shall question this precise statement of a French author interpreting his own language? It is the explanation that has been taught to all of us, though I know of only one field-geologist who seriously maintains that *roches moutonnées* might be taken for a flock of sheep. Agassiz states

that De Saussure is the author of the term; but I have long been foiled by its omission from the index of the famous "Voyages dans les Alpes." In "Open-Air Studies," however, I ventured to compare the mammillations of a glaciated surface to those upon an antique wig; but all the time, it seems, Mr. Whymper held the key of the matter for us, in a passage which has escaped the memory even of Prof. Bonney (see "Ice-Work," 1896, p. 10). Mr. Whymper, in fact ("Scrambles amongst the Alps," fourth edition, 1893, p. 133), supplies the reference to De Saussure; and in the "Voyages dans les Alpes," 1804, tome ii. p. 435, par. 1061, we may read of what are styled in the margin "montagnes moutonnées." De Saussure states that behind Envionne (the modern Envionnaz), in the upper valley of the Rhône, "ces rondeurs contiguës et répetées forment en grand l'effet d'une toison bien fournie, ou de ces perruques que l'on nomme aussi *moutonnées*." In face of this, there is no longer any need to tax the credulity of our pupils with a fanciful explanation, which we seem to have forced even upon French-speaking peoples.

GRENVILLE A. J. COLE.

Royal College of Science for Ireland,
Dublin, February 17.

The Age of the Present Canadian Flora.

PROF. D. P. PENHALLOW has recently identified some fragments of wood found in the Leda clays of Montreal, as *Picea nigra*, the common black spruce. This is another addition to the group of plants which represent our present knowledge of the flora of Canada in Pleistocene times. This Pleistocene flora may now be taken to include not merely the plants found in these Leda clays and in the clays believed to be equivalent to them in age in Ontario, but also the ancestors of the present inland maritime flora found on the shores of the Great Lakes, hundreds of miles from the sea-coast, and of the plants which are common to Europe and America, and which include so many arctic and sub-arctic, as well as northern temperate species. The inland maritime plants, and probably also the sub-arctic species now found so far south as the headlands of Lake Superior, made their way to their present localities during the deposit of the Leda clays when a considerable part of Eastern Canada was submerged. Six of the species which occur in the Leda clays at Ottawa and Montreal, and thirteen of the inland maritime plants, as well as several of the Lake Superior sub-arctic species, are also European, showing that at that period the intermingling of the American and European floras was well established, but leaving open the possibility of these plants common to the two continents being even older than the period of the Leda clays.

The intermingling of the Asiatic and American floras appears to have taken place at a still earlier period. The oldest known representatives of the existing Canadian flora are those few identical species found by Mr. Lester F. Ward in the Laramie rocks of the Western United States—rocks which Sir William Dawson refers to the Lower Eocene. Two of those identified now occur in both Japan and Canada; and one, still living in Japan, has, if correctly identified, become extinct on the American continent. Again, among the Leda clay and inland maritime plants there are several species which are likewise common to the two countries. The intermingling of Asiatic and American plants evidently took place prior to the upheaval of the Rocky Mountain chain, as the extensive flora peculiar to British Columbia, Oregon, and southward, is almost without a representative in Japan. This British Columbia flora, so well represented by various species of Claytonia, Lupinus, Trifolium, Astragalus, Saxifraga, &c., as well as Coniferæ, is of more recent birth—probably Later Tertiary and Post-Tertiary.

The most recent creations in Canada would appear to be the plants which—well represented by Compositæ, an order of no great antiquity—are now so marked a feature of the prairies of Manitoba and the surrounding country—prairies which in some places are still in process of formation.

A. T. DRUMMOND.

Children's Drawings.

WITH regard to young children drawing upside down, I have for some time past collected observations. It is certainly true, that a great many children do draw in this way; on the other hand, many from the first draw the right way up. I have seen a boy of four, when asked to draw a rook on a haystack, begin at the bottom of the paper with the rook's back, and gradually work his way up to the haystack; he then turned it round, and handed it to me to look at, evidently realising that it was inverted.

I do not think the explanation depends in any way on the inversion of the retinal image. If a child, who draws upside down when drawing on a horizontal table, is asked to draw on a blackboard placed vertically, he will draw everything the right way upwards. It seems to me, that the explanation simply is that the child has to draw an object, which he has seen in a vertical plane, on paper placed in a horizontal plane—an extremely difficult task to him—and it is a mere question of convenience to him at which end he begins, both being equally wrong from his point of view. This will also explain why children sometimes look at picture-books upside down, and also why small children are much more ready to draw objects, which they have been accustomed to see in a horizontal plane, such as a plate with oranges on it, than an erect object.

The Old Palace, Richmond. RINA SCOTT.

THE RÖNTGEN RAYS.

THE discovery by Prof. Röntgen of the rays which bear his name has aroused an interest perhaps unparalleled in the history of physical science. Reports of experiments on these rays come daily from laboratories in almost every part of the civilised world. A large part of these relate to the methods of producing Röntgen photographs, and the application of the "new photography" to medical and other purposes. A considerable amount of work has, however, been done on the physical properties of these rays; this has entirely confirmed the results stated by Röntgen in the paper in which he announced his discovery. The freedom of refraction of these waves, in which they are different from ordinary light, has been the subject of direct experiments made by M. Perrin and by Dr. Joly, while Dr. Lodge and others have confirmed the absence of any deflection in the magnetic field which differentiates these rays from the ordinary kathode rays.

Up to the present, however, no phenomena have been observed which enable us to say whether these waves are or are not transverse vibrations of very small wave-length, longitudinal vibrations, or even vibrations at all. Nothing of the nature of polarisation or of interference has been described. The absence of polarisation can at the present stage of the investigation hardly be pressed as an argument against these rays being transverse vibrations. For, of the three methods of producing polarisation in light—reflection, refraction, and absorption—only the latter is available for these rays. Now the number of substances which produce sensible polarisation in ordinary light by absorption is very small, and unless a much larger number possess this property for the Röntgen rays, it is hardly likely that, even if there are such substances, they would have been discovered in the three months which have elapsed since the publication of Röntgen's discovery. I may remark that I have made a large number of experiments on the opacity to these rays of plates of tourmaline (1) with their axes crossed, (2) with their axes parallel, testing the intensity of the rays which came through in some cases by their action on a photographic plate, in others by the discharge they produced in an electrified plate on which they were incident. The result of these experiments was entirely negative, for although the tourmaline plates produced very considerable absorption of the rays, no difference was detected between the absorption when the axes were crossed and when they were parallel. It is very desirable that a large number of substances should be tested in this way.

M. C. Henri has made the very interesting observation that an opaque coin coated with the phosphorescent sulphide of zinc will allow these rays to pass through it; the details of this experiment will be received with much

interest. I have found that when the Röntgen rays pass through any substance, they make it for the time being a conductor of electricity, even although the substance is in its normal state a perfect insulator. Thus solid paraffin, paraffin oil, solid sulphur, ebonite, mica, air—all conduct electricity when the Röntgen rays pass through them. This explains the fact observed by Righi, Bergman, and myself, that an electrified plate in air loses its charge when exposed to these rays, whether it be electrified positively or negatively. The air is converted into a conductor by these rays, and the charge escapes through it. It is not necessary that a gas should surround the plate, as I have found that the leakage takes place whatever the medium surrounding the plate may be. That this leakage is due to the condition of the insulator, rather than to that of the plate, is shown by the fact that it occurs when the plane of the electrified discs is parallel to the rays, as well as when it is at right angles to them. The air through which these rays have passed retains traces of conductivity for some little time after the rays have ceased to pass through it; this can be shown by blowing the air, from a place where the rays are plentiful, against a charged disc placed where there are only a few rays; the rate of leak from this disc is much increased by the blast.

With the assistance of Mr. J. A. McClelland, of Trinity College, Cambridge, I have made a large number of measurements of the rate of leak from positively and negatively electrified discs surrounded by air, and have found that the rate of leak in the two cases is almost identical. We have also made a series of measurements of the rate of leak through air at different pressures; the rate of leak is greater at a high pressure than at a low one, and is over a wide range of pressures approximately proportional to the square root of the pressure. The rate of leak is also greater in air than in hydrogen, being at atmospheric pressure about twice as great in air as it is in hydrogen, while the leakage through carbonic acid gas is faster than that through air.

The leakage of electricity through non-conductors is, I think, due to a kind of electrolysis, the molecule of the non-conductor being split up, or nearly split up, by the Röntgen rays, which act the part played by the solvent in ordinary electrolytic solutions. If the air through which the rays are passing is ionised, the number of ions would, according to the well-known law of dissociation, be proportional to the square root of the pressure, provided the amount of ionisation is small. Thus the result we obtained for the rate of leak through air at different pressures, indicates that the rate of leak is proportional to the number of ions.

The view that the air is turned by these rays into an electrolyte, is supported by some experiments made in the Cavendish Laboratory, by Mr. Erskine Murray, on the contact difference of potential between metal plates in air. He finds that when the Röntgen rays are passing through the air in the neighbourhood of the plates, the plates (as far as their potential differences are concerned) behave as if they were connected by an electrolyte.

Mr. C. J. R. Wilson has investigated, in the Cavendish Laboratory, the effects produced by Röntgen rays on the condensation of clouds caused by the expansion of air, and has found that when the rays pass through the vessel in which the cloud is formed, the cloud is very much denser than when the rays are absent, showing that these rays increase the number of nuclei which act as centres of cloud condensation. The ions with their electrical charges would act as such nuclei, so that this, again, is in favour of the view that these rays turn the air into an electrolyte. These experiments seem to show that these rays exert a powerful disintegrating effect on the molecules of substances through which they pass, and suggest that their use may throw light on some questions of molecular structure. It would be interesting, for example, to find the rate of leak through gases which are reputed to be monatomic, such as mercury vapour, argon, and helium. Again, if air and other gases can be made to act as electrolytes, we could use a mercury dropping arrangement, similar to that employed by Ostwald to measure the potential difference between metals and liquid electrolytes, to measure, by means of it, the potential difference between metals and various gases through which the Röntgen rays are passing.

By measuring the rate of leak from a disc charged to a fixed potential, we can compare the efficiency, as producers of Röntgen rays, of different tubes or of the same tube at different periods. The conclusion I have arrived at, by means of such measurements, is that bulbs generally improve for some time after they are sealed off from the pump, and attain a maximum efficiency, after which they begin to deteriorate.

Some measurements of the absorption of Röntgen rays by various thicknesses of metal, have led me to the conclusion that the Röntgen rays are not all of the same kind. The experiments were made by measuring the change of the rate of leak from an electrified disc, produced by changing the number of sheets of tinfoil interposed between the disc and the phosphorescent tube. When a small number of sheets of tinfoil were interposed, the addition of another sheet of tinfoil produced a very considerable diminution in the rate of leak; when, however, the phosphorescent bulb was a very good one, a considerable leakage remained when the number of sheets of tinfoil was considerable, and this "residual leakage" diminished but slowly as the number of sheets of tinfoil was increased. This seems to indicate that while there are some rays which are rapidly absorbed by the tinfoil, there are others which can pass through it with comparative facility. It is only when using one or two of the most efficient bulbs that I have remarked this "residual leakage," but with these bulbs when in their most efficient state it was very marked.

J. J. THOMSON.

THE DEEPEST SOUNDING YET KNOWN.

IN NATURE (vol. lii. p. 550, October 3, 1895), I mentioned that H.M.S. *Penguin*, Commander A. F. Balfour, R.N., had found in the Pacific Ocean deeper water than any yet known in lat. 23°40 S., long. 175°10 W., but had failed to reach the bottom owing to breakage of the wire at 4900 fathoms.

Captain Balfour has been enabled to try again, and I have just received the announcement of his obtaining three satisfactory soundings of over 5000 fathoms.

The deepest trustworthy sounding heretofore known is 4655 fathoms near Japan, obtained by U.S. S. *Tuscarora* in 1874.

The deepest of the *Penguin's* casts is 5155 fathoms, or 500 fathoms (3000 feet) deeper; but it is especially remarkable that the three casts now obtained are not in the same hollow, but are separated by areas of considerably less water, the two extreme soundings being 450 miles apart.

The usual abysmal red clay was brought up by the sounding-tube on two occasions; on the third the wire broke.

Mr. V. Thorpe, surgeon of the *Penguin*, reports that a microscopic examination of the specimen from 5147 fms. shows that the remains of siliceous organisms are almost, if not entirely, absent. The mineral particles are in a minute state of disintegration, and consist of exceedingly fine flocculent matter, mixed with pumice and other glossy volcanic products, green crystals of augite and reddish crystals of pelagonite.

These deep hollows furnish fresh evidence to the observed fact that all the extreme depths in the ocean

are near land or shallow water, and apparently follow the trend of such upheaved parts of the earth's crust.

The positions of the soundings are :—

Lat. S.	Long. W.	Depth. Fms.	Depth. Feet.	Nature of bottom.
23° 39′	175·04	5022	30,132	(Wire broke.)
28° 44′	176·04	5147	30,882	Red clay.
30° 28′	176·39	5155	30,930	Red clay.

The attached chart shows their general position, the Kermadec Islands being 500 miles north-east of Auckland in New Zealand.

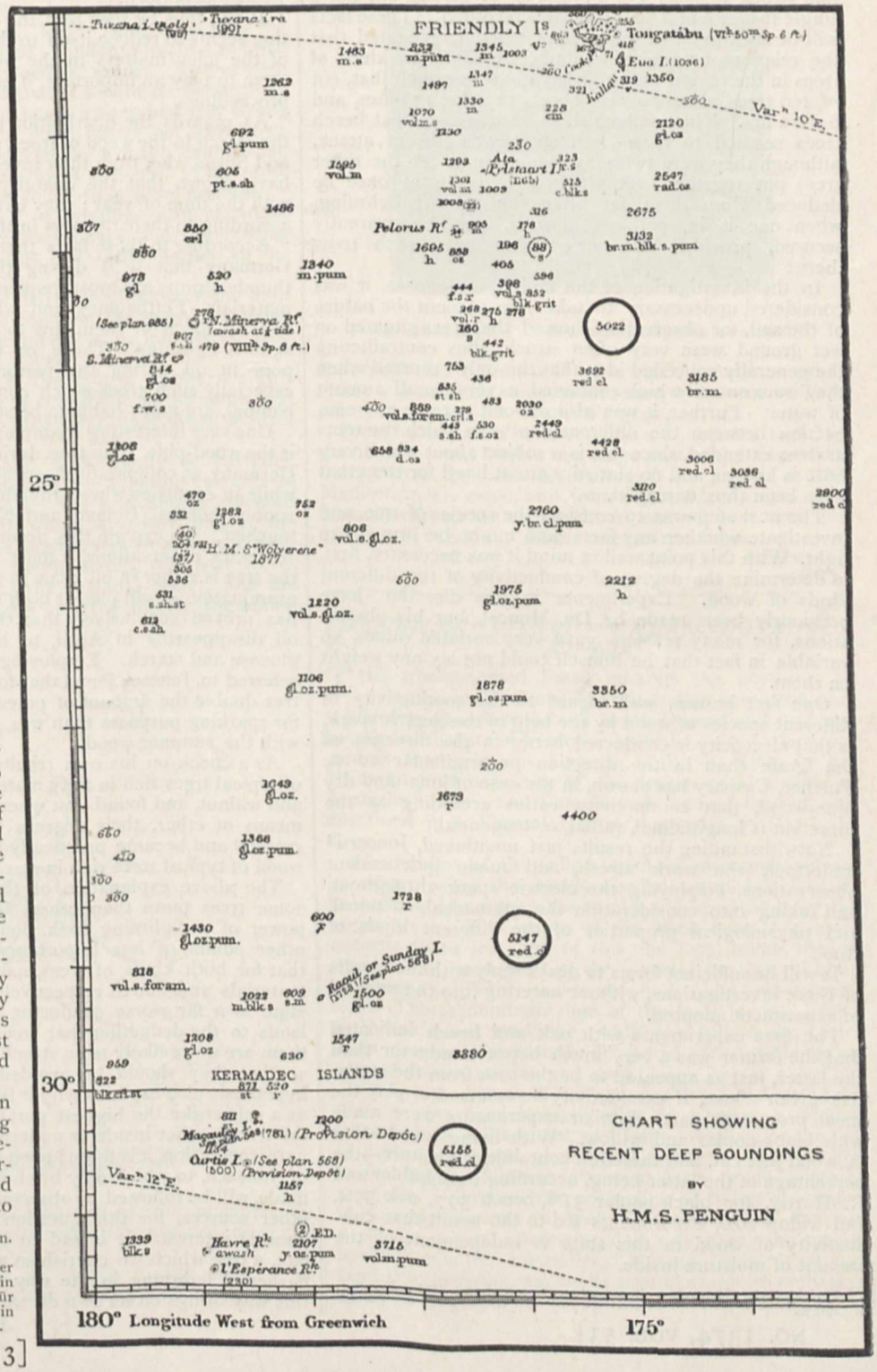
W. J. L. WHARTON.

THE DESTRUCTION OF TREES BY LIGHTNING.

IN an article[1] by Dr. Carl Müller, on the probable causes which induce lightning to strike certain kinds of trees and not others, the writer brings together some very interesting information, which has from time to time been gleaned from experiments and observations. In Germany, where the study of forestry is considerable, and where any experiments for procuring the welfare and preservation of trees are treated with great importance, the investigations on the point now under consideration have a very practical object, for great damage must be yearly done by the storms which occur there during the summer months. The work to which reference is here chiefly made is that of Dimitrie Jonescu,[2] and his observations are based on close observation in the field and experiments in the laboratory. The knowledge that we thus obtain contrasts strikingly with that previously attained, which was founded, for the most part, on conjecture and hearsay.

It has long been known that lightning seemed to have a special fascination for certain kinds of trees, and therefore preferred to strike these rather than others. We have been informed, for instance, that the laurel was seldom if ever struck; while the oak, on the other hand, was the tree which, above all others, was signalled out for this purpose. We do not mean to say, however, that other trees are never damaged in this way, for all are to a more or less extent; but it seems that, in consequence of an unknown reason, preference is given to some more than to others.

A study of this question therefore, if it is to be



[1] *Himmel und Erde* for Jan. 1896.

[2] "Uber die Ursachen der Blitzschläge in Bäume" in "Jahresheft des Vereins für Vaterländ. Naturkunde in Württemberg," 1893, S. 32-62.

thoroughly well undertaken, must not be restricted simply to the species of tree, but should include the conditions of their position and surroundings, such as soil, moisture, &c., as these may play an important part.

The only operations, as far as we know, that seem to have been systematically carried out on these lines, are those which since the year 1874 have been made by the fürstlich Lippe-Detmoldschen Forstdirektion.

The statistics show that from 1879 to 1890 lightning had struck 56 oaks, 3 or 4 pines, 20 or 21 firs, but not a single instance of a beech tree was recorded. These facts will be seen to be of importance when it is stated that the relations between the numbers of different kinds of trees in the region under observation were such that, out of 100 trees, about 70 were beech, 11 oaks, 13 pines, and 6 were firs. The numbers show at a glance that beech trees seemed to have been entirely free from attack, although they were twice as numerous as all the other trees put together. A practical hint can at once be deduced from this; for protection against lightning, when one is in, perhaps, a wood, can be apparently secured, provided of course there are beech trees there!

In the investigation of the underlying causes, it was considered unnecessary to take into account the nature of the soil, for observation showed that trees situated on wet ground were very often struck, thus contradicting the generally conceded idea that this only occurred when they were on soil which contained a very small amount of water. Further, it was also difficult to trace any connection between the different depths to which the roots of trees extended, since this is a subject about which very little is known, and no statistics are at hand for trees that have been thus damaged.

The next step was to consider the species of tree, and investigate whether any facts here might be brought to light. With this point well in mind it was necessary, first, to determine the degree of conductivity of the different kinds of wood. Experiments in this direction have previously been made by Du Moncel, but his observations, for many reasons, gave very variable values, so variable in fact that he himself could not lay any weight on them.

One fact known, with regard to the conductivity of different species of wood by the help of the electric spark, is that electricity is conducted better in the direction of the grain than in the direction perpendicular to it. Further, Caspary has shown, in the case of lime- and dry pine-wood, that conductivity varies according as the direction is longitudinal, radial, or tangential.

Notwithstanding the results just mentioned, Jonescu[1] undertook the work afresh, and made independent observations, employing the electric spark throughout, and taking into consideration the anatomical, chemical, and physiological properties of the different kinds of wood.

It will be sufficient for us to deal simply with the results of these investigations, without entering into the method of experiment adopted.

The first experiments with oak and beech indicated that the former was a very much better conductor than the latter, just as appeared to be the case from the statistics given above, if conductivity be assumed to play the most prominent part. Similar experiments were made with black-poplar and willow. With living wood—that is, wood just cut, and therefore containing moisture—the percentage of the latter being, according to Schübler and R. Hartig, for black-poplar 51·8, beech 39·7, oak 35·4, and willow 26·0, experiments led to the result that conductivity of wood in this state is independent of the amount of moisture inside.

[1] Berichten der Deutschen Botanischen Gesellschaft. Bd. xii., 1894, S. 129-136.

Extending the observations over a far wider range, and employing numerous different kinds of woods containing varying quantities of fatty materials, such as oil and resin, it was discovered that the wood cut from living trees was in every case a worse conductor of electricity the more oil or resin they contained. The fresh wood of trees, on the other hand, which are rich in starch but poor with regard to fatty matter, conducted electricity very well, although no large difference for the various kinds of wood was noticed.

It will thus be seen that the question under consideration seems to reduce itself to the finding out the qualities of the juicy matters in the wood of the trees, as these seem to play an important, if not the whole, *rôle* in the proceedings.

As regards the distribution of the fatty materials and the starch in the wood of trees, we have to apply to Fisher and Suroz, who, from their investigations on these points, have shown that the quantity of oil and starch varies with the time of year; they have, further, classified trees according to their richness in these materials.

According to these facts then, assuming in the case of Germany that it is during the summer months that thunderstorms are most frequent, those trees rich in fatty materials (Fettbäume), and which during the summer contain much of them, are to a great extent protected against lightning. Those, on the other hand, that are poor in oil during the period of thunder-storms, and especially such trees which contain much starch (Stärkbäume), are more liable to be struck.

One very interesting example to which reference is made is the wood-pine. This tree, during the summer months in Germany, is, comparatively speaking, very often damaged, while in countries where the thunderstorms occur in the winter months (Ireland and Norway) it is usually untouched. To explain this according to the deductions of Jonescu's observations, it must be shown that in winter the tree is richer in oil than in summer. A microscopic examination of samples at both these periods of the year has proved conclusively that this is really the case, the oil disappearing in April, to have its place taken by glucose and starch. Employing the apparatus previously referred to, Jonescu found that for the winter wood of this tree double the amount of potential energy was required for sparking purposes than was required when operating with the summer wood.

As a check on his own results, Jonescu took the wood of typical trees rich in fatty materials (Fettbäume), beech and walnut, and found that when deprived of their oil by means of ether, their degrees of conductivity were increased and became practically the same as those of the wood of typical trees rich in starch (Stärkebäume).

The above explanation of the causes which render some trees more than others liable to the destructive power of a lightning flash, helps certainly to explain other points of less importance. Experiment showed that for both kinds of trees, namely, those rich in fatty materials and starch respectively, the wood in the living state is a far worse conductor than when dead. This leads to the deduction that trees with dead branches on them are more likely to be struck than those without any, so that they should be avoided if possible. Jonescu's hypothesis also explains why it is that lightning does not as a rule strike the highest part of a tree, but generally the trunk, either inside or underneath the crown.

In conclusion, it is to be hoped that these investigations of Jonescu, to which only brief reference here has been made, will be followed by observations and statistics from other sources, for this question is one that is of very general interest. It is sad to think, however, that the oak, a tree which we cherish so much, is such a friend to flashes of lightning in the way of conduction, that it in this way brings on its own destruction. D.

THE GREAT MADRID METEOR.

ON Monday, February 10, at 9h. 29m. 30s., there was observed an instantaneous bluish-white illumination in the atmosphere, so strong and vivid as to be visible in the inner rooms and in the open air.

The day was a magnificent one: blue sky, no wind, and a radiant sun.

Soon after there was plainly visible near the zenith, and some few degrees to the south-east, a white spot, like smoke, bearing north-east to south-west, of about 6° length and 1° wide; its form was semicircular, with the convexity turned to the east. In the centre, and near the apex of the curve, it presented a condensation of a reddish colour, similar to those of clouds at sunset. The general appearance of the spot was that of a light cirro-cumulus.

At 9h. 30m. 40s. there was heard a deep and very strong detonation, accompanied by many others not so intense, similar to the noise produced by a large cannon-ball running along the upper storey of a house. This noise was very prolonged; it was found to last two minutes.

Meanwhile the vibration of windows and partitions (not the thick walls) was extraordinary, and the rattling of panes of glass alarming. In some houses all the window-glasses were broken.

Judging from the time which elapsed between the light and the sound of the first detonation, the meteor exploded in the air at a distance not inferior to 24 kilometres; and this number is evidently too low.

Considering the aspect of the spot of smoke, it seems probable that the meteor proceeded from the south-east towards the north-west, and that near the zenith of Madrid it exploded.

Changed into smoke and dust, totally or partially, this smoke was carried away by the superior currents of the atmosphere to the east. We find here a splendid confirmation of the theory which supposes that, at the upper limits of the air, the wind moves from west to east.

In the accompanying rough sketch, one part corresponds to the trajectory of the celestial body; and the other, which forms an angle with the first, to the action of the aerial current.

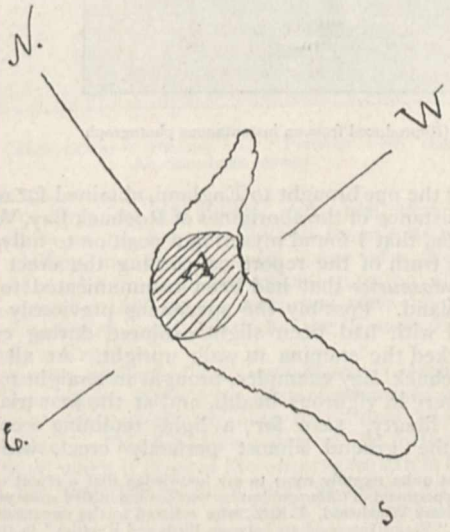


FIG. 1.—Aspect and position of the cloud some minutes after the explosion. A, Condensation of a reddish colour.

The accompanying photograph of the phenomenon was taken by an amateur some few minutes after the explosion.

The cloud continued its course to the E.N.E., or E. ¼ N.E., dissolving gradually away, and at 3h. p.m. it was still perfectly visible like a light cirrus in the east at some 20° above the horizon.

The compression of the atmosphere in the instant of the conflagration was indicated by the registering barometers. In the aneroids the trace is small; but in the mercurial one the column rose 1·6 m.m., and lowered 0·7 m.m., the amplitude of the total oscillation being 2·3 m.m.

In the neighbourhood of Madrid some fragments of the meteor fell, and I have obtained one of them.

FIG. 2.—Photograph of the cloud immediately after the explosion.

Externally the fragment is of a black metallic aspect; inside it is of white stony appearance, with some brilliant points like nickel; it weighs 6·3 grams.

From information received later, it appears that the phenomenon was visible in a large part of the Peninsula, from Sierra de Estrella (Portugal) to Denia in the Mediterranean coast, and from Segovia to Aguilas, or a distance of 700 kilometres from east to west, and 400 from north to south. These are inferior limits.

AUGUSTO ARCIMIS.

THE FRILLED LIZARD: "CHLAMYDOSAURUS KINGI."

THE above-named lizard inhabits the northern or tropical territories of the Australian continent, and is tolerably abundant in both North Queensland and the Kimberley district of Western Australia. Its earliest record is that given by Captain Philip P. King, in his "Narrative of a Survey of the Intertropical Coasts of Australia" (1826), and wherein it is named, figured, and described in a Natural History Appendix by Dr. J. E. Grey.

The habitat of the frilled lizard is essentially sylvan, its resort being the thickly-wooded scrublands, and its favourite abiding-place the trunks and lower limbs of the larger trees. The length of the finest examples rarely exceeds three feet, and of this the long, rough, though slender tail monopolises the greater moiety. Living specimens exhibit a considerable individual colour variation. The predominant hue of the body is pale brown with reticulated markings; while the frill, in the males more especially, is usually decorated with interblending tints of yellow, scarlet, and steel-blue.

No living example of this singular lizard had, up to the present year, been brought alive to Europe, a circumstance which will account, to a large measure, for the fact of certain abnormal phenomena connected with its life-habits having hitherto attracted little or no scientific attention. Through the possession of living specimens of *Chlamydosaurus* in both Queensland and Western Australia, several interesting data concerning the species have fallen within my notice. Having, furthermore, succeeded in bringing one out of several examples embarked safely to England, my presentation of the animal to the

Zoological Society's Gardens, where it was on view for some weeks, has afforded many fellow-naturalists the opportunity of verifying the phenomena here recorded.

The most conspicuous structural feature of *Chlamydosaurus kingi* is the extraordinary development of the cuticle of the neck, that gives to it its popular title. This takes the form of a voluminous frill or collar, which, while the animal is at rest or undisturbed, is neatly folded in symmetrical pleats around the creature's neck and shoulders. No sooner, however, is the lizard excited to hostility by the approach of a threatening assailant, than, coincident with the opening of the mouth, the frill is suddenly erected, much after the manner of the unfurling of an umbrella, and stands out at right angles to the longer axis of the body, measuring under such conditions some seven or eight inches in diameter.

The mechanism by which the erection and depression of the frill of *Chlamydosaurus* is accomplished is intimately connected with a slender process of the hyoid bone, which traverses the substance of the frill on each side, and is so adjusted that the opening of the creature's mouth and the erection of the frill are synchronous operations. A characteristic photograph from life of this lizard in a condition of excitement, and standing at bay, with mouth open and frill erect, is afforded by Fig. 1, representing one of many I was fortunate in securing from the specimen I brought to England.

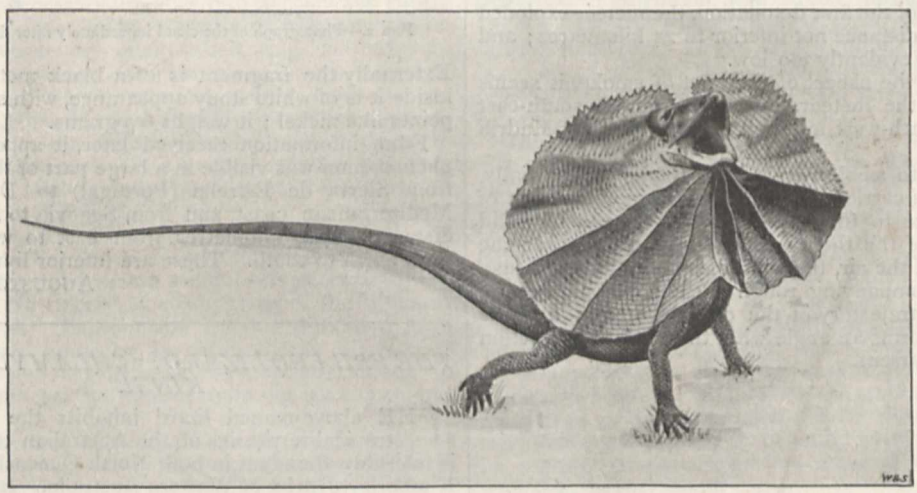


FIG. 1.—*Chlamydosaurus Kingi*, standing at bay with erected frill. (Reproduced from an instantaneous photograph by W. Saville-Kent.)

The function of the frill in *Chlamydosaurus* is, as apparently indicated by the circumstances and conditions under which alone it is displayed to view, purely that of a "scare-organ," wherewith by its sudden expansion many of its would-be assailants are frightened and deterred from attacking it. Instances have, in fact, been recorded to me of dogs, which will readily rush upon and kill other and larger lizards, such as *Varani*, refusing to come to close quarters with so formidable-looking an object as *Chlamydosaurus*, when it turns upon them with gaping mouth and suddenly erected frill.

Chlamydosaurus displays, however, additional defensive tactics. When approached these lizards will often spring aggressively at the intruder, and in addition to using their not very formidable teeth, will lash sideways with their long rough tails with such vigour as to smartly sting the hand which may fall within range of the unexpected impact.

The natural food of the frilled lizard consists almost exclusively of Coleoptera and other bark-frequenting insects; a fact which emphasises the difficulty of keeping them long in a state of captivity. The several specimens in my possession became fairly accustomed to dieting on raw meat, though they would not take to this artificially substituted pabulum voluntarily. On the slightest excitement, however, they would open their mouths and erect their frills, and on which occasions it was a simple matter to administer pieces of meat, which were then readily assimilated.

The most remarkable feature placed *en evidence* by the specimens I kept in captivity, was their peculiar method of perambulation. The statement that the frilled lizard was in the habit of running erect on its hind legs only, was made to me in Queensland some years ago. I failed, however, to verify this assertion through the single living specimen I there had in captivity for a short interval; and neither was a friend in the northern district of the colony more fortunate, who, at my request, made experiments with several specimens. I was, on these grounds, inclined to suspect that the rumour, that had previously reached me, was the outcome of an optical illusion; many lizards, such as *Grammitophoræ*, running so erect on their haunches that it might be imagined their fore-limbs were raised from the ground.[1]

It was consequently to my no small gratification and delight, on becoming the owner of several specimens, including the one brought to England, obtained for me with the assistance of the aborigines of Roebuck Bay, Western Australia, that I found myself in a position to fully establish the truth of the report concerning the erect gait of *Chlamydosaurus* that had been communicated to me in Queensland. Possibly the specimens previously experimented with had been slightly injured during capture, and lacked the stamina to walk upright. At all events the Roebuck Bay examples, brought in straight from the bush, were in vigorous health, and at the first trial when left at liberty, save for a light retaining cord, ran along the ground almost perfectly erect, with both

[1] It has quite recently come to my knowledge that a report of the bipedal comportment of *Chlamydosaurus* was communicated some years since to Dr. Henry Woodward, F.R.S., who referred to the circumstance in a paper on "Forms Intermediate between Birds and Reptiles" in the *Quart. Journ. Geological Society*, vol. xxx. 1874, The concluding paragraph of that paper, wherein Dr. Woodward favours the interpretation that "the bipedal habit of the secondary reptiles is a peculiarity still maintained by the Australian *Chlamydosaurus*," is of special interest with relation to the latter portion of this article. The assertion made by Dr. Woodward's informant in the journal quoted, that *Chlamydosaurus* is common near Sydney, is a mistake due, probably, to the circumstance that another lizard, *Amphibolurus barbatus*, having a less developed neck-membrane, inhabits that district, and is sometimes also known locally as the Frilled Lizard. The structure of this type, however, would not permit of its bipedal progression.

their fore-limbs and long tails elevated clear of the ground.

The attempt was made on the spot to permanently register, with the aid of the Kodak camera, the absurdly grotesque appearances these lizards presented when progressing in this bipedal fashion. Such, however, was the speed at which the animals ran, that the shutter of that instrument did not work fast enough to secure anything better than a blur at close quarters, and it was only by bringing an Anschutz camera with its most rapid roller-blind shutter to bear on the specimen, after its arrival in London, that the Figs. 2 and 3, here reproduced, were secured. While even these partake much of the nature of silhouettes, they will serve to indicate the more characteristic running attitudes which this lizard may assume.

Fig. 2 in this series carries with it so essentially human an aspect that one is sorely tempted, at the risk even of incurring scientific contumely, to place a cricket-bat in its right hand. The distance *Chlamydosaurus* will traverse in this remarkable erect position may average as much

FIG. 2.—*Chlamydosaurus* running erect. Posterior view, taken with Anschutz hand camera.

as thirty or forty feet at a stretch, and when, after resting momentarily on its haunches, it will resume its running course. When, however, a short space of a few yards only have to be covered, the animal runs on all-fours, sitting somewhat high on its haunches after the manner of many ordinary lizards, such as the *Grammitophoræ*, previously referred to.

The profile outline of *Chlamydosaurus*, presented by Fig. 3, is peculiarly interesting, since it possesses so much in common with that of a running long-tailed bird, such as a pheasant. This bird-like aspect of the frilled lizard, as exhibited when it crosses the observer's path in bipedal fashion, has been the recent subject of remark to me by a friend familiar with the species in the Kimberley district of Western Australia.

Special interest is attachable to this avian-like ambulatory deportment of *Chlamydosaurus* by reason of the generally accepted interpretation that the birds are modified descendants of a reptilian archetype. The temptation is naturally also very great to institute comparisons between, and to suggest possible affinities with, this peculiar lizard and the extinct group of the Dinosauria, and among whose representatives a bipedal locomotive formula was apparently a characteristic feature. A reference, however, to the skeleton of *Chlamydosaurus* does not encourage any sanguine anticipations that may have been previously entertained in this direction. It yields no indication of that peculiar avian modification of the pelvic elements, adapted for bipedal locomotion, that are so essentially diagnostic of the more typical Dinosauria, while in all general points it is indistinguishable from that of the ordinary Agamidæ.

Though, as a consequence, no serious attempt would be justified to correlate the erectly progressional *Chlamydosaurus* with such ponderous specialised Dinosaurs as, say, *Iguanodon* or *Brontosaurus*, there are some few species at the lacertilian end of the chain, that probably presented when living, a by no means remote likeness to this existing type in both aspect and gait. The *Compsognathus longipes* of A. Wagner, from the lithographic stones of Solenhofen, is more especially worthy of mention in this connection. In size, some three feet long only, and in the proportions of the limbs and other points, it must have been almost a counterpart of *Chlamydosaurus kingi*. It is particularly noteworthy of it, moreover, that, as pointed out by the late Prof. Huxley

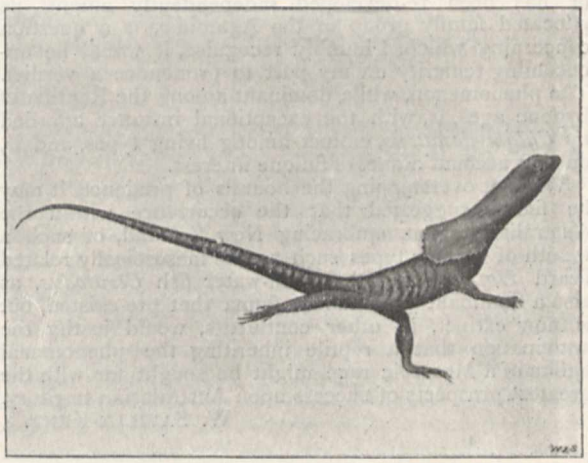


FIG. 3.—*Chlamydosaurus* running erect. Profile view.

("Anatomy of Vertebrata," p. 262, ed. 1871), the pelvic elements of *Compsognathus* correspond more essentially with those of the ordinary lizards than with those of the aviform Dinosauria, the pubes in particular being apparently directed forwards and downwards, like those of lizards. This type, as likewise *Stenopelyx*, is also referred to by the same authority (p. 263) as indicating that the more typical modification of the pelvis, and in which the pubes are directed backwards parallel with the ischia, as in birds and Iguanodon, "was by no means universal" among the Dinosauria or Ornithoscelida, as Prof. Huxley preferentially named them.

Notwithstanding the distinctly recognised lacertilian character of the pelvis of *Compsognathus*, Prof. Huxley had no hesitation in assigning to this type an erect bipedal method of locomotion. Writing of it in the *Popular Science Review*, 1866, that illustrious biologist remarks: "It is impossible to look at the conformation of this strange reptile, and to doubt that it hopped or walked in an erect or semi-erect position after the manner of a bird, to which its long neck, slight head, and small anterior limbs must have given it an extraordinary resemblance."

The silhouette presentment of *Chlamydosaurus* afforded by Fig. 3, forms a not inapt embodiment of the flesh-clad

skeleton that must have suggested itself, ghost-like, to the learned Professor's mind. And it is among my keen personal regrets for the loss the world has sustained through the decease of Prof. Huxley, that I should have been deprived by so short an interval of gladdening my former teacher's eyes with the sight of a living organism which, if only in the direction of superficial analogy, so nearly realised one, among the many, of his most sagacious interpretations of the fossil past. One remaining point in the erect running gait of *Chlamydosaurus* invites brief attention. Such is the conformation of the hind foot and its component digits, that when thus running the three central digits only rest upon the ground. As a consequence of this structural peculiarity, the tract made by this lizard when passing erect over damp sand or other impressible soil, would be tridactyle like that of a bird, and would also correspond with such as are left in Mesozoic strata by various typical Dinosauria. This tridigitigrade formula of the gradation of *Chlamydosaurus*, induced by the great relative shortness of the first and fifth digits, is distinctly indicated in the second of the accompanying figures.

Whether or not the bipedal locomotive comportment of *Chlamydosaurus* has been transmitted by heredity from a lizard-like Dinosaurian such as *Compsognathus*, or has been re-developed independently among its allocated family group of the Agamidæ, is a question concerning which, I humbly recognise, it would be unbecoming temerity on my part to pronounce a verdict. The phenomenon, while dominant among the Reptilia of bygone ages, is, with the exceptional instance afforded by *Chlamydosaurus*, extinct among living types, and is, on that account alone, of unique interest.

Without overstepping the bounds of prudence, it may be finally suggested that the occurrence within the Australian region, embracing New Zealand, of such a wealth of archaic types such as the mesozoically related lizard *Hatteria* and the fresh-water fish *Ceratodus*, as also a dominant mammalian fauna that pre-existed, but is now extinct, in other continents, would justify the anticipation that a reptile inheriting the phenomenal habits of a Mesozoic race might be sought for with the greatest prospects of success upon Australasian territory.

W. SAVILLE-KENT.

NOTES.

THE list of Presidents for the ten Sections of the British Association, for the Liverpool meeting in September next, has been published. All the Sectional Presidents having accepted the nominations, the list may be regarded as definitive. President of the Association—Sir Joseph Lister, Bart., P.R.S. Section A—Mathematics and Physics, Prof. J. J. Thomson, F.R.S. Section B—Chemistry, Dr. Ludwig Mond, F.R.S. Section C—Geology, Mr. John Edward Marr, F.R.S. Section D—Zoology, Prof. E. B. Poulton, F.R.S. Section E—Geography, Major Leonard Darwin. Section F—Economics, Right Hon. Leonard Courtney, M.P. Section G—Mechanical Science, Sir Charles Douglas Fox. Section H—Anthropology, Mr. Arthur Evans (Keeper of the Ashmolean Museum, Oxford). Section I—Physiology and Pathology—Dr. Walter Holbrook Gaskell, F.R.S. Section K—Botany, Dr. D. H. Scott, F.R.S. Evening discourses will be given by Prof. Flinders Petrie and, probably, by Sir Andrew Noble. The lecture to working men will be given by Prof. Fleming, F.R.S.

THE Toronto Local Committee are assiduously engaged in preliminary work for the meeting of the British Association for the Advancement of Science in 1897. Meetings of the executive committee are held every fortnight. Besides the executive committee, a number of sub-committees are at work, including those on finance, conveyances, publication and printing, rooms for offices, meetings of the association and committees, hotel and lodgings, press, hospitality, reception, and for securing co-operation of other institutes, associations, and corporations, postal, telegraph and telephone facilities. The attention of the committee on conveyance has already been called to the desirability of securing from the Canadian Pacific Railroad transportation for such members of the Association as may desire to extend their travels to the Pacific coast, with special reference to the suggestion that a meeting of the American Association for the Advancement of Science may follow the Toronto meeting, if adequate facilities for transportation are assured. This suggestion is based upon the fact that the American Association have already once voted in favour of such a meeting if satisfactory rates could be obtained; and the hope is still entertained that delegates from both British and Australasian Associations might find San Francisco a convenient point at which to meet the American Association. Mr. Griffith, the general secretary of the British Association, is expected to be in Toronto about May 22, to make arrangements for the meeting, and set out the proper lines of work.

FROM McGill University, Montreal, comes the information that Röntgen's experiments were not only repeated there with considerable success immediately on the announcement of his results in America, but have been applied to two important medical cases within the first week of their demonstration. Before any full description of Röntgen's method had crossed the ocean, Prof. Cox was enabled by a lucky guess, and with the aid of the fine McDonald apparatus, to reach success at the first attempt. Four days later a photograph was obtained, clearly showing the bones of the leg from the knee downwards, with the image of a bullet (which had been there for seven weeks and was causing trouble) clearly defined between the two bones, and resting against the inner angle of the tibia. The same photograph showed a copper wire which had been bound round the leg as a fiducial mark from which to measure. The bullet was six centimetres below the wire. On the following day the bullet was reached at a depth of two inches, and was extracted successfully. The exposure required for this photograph was forty minutes. The Pulüj tube (Geissler Catalogue 3080) has been found by Prof. Cox to be superior to any others tried. Its fluorescing screen seems to protect the glass, and is far brighter than that of the other tubes. It gave continuous exposures of 65 minutes without injury, and has since been used to detect a fracture of the ulna, and to produce a photograph of the hand, with perfect definition.

OUR U.S. correspondent writes under date February 14:—"The new photography continues to be the absorbing topic in scientific circles, and innumerable experiments and results are reported. Dr. Henry W. Cattell, of the University of Pennsylvania, has taken pictures of anatomical preparations with such success, that he infers it will be easy to obtain pictures of acromegaly, osteitis deformans, rheumatoid arthritis, &c. Prof. W. F. Magie, of Princeton, has invented a new instrument for use in diagnosis. A sheet of black paper, coated on one side with barium platino-cyanide, is placed with the coated side inward across the end of a tube or box, into which the observer looks, and which is so fitted to the face, or so shielded by cloths, that the phosphorescent substance and the eyes are protected from all extraneous light. If the tube be then directed towards the excited Crookes' tube giving the Röntgen rays, the phosphorescent paper in the tube glows, and the shadows of objects interposed between it and the Crookes' tube appear upon it. The first successful experiments in Brooklyn are by Prof. William C. Peckham, at the Adelphi Institute, using more direct methods than have heretofore been used, with a current of 3½ amperes and an electrical pressure of six volts. Dr. A. Mau succeeded in

obtaining a photograph of a key, covered by a board, by five hours' exposure to direct sunlight. Elaborate experiments are in progress at Columbia, under the direction of Profs. Rood, Papin, and Hallock, with a prospect of important results."

WITH reference to the report that Prof. Salvioni had discovered how to make directly visible the bones of the hand by means of Röntgen rays, the Rome correspondent of the *British Medical Journal* says :—"At a meeting of the Perugia Medico-Chirurgical Society, held on February 5, Prof. Salvioni, teacher of physics at the University, made a most important communication on the new results obtained by him in Röntgen's rays. In studying the question, his aim was to invent an apparatus which would enable one to see direct and without the intervention of photography certain bodies enclosed in wood, flesh, cardboard, &c. He therefore studied the possibility of rendering the retina sensitive to Röntgen's rays. In this he has succeeded by inventing an apparatus which he has called a cryptoscope, which he exhibited at the meeting, and by means of which one can clearly see the contours of the bones of one's own hand, objects enclosed in cardboard boxes, leather purses, &c. This apparatus is very simple, and consists of a black cardboard tube enclosed at one end with a disc of black cardboard coated internally with a fluorescent substance (barium platino-cyanide, sulphate of calcium, &c.); in the other end is placed a lens which permits one to clearly see the fluorescent surface. The object to be observed is placed before the luminous source given by a Crookes' tube, and then one looks at it through the cryptoscope placed at a suitable distance. As in the fluorescent cardboard the parts of the object impermeable to Röntgen's rays are drawn in shadow, thus one clearly sees the contours of the bones of the hand, &c. A model of the instrument was made under the direction of Prof. Blasema at the Physical Cabinet of the Roman University on February 11, and with it one could clearly see the bones of one's own hand, coins in a purse or the clenched hand, &c. It is evident from these results that the apparatus, when perfected, will be of great use in medicine and surgery."

THE current number of the *Comptes rendus* contains no less than seven papers bearing on the Röntgen rays. In following up the analogy of certain properties of these rays with some properties of the ultra-violet rays, M. R. Swyngedauw has found that the X-rays cause a lowering of the explosive potential according to the same general laws as the electrically active ultra-violet rays. Whilst the influence of the latter, however, is entirely suppressed by interposing a screen of wood, glass, or blackened paper, these materials do not affect this property of the Röntgen rays. It was also noticed that these rays lowered the dynamic explosive potentials to a greater extent than the static potentials. As a result of the study of the property of the Röntgen rays of discharging an electrified body, M. A. Righi concludes that the time necessary for a given fall of potential is practically the same, whether the original charge be positive or negative. With an initial positive charge the discharge is not complete; but if negative initially, not only is the discharge complete, but the disc becomes positive. The results obtained by MM. J. J. Borgman and A. L. Gerchun, however, are precisely contrary to these, a positively charged disc losing its charge nearly instantaneously, and becoming negative on prolonged exposure to a Crookes' tube. MM. L. Benoist and D. Hurmuzescu contribute further researches on the same subject of a quantitative character. By measuring the time required for a given reduction of angle between the leaves of an electroscope, and the distance of the leaves from the Crookes' tube, they prove that the ratio of the times are as the ratio of the squares of the distances. From the coefficient of transmission (0·85) of an aluminium plate, 0·1 mm. thick, it is shown that a plate of aluminium 15 mm. thick, such as was used by Röntgen in his original experiments, must be practically opaque to the rays *unless the rays are heterogeneous*. In an extract from a letter by M. de Heen, an ingenious experiment is described which proves conclusively that the X-rays proceed from the anode, and not the kathode. A leaden plate perforated with holes is placed between the Crookes' tube and the photographic plates, and the direction of the bundles of rays thus obtained shows clearly that these rays are anodic.

DR. M. ARMAND RUFFER has resigned the post of Director of the British Institute of Preventive Medicine, and has been appointed Professor of Bacteriology at the Medical School of Cairo, vice Dr. Kaufmann, resigned.

COLONEL C. F. CROCKER, a member of the Regents' Committee of the Lick Observatory, has undertaken to pay the expenses of an expedition which will be sent from the Observatory to Japan to observe the forthcoming solar eclipse. The expedition will be under the direction of Prof. Schaeberle, and its programme will be wholly photographic.

CHARLES WACHSMUTH, well known as a palæontologist in the line of Crinoids, died suddenly at Burlington, Iowa, February 17, aged sixty-six years. He was a native of Germany, and had spent forty years in scientific research among the Crinoids of the Mississippi Valley and the Tennessee Mountains.

THE deaths are announced of Prof. J. Graindorge, Professor of Mathematical Physics and Kinematics at Lüttich; M. Abel Hovelacque, the distinguished Anthropologist and Orientalist, at Paris; Dr. K. Stölzel, Professor of Technical Chemistry and Metallurgy in the Technical High School at Munich; Dr. P. Hedenius, Professor of Pathology and Pathological Anatomy at Upsala.

THE progress in electric propulsion appears in many ways. Electric motors have been tried and will be substituted for steam on the New York and Brooklyn Bridge as a means of switching trains at the termini, thus practically doubling the capacity of the bridge. A Westinghouse system railroad locomotive, the first one constructed, has just been completed at Philadelphia, and sent to Pittsburgh for its electric equipment. A speed of 200 miles an hour is claimed. Experiments indicate that electricity will soon supplant steam as a motor on the entire New York elevated railroad system.

THE following prizes have recently been awarded by the Académie Royale de Belgique: M. J. Verschaffelt, 600 francs for his work on the determination of molecular weights of bodies in solution; M. E. Haerens, 1420 francs (Prix Charles Lemaire) for the best treatise on public works. The following have been elected Foreign Associates of the Academy: Profs. Sylvester (Oxford), Cannizzaro (Rome), Strasburger (Bonn), Cope (Philadelphia), M. Marey (Paris), and Sir Archibald Geikie (London). M. Fraipont (Liège) has been elected Correspondant in the Natural Science Section.

ALL who are working for the reform of our system of weights and measures will be interested to know that the Swiss Government have recently invited the countries parties to the Berne Convention—in other words, all the leading countries of the continent of Europe—to a conference to discuss *inter alia* the introduction of a uniform gauge of screws based on the metric system. Mr. W. M. Acworth remarks in the *Times* that, according to the official document, this gauge is intended to take the place of the "so-called Whitworth system, based on English measures, which is at present in use under various forms." It is pointed out that there is an immense advantage in having the material for the repair of rolling-stock, which often travels

thousands of miles from home, interchangeable. It is added, moreover, that, if the way to this reform be once opened under the lead of railways, private manufacturers may be confidently expected to promptly follow suit.

THE spring meeting of the Iron and Steel Institute will be held in London, at the Institution of Civil Engineers, on May 7 and 8; and the autumn meeting will be held at Bilbao at the beginning of September, under the presidency of Sir David Dale. Special arrangements are being made for the autumn meeting, the programme for which will include visits to the important Spanish mines, from which so large a proportion of the iron ore used in Great Britain is obtained. Owing to the limited hotel accommodation at Bilbao, arrangements are being made to secure one of the Orient Company's steamers to convey the members to Bilbao and back, and to serve as a floating hotel. It is proposed that the cruise should last a fortnight, and that calls should be made at some of the Spanish and French watering-places.

IN a letter to the *Times*, Admiral Richards briefly reviews Dr. Nansen's expedition and the report of its having reached the North Pole. It will be remembered that Nansen's intention was to place his ship in the solid ice off the coast of Siberia and to drift with it across the Pole into the Greenland Sea, believing it would be carried there by a current. Admiral Richards points out, however, that in the Polar basin proper it is doubtful if the ice ever finds an exit. The ships which entered on its confines in Wellington Channel found it blocked there; M'Clure also found it blocked between Banksland and Melville Island. Nares could not get a mile north from the top of Smith Sound for very heavy ice, and the only channel it could escape by is the Greenland Sea, of which there is no evidence, while by Davis Strait great numbers of bergs and enormous quantities of ice are constantly passing down in the months of July and August, but none of it from the Arctic basin proper. These facts, remarks Admiral Richards, tell strongly against Nansen's succeeding in his original project, but they need not have been an obstacle in his reaching a certain distance north from the coast of Siberia.

THE anniversary meeting of the Geological Society of London was held on Friday, when Dr. Henry Hicks, F.R.S., was elected President for the ensuing year. The retiring President (Dr. Edward Woodward) delivered his anniversary address, which dealt with the life-history of the Crustacea in later Palæozoic and in Neozoic times. The following awards of medals and funds were made: The Wollaston medal to Prof. E. Suess; the Murchison medal, and part of the proceeds of the Murchison fund, to Mr. T. Mellard Reade; the Lyell medal, and part of the proceeds of the Lyell fund, to Mr. A. Smith Woodward; balance of the Wollaston fund, and part of the proceeds of the Barlow-Jameson fund, to Mr. Alfred Harker; balance of the proceeds of the Murchison fund to Mr. Philip Lake; moiety of balance of proceeds of Lyell fund to Dr. W. F. Hume; moiety of balance of proceeds of Lyell fund to Mr. C. W. Andrews; moiety of balance of proceeds of Barlow-Jameson fund to Mr. Joseph Wright; moiety of balance of proceeds of Barlow-Jameson fund to Mr. John Storrie.

WE understand from the *Lancet* that the arrangements for the next International Congress, which will be held in Moscow in August 1897, are now being worked out by the special Committee appointed for the purpose. There will be twelve sections, as follows: (1) anatomy, (2) physiology, (3) general pathology and pathological anatomy, (4) general therapeutics, (5) internal diseases, (6) children's diseases, (7) nervous and mental diseases, (8) dermatology, (9) surgery and diseases of the eye, (10) midwifery and gynæcology, (11) hygiene, and (12) legal medicine. The Government has assigned 35,000 roubles for the expenses of the congress. The official language of the congress will be the French language, but in the general meetings, of which there will be three, communications may be made in any European tongue. In the sectional meetings only three languages will be admitted—namely, French, German, and Russian. Englishmen must regret that they will be debarred from making communications in their own tongue to the sectional meetings, and that their only opportunity of reading papers in the English language will be in the three general meetings.

THE scientific study of the mental and physical condition of children, carried out by Dr. Francis Warner in connection with a Committee of the Congress of Hygiene, has led to results which claim full consideration. Dr. Warner gave an account of his investigations before the Royal Statistical Society last week. It appears that defective development is more frequent in boys than in girls, and more associated with nervous disorder in the former and with delicacy and dulness in girls. Mental dulness is found much associated with irregular movement and action, especially among boys, showing that physical exercises should form a part of brain culture in school. Dealing with the question of mental dulness, Dr. Warner showed that the want of physical training of the brain appears to be a more frequent cause than defective development of the body. Defective physiognomy and proportioning of the features and parts of the body is often associated with mental dulness, but the occurrence of brain disorderliness, indicated by observable signs, is a more general and direct cause. Both defect in development and nerve disorderliness, either alone or in combination with low nutrition, are much associated with mental dulness. From the facts collected, Dr. Warner has been able to deduce the indications of some of the physical causes of defect of body, defect of brain, and mental dulness. It is to be hoped that it will be possible to continue such research beyond the metropolitan area, and that a commission might be appointed by the Government to consider the many important recommendations on national education resulting from the investigation thus far completed.

THE ancient and familiar process used in the manufacture of linen, and known as the "retting" of flax, has long eluded all endeavours to place it upon a sound scientific basis. Prof. Winogradsky, of St. Petersburg, has, however, recently shown that it is directly dependent upon the action of particular bacteria. Considerable difficulty was experienced in discovering the special microbes responsible for the process, and several different varieties were isolated by means of gelatine plate culture from the retted or fermented flax; but in no case, when inoculated on to sterilised flax, did retting ensue. When, however, portions of retted flax were added to the sterilised flax, vigorous fermentation was set up in from twelve to fifteen hours. In the next series of experiments pieces of sterilised flax were inoculated, placed in tubes containing water, the surface of which was sealed from the air by means of a film of oil. In this manner, after a long series of successive inoculations, a somewhat large, spore-forming bacillus was discovered, which subsequent experiments proved to be the specific microbe responsible for the retting of flax. It was obtained in a condition of undoubted purity by anaërobic cultivation on slices of potato which were rubbed over with chalk, and from these cultures the retting of sterilised flax was accomplished with the greatest ease. Prof. Winogradsky is of opinion that the so-called pectic fermentation, by which is understood the transformation during retting of insoluble pectic substances into soluble, must now be regarded as a fermentation process in the strict bacteriological sense of the word.

IN the *Meteorologische Zeitschrift* for December 1895, Prof. G. Hellmann discusses the yearly period of storms in Europe, with

especial reference to the so-called equinoctial gales. In order not to entirely omit large districts, observations both at stations with and without anemographs have been utilised, and he has deduced the yearly period at some fifty stations; but, partly not to complicate the discussion, and partly from want of necessary details, no account has been taken of the duration, force and direction of the storms. The position of the station has a great influence upon the yearly period; a place with a good western exposure will have more westerly storms than a station with an easterly exposure, and *vice versâ*. The author finds that in the extreme south-west of Europe March is the most stormy month; this is very marked at San Fernando, near Cadiz, where 45 per cent. of all storms occur in that month. Further northwards, on the Atlantic coast, the March maximum gradually recedes; and on the coasts of France, the British Isles, and Norway, there is a decided maximum in January, and at some inland places this also holds good. This agrees with the results obtained by Mr. R. H. Scott for the British Isles (*Quarterly Journal* of the Roy. Meteor. Society, 1884), who showed that mid-winter was the stormiest season. The stations of South Norway and part of North Germany show a considerable increase of storms in October, but there is a great variation in the yearly period in relatively small districts. The author considers that although storms do not preponderate exactly at the times of the equinoxes, the popular theory holds good to a certain extent, that they frequently occur near those seasons; and that if the year be divided into two parts—one of stormy, and one of relatively calm weather—the months of March and October must be taken as the limiting periods, at all events over a great part of Europe.

WE have received an atlas of the "isanomales" and of the lines of secular change of the earth's magnetism, by Lieut.-General Alexis de Tillo. The atlas contains sixteen maps, which give the isanomales and the lines of equal secular change of the declination, dip, horizontal force, vertical force, and total force for the epoch 1859. In addition there are two maps showing the agonic lines for the epochs 1700, 1800, and 1859, and the lines of maximum secular change in declination for the epochs 1745, 1810, and 1859. The author, from an examination of these maps, concludes that with reference to each of the magnetic elements the globe can be divided into two hemispheres by a great circle approximately parallel to the meridians. In one of these hemispheres the values of the magnetic element are greater than in the other hemisphere, and there is a similarity between the general lie of the isanomales (*i.e.* of the lines of equal departure of each element from the mean value of the element along a parallel of latitude) of the several elements. The agonic lines are reproduced on the maps of the isanomales of dip, vertical force, and of magnetic potential. In particular the places at which the declination is zero coincide with the points of maximum or minimum value of these elements along the parallels of latitude. The isanomales of the horizontal force show that in general in those parts of the surface of the earth at which the declination is westerly the horizontal force is less than in the parts of the surface of the earth at which the declination is easterly. An indication of the Siberian oval appears on the vertical force and dip charts, while on the horizontal force and total force charts there is an indication of a similar oval near the Sandwich Islands.

THE belief in the vampire—that is, a spirit which leaves its dead body in the grave to visit and torment the living—is a very ancient and widely-spread superstition. It is startling to find, according to Mr. G. R. Stetson (*The American Anthropologist*, ix. p. 1), that this ghastly belief still persists in Rhode Island, U.S.A. Persons now living claim to have had their life saved from death by consumption by the exhumation, mutilation, and generally the cremation of some member of their families who had died a short time previously. In the same journal, Dr. J. W. Fewkes has a preliminary article on Tusayan Ethno-botany. This is a subject which has not received the attention it deserves, and it would be well if residents in our colonies and dependencies, who have a taste for botany, would preserve the transient plant-lore of our native races.

WHILE the old-fashioned view of igneous rocks as merely accidental and irregular intruders into the regular sedimentary series has been greatly modified by the results of petrological researches, it is not often that it is found possible, from an investigation of rock-structures, to obtain so complete an account of a series of events in a district as Messrs. Holland and Saise have recently done in the Giridih coalfield in Bengal. They show how a liquid rock-magma of highly basic composition was injected as a series of dykes through the rocks of this area at a temperature so high that near the dykes the coal was coked and columnar structure developed in it, while sandstones were so far fused that they came to closely resemble siliceous lavas. This magma was rich in chlorine, as the abundance of apatite in it shows, and from it thermal waters conveyed chlorides in solution to permeate the rocks around. This permeation by chlorides produced marked changes in certain more ancient igneous rocks, so that when at a later stage earth-movements crushing them led to their metamorphism and re-crystallisation, the results of that metamorphism were quite different in the areas where the chloride-permeation had and had not been effected. Where there were no dykes to supply the chlorides, hornblende-schists were produced; in the neighbourhood of the dykes, scapolite rocks were formed. These and other interesting facts are worked out in convincing manner in a paper contributed to the *Records* of the Indian Geological Survey (vol. xxviii. pt. 4).

MR. CHARLES J. JOLY, Fellow of Trinity College, Dublin, is editing an annotated edition of Sir W. Rowan Hamilton's "Elements of Quaternions." The work is now passing through the press.

AN important article on "Venezuela: her Government, People, and Boundary," by Mr. W. E. Curtis, appears in the February number of the *National Geographic Magazine*, illustrated by pictures of La Guayra, and the Valley of Caracas, east and west of the capital.

WE have received the second volume of meteorological data, published by the U.S. Weather Bureau, containing the results of observations made during 1893, and, as a special contribution, the records in detail of temperature, pressure, and wind at Pike's Peak and Colorado Springs.

A SET of thirteen "Laboratory Tables for Qualitative Analysis," drawn up by the Demonstrators in Chemistry of the Owens College, has been published by Mr. J. E. Cornish, Manchester. The tables are printed upon cards apparently intended for use in chemical laboratories, so that students can be drilled in the mechanical operations of analysis.

THE second "Psychological Index," published annually as part of the *Psychological Review*, has just been issued. The index is a bibliography of the literature of psychology and cognate subjects for 1895, compiled by Dr. L. Farrand and Mr. H. C. Warren. To psychologists, this well-arranged and complete list of published books and papers must be invaluable.

A SECOND edition of "The Methods of Microscopical Research," by Mr. Arthur C. Cole, has been published by Messrs. Baillière, Tindall, and Cox. The book is a practical guide to microscopical manipulation, embodying descriptions of many original processes and methods of work. The first edition was

well received, and the second, much enlarged and in great part re-written, will assuredly be just as successful.

A VOLUME has been received containing the results of rain, river, and evaporation observations made in New South Wales during 1894, under the direction of Mr. H. C. Russell, C.M.G., F.R.S. Two new maps of the colony have been introduced into the report, one showing the average monthly temperature in each square degree, and the other showing the temperatures of spring, summer autumn and winter, also the mean temperature for the year, and the highest and lowest temperatures ever recorded in each square degree.

MESSRS. G. BELL AND SONS have published a dainty brochure on the Koh-i-Nur diamond and the celebrated Pitt diamond, reprinted from Mr. E. W. Streeter's "Great Diamonds of the World." Mr. Streeter prints a letter received from Mr. J. Ball in 1882, containing an opinion against the identity of the Great Mogul and Koh-i-Nur diamonds; but he does not seem to have made much use of the detailed history of the Koh-i Nur in relation to the Great Mogul, as told by Prof. Story-Maskelyne in these columns in 1890 (vol. xliv., p. 555).

THE Library Bureau has sent us the first number of this year's "New Book List"—a catalogue of British literature published during January—compiled and arranged by Mr. Cedric Chivers. We have also received a specimen of a card catalogue which has been inaugurated with the list. It is proposed to publish at monthly intervals, and at a low price, a catalogue of new publications, printed on cards. Every book published will be catalogued under the author's name, and full particulars of the book will be printed upon the card. The card catalogue thus constructed should be of great service in libraries and other institutions.

A CATALOGUE of the "Students' Geological Collection" of the Bristol Museum has just been issued by Mr. E. Wilson, the Curator. This is a special collection of the commonest fossils of British formations, and of typical rocks and minerals, which is available, under proper conditions, for actual handling by elementary students. Such a collection must both be a boon to those who use it, and save the general collections from possibility of misuse. As the specimens are carefully selected, and the localities of almost all are given, the list may prove useful as a suggestion for the formation of similar ones elsewhere. From the same source comes the sixth edition of the popular penny guide to the Bristol Museum.

THE Magnetical and Meteorological Observatory of the Royal College of Belen, Havana, has published a pamphlet on the circulation and cyclonic translation of West India hurricanes, which was originally prepared by the late Father B. Viñes for the Chicago Congress. The paper is one of considerable importance upon the subject in question, as the author spent twenty-three years of his life in constant study of the storms in that part of the world. The first section deals with the general laws of cyclonic circulation and the relations of the movements of cirrus and other clouds to the locality of the centre of disturbance. The second part explains at considerable length the laws of the translation of the disturbance in different months, and its rate of travel in various parts of its path. It is well known that the West India hurricanes first advance towards the west, then turn northwards and recurve towards east-north-east or north-east. The rate of progress is found to differ in various parts of the path, and according to different seasons and latitudes. On these important points and their practical application to navigation Father Viñes' long and attentive studies have led to very valuable results. The work is written in the Spanish language.

THE Society for the Protection of Birds reports progress. The total number of members is now 13,134, no less than 1673 names being enrolled during the year 1895. Various are the reasons which result in an increase of membership of the Society. Naturalists join because they desire to prevent the extermination of rare species, many people become members from æsthetic considerations, and others because they have regard for the feelings of birds. The Society mourns a "deplorable outbreak of savagery in female adornment"—to wit, a recrudescence of the feather-wearing fashion, especially a rage for aigrettes. But, apart from this, the Committee reports the existence of a growing desire in the country to preserve its wild bird life. It is certain that in 1895, such signs have been more frequent and unmistakable than in former years. A greater and ever-increasing impatience is felt against the annual massacre, in August and September, of gulls, terns, guillemots, razorbills, puffins, and other sea-birds on our coasts; the shooting of every rare bird, in the interests of private collectors; the wholesale trapping of songsters, 70 per cent. of which perish within a week of capture, by unlicensed bird-catchers; and the use of the pole-trap. We give our support to the remark that last year was astonishingly prolific in ornithological literature, scientific and popular: it is certain that so large a number of books on the bird-life of the British Islands has not appeared in any previous year. These works should have a beneficial influence upon the Society.

THE preparation of metallic carbides in the electric furnace has, as is now well known, led to an easy method for the direct synthesis of pure acetylene, this gas being produced by the action of water upon the carbides obtained from the alkaline earths. But all metallic carbides do not behave similarly towards water; some (chromium, molybdenum, titanium) being unacted upon at ordinary temperatures, others (aluminium, beryllium) giving methane. In a recent number of the *Comptes rendus* (February 10), M. H. Moissan gives a detailed account of the preparation and properties of uranium carbide. This substance, which has the composition $C_3.Ur_2$, does not differ to any marked extent in its general chemical and physical properties from other substances of the same class, except in its reaction with water. This gives rise to a complex series of solid, liquid, and gaseous hydrocarbons. Of these, only the last have been completely examined, the analysis of the gaseous mixture showing hydrogen (13 per cent. to 15 per cent.), methane (78 per cent. to 80 per cent.), and ethylene (5 per cent. to 7 per cent.), together with a trace of acetylene. M. Moissan, remarking on the presence of the hydrogen, points out that this is probably produced by a secondary reaction, the lower oxide of uranium being able to decompose water. The acetylene also is stated to be probably due to the presence of a little calcium carbide as an impurity.

THE researches of M. Guntz, on the preparation of metallic lithium and its nitride, have led to the discovery of a hydride of this metal possessing some remarkable properties. Wishing to heat some lithium in a current of an inert gas, and nitrogen being obviously excluded, some lithium was raised to a bright red heat in a current of hydrogen, when, much to the astonishment of M. Guntz, the whole caught fire and burnt with flame in the tube, depositing a white powder, and leaving no trace of unburnt lithium. On analysis this proved to have the composition LiH, and is noteworthy as giving the maximum weight of hydrogen on treatment with water for minimum weight of substance, one kilogram giving 250 grams, or 2780 litres of hydrogen. It is not deliquescent, and alters very slowly in air, and is stable at a full red heat, thereby differing from the previously known hydrides of the alkali metals. Heated in a current of nitrogen converts LiH into Li_3N.

THE additions to the Zoological Society's Gardens during the past week include a Lion (*Felis leo*, ♂) from Africa, presented by Mr. Rowland Ward; a Common Squirrel (*Sciurus vulgaris*), British, presented by Mrs. Herbert Morris; a Woodlark (*Alauda arborea*); a Whinchat (*Pratincola rubetra*), British, presented by Mr. J. Young; a Black Tanager (*Tachyphonus melaleucus*) from South America, presented by Madame Caté; a Rhinoceros Hornbill (*Buceros rhinoceros*, ♂) from the Malay Peninsula, deposited; two Black-necked Stilt-Plovers (*Himautopus nigricollis*) from South America, a Long-eared Owl (*Asio otus*), two Common Pheasants (*Phasianus colchicus*, ♀ ♀), British, purchased.

OUR ASTRONOMICAL COLUMN.

CASSEGRAIN AND GREGORIAN REFLECTORS.—For some time past, Prof. Schaeberle, of the Lick Observatory, has been experimenting on the applications of these rather neglected forms of reflecting telescopes with the special view of applying them for celestial photography. The field of view in such instruments is darker than in refracting telescopes, and if the mirrors are good, there is every reason to expect that in planetary photography the results obtained by a telescope twelve or fifteen feet in length will be at least equal to those obtained with the most powerful refractors. There is so little published on the theory of the instruments that Prof. Schaeberle has re-investigated the fundamental formulæ, which may be useful to many observers (*Astronomical Journal*, No. 364). In the case of the Cassegrain it is easily shown that the secondary mirror must theoretically be the convex side of an hyperboloid of revolution, while in the Gregorian it must be the concave side of an ellipsoid of revolution; in both cases the axis and focus of the secondary reflector must coincide with those of the primary. If F denote the focal length of the parabolic reflector, H the distance between the centre of the mirror and the secondary focus (being negative when it falls between the two reflectors); the axial radius of curvature of the secondary reflector; L the equivalent focal length of the combination; then, for both forms

$$L = \frac{F}{r}\left\{(F + H) \pm \sqrt{r^2 + (F + H)^2}\right\} \quad . \quad . \quad . \quad (1)$$

$$r = \frac{2LF(F + H)}{L^2 - F^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$H = \frac{r(L^2 - F^2)}{2LF} - F \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

These formulæ refer to the theoretical conditions for perfect definition; in practice, the secondary mirror is so small that for the same value of r, a spherical surface, or a paraboloid, hyperboloid, or ellipsoid, of any eccentricity, gives tolerable images, the size of which may be varied by simply moving the secondary along the optic axis. There will, however, always be a point of best definition; and if this does not give a convenient position for the secondary focus, the eccentricity of the small reflector must be altered by local polishing. The figuring of the secondary mirror is too delicate for direct measurements, and can only be tested in the telescope itself.

WELLS' ALGOL VARIABLE.—Further particulars of the new variable of the Algol type in the constellation Delphinus (NATURE, vol. liii. p. 206) are given in *Harvard Observatory Circular*, No. 5. The observations so far obtained show that its time of minimum, uncorrected for the velocity of light, can be closely represented by the formula J.D. 2412002·5 + 4·8064 E. For nearly two hours before and after the minimum it is fainter than the twelfth magnitude, but it is not yet possible to say how faint it really becomes. The increase of brightness takes place at first very rapidly, but afterwards more slowly, and the full brightness, magnitude 9·5, is reached in about five hours. Numerous photographs indicate that during the four days between the minima, the brightness is sensibly constant. The changes can be explained on the assumption that the star revolves about a relatively dark body, and that it is totally eclipsed at the minimum, the light then, if any, being that of the companion. The conditions are accordingly somewhat similar to those of U Cephei. The new variable is BD + 17° 4367, its R.A. and decl. for 1900 being respectively 20° 33′·1 and + 17° 56′.

THE NEW COMET.—From observations of the new comet, Perrine-Lamp, made on February 15, 16, and 17, the following elements and ephemeris for Berlin midnight have been computed by Dr. Lamp:

T = 1896 January 31·999 Berlin mean time.

$$\left.\begin{array}{rl} \omega = & 358^\circ\ 38'\ 16'' \\ \Omega = & 208\ 36\ 29 \\ i = & 155\ 30\ 15 \end{array}\right\} 1896{\cdot}0$$

$$\log q = 9{\cdot}77022$$

	R.A.	Decl.	Brightness.
	h. m. s.	° ′	
Feb. 27 ..	22 59 40 ...	+ 46 8·7	
,, 29 ...	23 54 31 ...	+ 49 49·2	... 0·9

M. Bigourdan, who observed the comet at Paris on February 16, states that the comet was not then visible to the naked eye, though bright enough to be easily seen in a telescope of 50 mm. aperture. It was observed to be round, about 2′ in diameter, with a diffuse central condensation about 20″ in extent. At the centre of this condensation a small stellar nucleus was occasionally suspected. No tail was visible.

PERRINE'S COMET (1895).—Dr. E. Lamp has drawn our attention to a misprint in the ephemeris of Perrine's comet, given in NATURE on January 23; the declinations throughout should be placed a line lower. Hence our statement last week, that on re-discovery the declination of the comet was a degree in error was unfounded; as a matter of fact, the corrections to the ephemeris were only + 4s. and + 0′·5. The following is a corrected and extended ephemeris:—

	R.A.	Decl.	Brightness.
	h. m. s.	° ′	
Feb. 29 ...	19 46 48 ...	+ 1 55·1	... 0·12
Mar. 4 ...	46 41 ...	3 0·7	... 0·11
,, 8 ...	19 46 16 ...	+ 4 6·7	... 0·10

M. Bigourdan describes the comet as being round, with a diameter of about 50″, and showing a somewhat diffuse nucleus. It is seen with about the same facility as a star of the twelfth magnitude.

MAGNETIC SURVEYS.[1]

ON looking through these two volumes, the first thought that strikes one is that magnetical observations require a great deal of time for reduction and preparation for publication. In the Russian work, this great consumption of time is perhaps to some extent explained by the distance that separates the place of observation from any centre of civilisation, whence the results could be published, and the inevitable difficulties of communication. Perhaps still more is it to be explained by the fact, that several authors have to compile their separate portions under editorial supervision. Still, eleven years does seem a long interval to elapse between the completion of the observations and the distribution of the results to the public. In the Italian work; carried out in the cultured and accessible cities of Italy, six years have sufficed for the reduction and the printing.

This remark must not be construed as expressing any wish to minimise the difficulties that a scientific expedition to the wilds of North-East Siberia must of necessity encounter, or to make light of the dangers that these enterprising officers experienced in their expatriation, cheerfully endured for scientific ends. One disaster that these scientific experts had to undergo may be mentioned, as it illustrates not only the severities under which they were placed, but the readiness of resource with which they remedied the mishaps, far away from trained workmen and mechanical apparatus. On August 6, 1882 (about the time of the Fort Rae Expedition, it may be remarked), when nearing their destination, they experienced a north-east storm of more than an unpleasant character, which carried their craft on to the rocks, and tumbled their apparatus into the water. The chest containing the instruments for observing the magnetic variation at Ssagastyr (Long. E. 8h. 26m.; Lat. 73° 23′ N.) remained some hours at the bottom, before it could be successfully landed,

[1] "Beobachtungen der Russischen Polarstation an der Lenamündung." I. Theil Astronomische und Magnetische Beobachtungen 1882–1884." Bearbeitet von V. Fuss, F. Müller und N. Jürgens. Herausgegeben von Dr. A. v. Tillo, 1895.

"Misure Assolute degli Elementi del Magnetismo Terrestre, eseguite in Italia negli anni 1888 e 1889 dal Dott. Luigi Palazzo." (Roma, 1895.)

and when opened, on September 6, it presented a gruesome spectacle. The magnets were covered with rust, the wood-work was swollen and would not fit the joints for which it was intended, the wires in the eyepieces missing, silvered mirrors spoilt, and other horrors which it can be imagined scientific apparatus would present after such treatment. All the damages had to be remedied on the spot by their own ingenuity, while, to add to their distress, they lost by the upset much of their petroleum, and had to reduce their light. Nevertheless, in the early days of November, all repairs were effected and the instruments ready for work.

The results of the expedition are practically divided into three parts. In the first, which is more especially under the superintendence of M. V. Fuss, are given the description of the method and the results of the observations at numerous stations for the determination of geographical position. These observations have not been made with that rigorous accuracy to which we are accustomed in inquiries that have for their aim the discussion of the variations of latitude. They are rather field observations, made with the sextant, and instruments possessing similar accuracy, and are no doubt very useful in constructing maps of a practically unknown country. In the same way with the longitude determinations, there is no electrical communication between these places, of which Jakutsk is possibly the only one that would be recognised by the ordinary English reader. A few box chronometers were carried from station to station to determine the difference of local time. Moon culminations and occultations were also employed, and, strange to say, eclipses of Jupiter's satellites. Nothing is said about the errors of the tables or the corrections that have been applied to remove those errors, but the results agree fairly well with other methods. Possibly those observations only have been used, which coincided with others made in a known longitude; but since the whole chain is made to depend for absolute longitude on that of a station at Jakutsk, determined on the occasion of the eighteenth century transits of Venus, and now unrecognisable, they do not probably interfere much with the final accuracy. The outcome of the inquiry is to give us more or less trustworthy positions of some twenty-four stations ranging between 8h.–9h. east longitude from Greenwich, and from 60°–74°, north latitude.

In the next section, under the superintendence of MM. N. Jürgens and F. Müller, are presented the results of the magnetical observations. M. Müller's part is more particularly confined to deriving the elements of the earth's magnetism at a considerable number of stations, all in North-East Siberia, by a few observations of the declination, dip, and horizontal force at each. M. Jürgens took charge of the Ssagastyr station, where, in greater detail, he sought not only the absolute force, but the hourly variation of the magnetic elements. M. Müller, as his share, is able to present a table in which, for seventeen stations, the three elements have been fairly well determined, while in twenty-eight more or less complete observations have been made. From November 1882 to June 1884, M. Jürgens' department made hourly observations of the declination, and of the horizontal and vertical force, and on selected days observations at every five minutes. The instruments appear to have been critically examined, and the results of an inquiry conducted so far away from beaten tracks possesses a special interest.

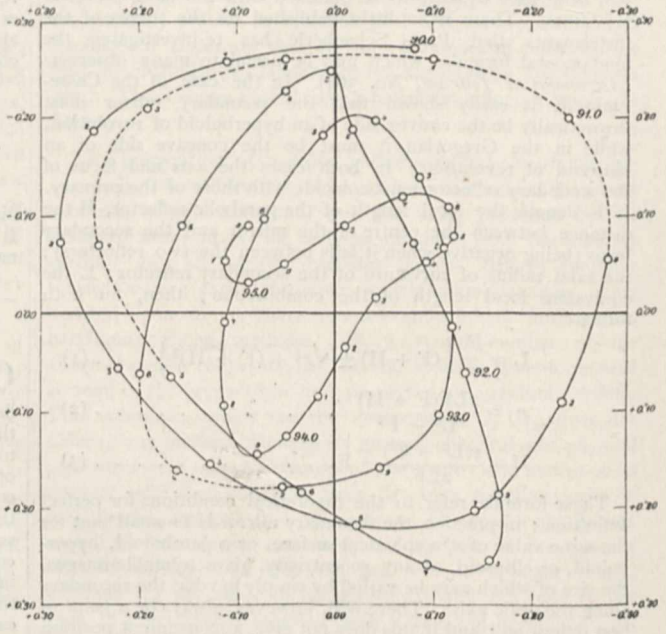
Advantage was taken of the peculiar position to make some observations on the aurora as to its form, colour, direction, and altitude. These will be found in what may be called the third section, together with the history of the expedition written by Dr. A. Bunge, wherein will be found many interesting remarks on a country but little known. The climate, the native inhabitants, the flora and fauna of the district, all come more or less under his observant notice, and are treated easily and pleasantly.

In the second work the element of adventure is, of course, wanting, and, with greater ease, Dr. Palazzo has been able to collect his data from various points on the Italian Peninsula, in such a way as to present a tolerably complete magnetic survey of the whole country. A chain of stations has been selected, starting from Rome and proceeding south-east past Naples towards Brindisi. Other positions have been occupied on the Adriatic coast, including one in the Tremiti Isles; while another group occupies the north-east, and includes Venice, Ravenna, and other well-known places. The entire series includes twenty-two stations. Dr. Palazzo has devoted great attention to the form of his instruments, and has been alive to the importance of deriving the instrumental constants with accuracy. His method of procedure is set out at length in the first part of his paper. In the second part, the details of his observations are given. On the average, these do not extend over more than two or three days at each station, which have sufficed for the determination of the declination by observing azimuths of the sun. The horizontal force has been obtained by the method of counting the number of oscillations made by the magnet in a given time. These in connection with the dip, also derived at each of the stations, have permitted him, in the usual method, to derive the vertical force and total intensity. The whole operation and deductions are conveniently exhibited in symmetrically arranged tables.

THE MOVEMENTS OF THE TERRESTRIAL POLE DURING THE YEARS 1890–95.

TOWARDS the latter end of last year Prof. Albrech gave a preliminary account of the, then, known movements of the terrestrial pole at the eleventh general conference of the "International Erdmessung." Since that date he has made a more definite investigation, the results of which will be published in the *Verhandlungen der Berliner Conferenz;* but as this will not just yet appear, he gives in the current number of the *Astr. Nach.* (No. 3333) a brief summary of the results.

The observations have been made at several observatories, namely, Kasan, Pulkowa, Prag, Berlin, Bamberg, Kiel, Karlsruhe, Strassburg, New York (Columbia College), and Bethlehem, also at the Military Geographical Institute in Vienna, the



Curve showing the relation between the *mean* and *apparent* positions of the pole during the years 1890-95.

Geodetic Institute in Potsdam, and at the American Coast and Geodetic Survey.

Prof. Albrech has not, however, used all the observations in the discussion, but enough "um den Versuch einer Ableitung der Bahn des Pols für den ganzen fünfjährigen Zeitraum mit Aussicht auf Erfolg durchführen zu konnen."

The method of computation adopted was somewhat analogous to that employed by Kostinsky in 1893. Commencing with the monthly observed mean from each station, the deviations $(\phi - \phi_0)$ of the instantaneous pole elevations from a very accurate mean value were graphically formed for every tenth part of the year; a system of coordinates was also arranged in which the positive-axis of x pointed towards Greenwich, that of y 90° to the westward, the origin coinciding with the mean position of the pole.

In this way Prof. Albrech obtained a series of points, which, when plotted out and connected together by means of a curve, would show the relation of the position of the terrestrial pole, at any moment during the interval covered by the observations, to its mean position.

The accompanying curve is a reproduction of that given by Prof. Albrech.

It will be seen that the curve commences moving round the origin of coordinates, gradually closing up, and becoming more elongated in form, the difference between its instantaneous and mean positions decreasing up to 1895 very perceptibly. The dotted path is traced through points which have been interpolated, and which could not be directly obtained owing to insufficiency of observations.

The general trend of the plotted points indicates an unmistakable decrease in the amplitude during the five years of observation, and, as Prof. Albrech points out, the movement is by no means simple, but necessitates the presence of more terms in the expression for representing this motion.

The communication concludes with a table giving the values for every 30° of longitude of the terms

$$x \cos \lambda + y \sin \lambda$$
$$\text{and } y \cos \lambda - x \sin \lambda$$

for the different epochs in connection with the three equations for calculating the variations in the altitude, azimuth, and longitude, namely,

$$\phi - \phi_0 = + x \cos \lambda + y \sin \lambda$$
$$\alpha - \alpha_0 = + (y \cos \lambda - x \sin \lambda) \sec \phi$$
$$\lambda - \lambda_0 = - (y \cos \lambda - x \sin \lambda) \tan \phi$$

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. J. J. Thomson, F.R.S., has been appointed Rede Lecturer for the present year.

The Natural Sciences Tripos will begin on May 27, and the various practical and oral examinations will not be concluded until June 16.

Prof. Ramsay, F.R.S., has been appointed an Elector to the Jacksonian Professorship of Natural Philosophy, now held by Prof. Dewar, F.R.S.

A meeting of members of the Senate, presided over by the Provost of King's, was held on Saturday last, at which resolutions were passed unanimously in favour of granting a titular recognition (such as an honorary B.A.) to qualified women, and against conceding anything that might lead to the transformation of Cambridge into a "mixed" University.

SIR HENRY ROSCOE has been elected Vice-Chancellor of the University of London, in the place of the late Sir Julian Goldsmid. Mr. F. V. Dickins, the Assistant-Registrar, has been elected Registrar, in the place of Mr. A. Milman, retired.

WE have received a combined Calendar, History, and General Summary of Regulations of the Department of Science and Art (1896). From the statistics therein given it appears that there are 2889 Science and Art Schools in the United Kingdom, and that they contain among them 167,822 students in science classes, and 132,256 students in art classes.

THE fourth annual Report of the Technical Instruction Sub-Committee of the City of Liverpool, which deals with the work accomplished by them during 1895, is eminently satisfactory. Abundant evidence is furnished that great things have been accomplished in Liverpool during the past year. Preliminary steps have been taken towards the erection of a central institution for the accommodation of evening science and technological classes. Three organised day science schools have been established; and a school of applied arts has been called into existence. An electro-technical department, evening courses of advanced work in the engineering laboratories, a special department deaiing with the science and art of education, have all grown up at the University College of the city as a result of the assistance given by the Technical Instruction Sub-Committee. But the difficulty arising from insufficient previous education, which is hampering the work of similar Committees in all parts of the country, is very much felt in Liverpool. The Chairman reports: "Institutions which were founded to give a strictly technical education have had, in many cases, to enlarge their borders, and provide preparatory departments or classes, in which to prepare students, by a general preliminary training, to take proper advantage of the special technical teaching." We cordially commend the following decision of the Liverpool Committee to all whom it may concern: "Partly on this ground, but still more from a conviction that the best preparation for commercial pursuits—the staple 'industry' of Liverpool—is to be found in a thoroughly good modern general education, the Committee have sought to encourage and assist the public secondary schools of the city to adapt themselves to give such an education."

The variegated nature of the technical education which has been developed throughout the country as a result of the Acts dealing with the question, is strikingly apparent to us each time we receive a new report. Though that of Liverpool is so satisfactory as a whole, its list of "technical" subjects emphasises this point yet again. On p. 49 of the Technical Instruction Committee's report, we find they encourage the teaching (amongst a large number of other subjects) of singing and musical notation, instrumental music, type-writing, tailors' work, cabinet-making, ship carpentry and joinery, and so on. The extraordinary thing is, in view of the express clause of the Technical Instruction Act, 1889, "that technical instruction shall not include teaching the practice of any trade or industry, or employment," that the Science and Art Department should sanction such subjects as these.

SCIENTIFIC SERIALS.

Bulletin de la Société des Naturalistes de Moscou, 1895, No. 1.—The vascular cryptogams of the Middle Urals and the surrounding territory, by P. W. Ssüsew (in German). The ferns which freely grow in the shadow of the pine forests of the Urals, make a substantial and most picturesque part of the flora of the country. The most common species are:—*Polypodium dryopteris*, *Phegopteris polypodiodides*, *Athyrium filix femina*, *Asplenium crenatum*, *Aspidium spinulosum*, &c. In the stony parts of the highlands one finds the elegant species of *Allosurus*, *Woodsia*, *Asplenium ruta muraria*, *A. viride*, *A. septentrionale*, and many others, which disappear already at a short distance from the Ural range, although the conditions for their growth seem to be the same. Latest research has shown that only three species, characteristic of the Northern Urals, do not appear in the middle and southern parts of these mountains. Forty-seven different species are described.—On adhesion between metals, glass, and different other substances, by J. Weinberg (German). The observations of M. Charles Margot are discussed, and the author shows that the different degrees of adhesion between different substances agree with his molecular formula.—From the shores of the Mediterranean, by H. Trautschold (in German). The structure of the conglomerates and other deposits on the shores of the Mediterranean Sea at Nizza is discussed in order to show that the phenomena are best explained by a retreat of the sea, but do not agree with an upheaval of the coast.—*Lanius eleagni*, a new species, akin to *Otomela Bogdanowii*, Bianchi, by P. Suschkin.—The tail-organ of the *Raja*, by N. Iwanzoff (in German), with three plates. Detailed anatomical work, in which the difficulties that the pseudo-electrical organs of fishes are supposed to offer to Darwin's theory are discussed and explained.—On the *Libellulideæ* of Poltava and Kharkov, by V. N. Roozianko (in Russian). Fourteen species are described.—Catalogue of the fungi of Smolensk, by A. A. Jaczewski (in Russian). Two hundred and fifty-four species are enumerated. The author makes the remark that the forests are extremely rich in species of *Russula*, and that all the species of this genus, without exception, are used for food by the peasants, but that cases of poisoning are never heard of. He makes the suggestion that perhaps the poisonous species, *Russula emetica* and *R. rubra*, are very rare (each was found only once); but altogether it must be supposed that the manner of cooking destroys their poisonous properties, if they exist—a question which well deserves scientific investigation.—List of members.

Bollettino della Società Sismologica Italiana, vol. i., 1896, No. 8.—The Cecchi microseismograph, by G. Giovannozzi. The first description of the instrument published in a scientific journal.—Hydrothermal observations at Fiumecaldo (Catania) in May and June 1895, by C. Guzzanti.—Notices of Italian earthquakes (June–July 1895), the more important being the Venetian and Lubiano earthquakes of June 10, and the disastrous earthquake which occurred on the east coast of the Caspian Sea during the night of July 8–9. Copies of two of the microseismographic records of the latter earthquake obtained at Rome are given.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 12, 1895.—"Impact with a Liquid Surface, studied by means of Instantaneous Photography." By Prof. A. M. Worthington, F.R.S., and Mr. R. S. Cole.

This communication was the first instalment of a review by the aid of instantaneous photography of the ground covered by three previous papers (*Roy. Soc. Proc.*, vol. xxv. pp. 261 and 498, 1877, and *ibid.*, vol. xxxiv. p. 217, 1882), in which the phenomena that accompany various kinds of splashes are described. The advance made lies in the unquestionable accuracy and fullness of detail of the information now afforded.

Chemical Society, February 6.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—The molecular weight and formula of phosphoric anhydride and of metaphosphoric acid, by W. A. Tilden and R. E. Barnet. Vapour density determinations of phosphoric anhydride show that it has the molecular composition P_4O_{10}; metaphosphoric acid, which partially dissociates into water and the anhydride on heating, is similarly shown to have the formula $H_2P_2O_6$.—Lead tetracetate and the plumbic salts, by A. Hutchinson and W. Pollard. Lead tetracetate, prepared by dissolving red lead in acetic acid, crystallises in monosymmetric needles. Lead tetraphosphate and tetrapropionate have also been prepared.—An improved method of determining urea by the hypobromite process, by A. H. Allen. The incomplete evolution of nitrogen occurring when hypobromite is added to urea may be avoided by mixing potassium cyanate with the urea solution; it is also preferable to run the urea and cyanate solution into the hypobromite instead of *vice versâ*.—Preliminary note on the absorption of moisture by deliquescent salts, by H. W. Hake. The author has determined the amount of water absorbed by exposing deliquescent salts to the air, and finds that in many cases the amount of water taken up points to the formation of a definite hydrate.—Some derivatives of γ-phenoxyethylmalonic acid and of γ-phenoxyethylacetic acid, by W. H. Bentley, E. Haworth, and W. H. Perkin, jun.—Note on the preparation of glycol, by E. Haworth and W. H. Perkin, jun.—Luteolin, by A. G. Perkin. Luteolin, the yellow colouring matter of Weld (*Reseda luteola*), has the composition $C_{15}H_{10}O_6$, combines with mineral acids, and yields tetracidic derivatives; it seems to be allied to its isomeride fisetin.—An examination of the products obtained by the dry distillation of bran with lime, by W. F. Laycock. On distilling bran with quicklime an aqueous and oily distillate is obtained, which contains ammonia, ketones, ethylic alcohol, pyridines, pyrrolines, furfuranes, hydrocarbons, and an indole.—Constitution of glycocine, by Jōji Sakurai.

Entomological Society, February 5.—Prof. Raphael Meldola, F.R.S., President, in the chair.—The President announced that he had nominated Dr. D. Sharp, F.R.S., Mr. Roland Trimen, F.R.S., and Mr. Walter F. H. Blandford, Vice-Presidents for the Session 1896–97.—Mr. Waterhouse exhibited pupæ and portions of pupæ of a silk moth, *Antheræa mylitta*, selected from some scores of specimens, which he had opened to see if they showed stages of development agreeing with the examples given by Dr. Spuler. The results appeared to confirm Dr. Spuler's researches; some specimens showed the tracheæ, the median vein having two branches, very rarely emitting a third branch in the direction of the radial. Other specimens had faint indications of the veins and of the discoidal spot of the imago. Even at this very early stage the vein branching from the subcostal vein to unite with the upper radial, and the short branch uniting the second median vein with the third median were distinctly traceable, no tracheæ being yet visible in these branches. Mr. Merrifield, Mr. Hampson, and Dr. Sharp took part in the discussion which ensued.—Mr. E. E. Green remarked that in the *Trans. Ent. Soc.*, 1881, p. 601, there was a short paper by the late Prof. J. O. Westwood, describing a curious little insect from Ceylon under the name of *Dyscritina longisetosa*. Prof. Westwood believed his typical specimens to be immature. Mr. Green exhibited what he supposed to be a later stage of the same species. He said his example differed in some particulars from Westwood's description and figure—notably in the proportions of the caudal appendages. Prof. Westwood pointed out the affinities of *Dyscritina* to the Forficulidæ. This was very apparent in the specimen under consideration. Putting aside the nature of the caudal appendages the insect was in all particulars an earwig. The present specimen was taken in the Punduloya district of Ceylon, at an elevation of about 4000 feet. Mr. Green said he had more than once seen this insect under loose pieces of bark and in crevices of rocks, and had always been struck by its likeness to an earwig both in appearance and habits. Mr. McLachlan, F.R.S., Dr. Sharp, Mr. Gahan, Mr. Blandford, and Mr. Hampson made some remarks on the subject.—Mr. O. E. Janson exhibited a Goliath beetle, from the Upper Congo, which he believed to be the male of *Goliathus rusus*, Kolbe, described from a unique female example in the Berlin Museum.—Mr. Blandford called attention to the case of the eye of a boy affected with inflammation caused by the hairs of the larvæ of *Lasiocampa rubi*. The attack recurred after an interval of nineteen weeks, and in several continental cases this recurrence of the attack had been found to take place, and in some cases permanent injury to the eye had followed. Mr. Blandford discussed the various kinds of hairs on several caterpillars, certain species having hairs of two kinds, one kind being barbed, and thus having the power to work into the skin. He said that the urticating property of the hairs appeared to be mechanical: there was no evidence of any poison glands. Mr. Lawford said he had had some difficulty in discovering hairs in the lid, and he thought that the symptoms in the case in question were not to be explained by mechanical irritation due to the presence of hairs in the tissues. The subject was a new one to him, and he had looked up all the medical literature bearing on it. Lord Walsingham, F.R.S., Mr. Tutt, Prof. Poulton, F.R.S., Canon Fowler, and Mr. Jacoby made some remarks on the subject.—Dr. F. A. Dixey read a paper entitled "On the Relation of Mimetic Patterns to the Original Form." The paper was illustrated by a number of coloured diagrams. Prof. Poulton expressed his gratification with the paper, and that the Hope Collection under his charge had afforded material for the work. He thought the result of the paper was to give support to the theories of Fritz Müller rather than to those of Bates. Mr. Blandford, Mr. Tutt, and Prof. Meldola continued the discussion.—Dr. Sharp contributed a paper entitled "The Rhynchophorous Coleoptera of Japan. Part iv."

Linnean Society, February 6.—Mr. C. B. Clarke, F.R.S., President, in the chair.—Sir W. H. Flower, K.C.B., F.R.S., presented to the Society, on behalf of the subscribers, a portrait of Mr. William Carruthers, F.R.S., a former President of the Linnean Society, painted by Mr. J. Hay. At the motion of Mr. J. G. Baker, F.R.S., it was resolved that the portrait be accepted, and that a cordial vote of thanks to the donors be recorded.—Prof. C. Stewart exhibited a series of dissections of skulls, illustrating the development of air cavities. The skull of a herring, carefully dissected to show the relations of the ampullæ of the pneumatocyst to the cranial bones; of a crocodile, to show those of the extra tympanic cavity and siphonium; of a rook, to show the limitations and relationships of the vesicular and other strata of the cranial roof; and of a chinchilla and a *Phascolarctus*, to illustrate the variations and development of the "bulla" and of its associated structures, were the chief objects shown. Prof. Stewart expressed himself favourable to the belief that the parts mentioned in the herring are functional for acoustic purposes. In this he was supported by Prof. Howes, who referred in detail to the arrangements occurring in *Hyodon* and *Myonomyrus* as substantiating this conclusion.—On behalf of Mr. B. G. Cormack, Dr. D. H. Scott gave the substance of a paper on polystelic roots of certain palms. He remarked that with scarcely any exception roots show one normal vascular bundle or stele. The author, utilising material from Ceylon, found that in *Areca Catechu*, Linn., *Cocos nucifera*, Linn., and a species of *Verschaffeltia*, the young roots agree with this condition, but on examining older and thicker portions of the same roots, he found many steles present. After discussing the origin of this, the author considered the change to be primary, not secondary, and suggested that these roots might serve as props to the stem. The paper was criticised by Mr. George Murray and Prof. Trail, Dr. Scott replying to objections. Mr. R. Morton Middleton then read a paper on a remarkable use of ants in Asia Minor, communicated by Mr. Miltiades Issigonis, of Smyrna. It was stated that the Greek barber-surgeons of the Levant employed a large species of ant for the purpose of holding together the edges of an incised wound. The ant, held with a forceps, opens its mandibles wide, and being then permitted to seize the edges of the cut, which are held together for the purpose, as soon as a firm grip is obtained the head is severed from the body. Mr. Issigonis had seen natives with wounds in

course of healing, with the assistance of seven or eight ants' heads. The species of ant referred to was a large-headed *Camponotus*, not unlike one found in India. Mr. Middleton recalled the fact that a similar observation, concerning a species of ant in Brazil, had been recorded many years ago by Mr. Mocquerys, of Rouen (*Ann. Soc. Entom. France*, 2me sér. ii. 67), as quoted by Sir John Lubbock in his work on ants, bees, and wasps; but the observation, strange to say, had not been confirmed either by Bates or Wallace during their travels in South America. Dr. John Lowe pointed out that in this operation apparently no attention was paid to the usual antiseptic precautions which are regarded as indispensable in modern surgery. Sir William Flower considered the observation of much interest from an ethnological point of view, as showing the independent existence of the same custom in countries so far apart as Brazil and Asia Minor.

Mathematical Society, February 13.—Prof. M. J. M. Hill, F.R.S., Vice-President, in the chair.—The Chairman read the opening paragraphs of a paper by Prof. Forsyth, F.R.S., entitled "Geodesics on a Quadric, not of Revolution."—Prof. Elliott, F.R.S., gave an account of a paper by Mr. A. L. Dixon, on the potential of cyclides.—Mr. Love, F.R S. (Hon. Sec.), communicated a paper on solid ellipsoidal vortex, by Mr. R. Hargreaves.—Dr. J. Larmor, F.R.S., and Lieut.-Colonel Cunningham took part in the discussions on the papers.—The Chairman (Mr. M. Jenkins, Vice-President *pro tem.*, in the chair) and Mr. Tucker (Hon. Sec.) made short impromptu communications. The latter was to the effect that if any square PQRS be inscribed in a circle ABC, and the Wallace lines of P, Q, R, S, with regard to the triangle ABC be drawn, they form by their intersection a quadrilateral the mid-points of whose *three* diagonals are the centre and ends of a diameter of the nine-point circle of ABC.

Zoological Society, February 18.—Prof. G. B. Howes in the chair.—A communication was read from Dr. Arthur G. Butler on the butterflies obtained in Arabia and Somaliland by Captain Charles G. Nurse and Colonel J. W. Yerbury in 1894-95.—A communication was read from Lord Walsingham, F.R.S., and Mr. G. F. Hampson, on the moths collected at Aden and Somaliland by the same naturalists and by other collectors.—Mr. F. E. Beddard, F.R.S., communicated (on behalf of Miss Marion Newbigin) a paper dealing with the metallic colours of humming-birds and sun-birds. It had been held that these peculiarly coloured feathers played some special part in the economy of the bird, for they could not be of much use for flight owing to the disconnected barbules. The author combated this view, pointing out in the first place that the statement of fact did not apply to all humming-birds, in the metallic feathers of which the barbules were often connected by cilia. It was urged in the next place that the very perfection of the flight of humming-birds led to correlated variations in feather structure productive of their especially brilliant metallic tints. The difficulty of the plain-coloured swifts—possibly near allies of the humming-birds—was met by the suggestion that the latter have fewer enemies, and had therefore had greater scope of possible colour-variation.—Mr. C. W. Andrews read a note on a skull of *Orycteropus gaudryi*, an extinct species of ant-bear from the Lower Pliocene deposits of Samos, originally discovered and described by Dr. C. J. Forsyth-Major.—Mr. Frank E. Beddard, F.R.S., read a paper upon the anatomy of the Scissor-bill (*Rhynchops*), in which the structure of the viscera and muscles of this bird were described. The muscular anatomy was found to differ greatly from that of the gulls, skuas, and terns, and was held amply to justify its separation as a distinct subfamily *Rhynchopinæ*.

PARIS.

Academy of Sciences, February 17.—M. Cornu in the chair.—Preparation and properties of cerium carbide, by M H. Moissan. This substance, of which the composition is CeC_2, is produced in the electric furnace from charcoal and CeO_2. Its properties and reactions are similar to those of other carbides previously described, water, however, giving a gas containing ethylene (4 per cent.), methane (21 per cent.), and acetylene (75 per cent.), the composition of the gas obtained in different experiments being very constant. A small proportion of the carbon is obtained in the form of liquid and solid hydrocarbons.—On carbide of lithium, by the same. This carbide, LiC_2, forms a transparent crystalline mass, which, on account of its high percentage of carbon (69 per cent.), acts as a powerful reducing agent. It is volatile at the temperature of the electric furnace, with partial decomposition into its elements, and on treatment with water yields pure acetylene.—Observations of the Perrine comets (*a* 1896 and *c* 1895) made at the Observatory of Paris, by M. G. Bigourdan.—Observations on the Perrine comet made with the large equatorial at the Observatory of Bordeaux, by M. L. Picart.—On the integration of some partial differential equations, by M. Le Roy.—On Taylor's theorem, with approximation to the third degree, by M. N. Bougaief.—On groups of substitutions, by M. A. Miller.—On sensitive flames, by M. E. Bouty. A study of the influence of the nature of the gas on the sensibility to sound. The sensitiveness of a pure hydrogen flame is very small, but it can be increased by the addition of a sufficient proportion of an inert gas, such as nitrogen or carbon dioxide. Pure acetylene gives only a moderately sensitive flame, but a mixture of equal volumes of hydrogen and acetylene responds readily to the ticking of a watch.—On the lowering of the statical and dynamical explosive potentials by the X-rays, by M. R. Swyngedauw.—Electric phenomena produced by the Röntgen rays, by M. A. Righi.—Action of the Röntgen rays on the electrostatic charges and the explosive distance, by MM. J. J. Borgman and A. L. Gerchun.—New researches on the X-rays, by MM. Benoist and D. Hurmuzescu.—Photographic researches on the Röntgen rays, by MM. Auguste and Louis Lumière.—An experiment showing that the X-rays proceed from the anode, by M. de Heen.—Photographs obtained with the Röntgen rays, by MM. A. Imbert and H. Bertin-Sans.—On the property possessed by phosphorescent rays of passing through bodies opaque to solar light, by M. G. H. Niewenglowski.—Nature and properties of dark light, by M. Gustave Le Bon.—Photographic prints obtained in the dark, by M. A. Briançon.—On a rapid method for the estimation of arsenic, by MM. R. Engel and J. Bernard. The arsenic is precipitated in hydrochloric acid solution by hypophosphorous acid, and titrated with standard iodine solution in presence of sodium bicarbonate. The results of the test analyses are satisfactory.—Partial synthesis of geranic acid and constitution of lemonol and lemonal, by MM. P. Barbier and L. Bouveault.—On some derivatives of eugenol, by M. Ch. Gassman.—On the composition of fire-damp, by M. T. Schlœsing, jun. A careful examination of the combustible gas in sixteen samples of fire-damp, from various mines, showed that in thirteen cases the hydrocarbon was pure methane; in the other three, besides methane, traces of ethane (from 2–4 per cent.) appeared to be present.—Walking and running *en flexion*, by MM. Comte and Regnault. A study of a new method of walking and running called *en flexion*, on account of a sudden bend of the knee at a particular point of the stride. It is shown that in this method, which has already been proved to be of great practical advantage in the movement of troops, the vertical oscillations of the body are rendered more gradual, besides being reduced in magnitude. A dynamographic study of the variations of the pressure on the feet also brings out the same point, sudden variations of pressure disappearing from the curve.—On a new application of photography, by M. G. Guéroult.—Some applications of a mode of production of colour, hitherto unexplained, by M. C. Henry.—Undulatory irradiation of luminous impression, by M. A. Charpentier.—Assimilation and activity, by M. P. Vuillemin.—On an epidemic of pneumonia of the hare, caused by *Strongylus retortæformis*, Zeder, by M. E. Yung.—The lacunar apparatus of the starfish, by M. L. Cuénot.

BERLIN.

Physiological Society, January 10.—Prof. Munk, President, in the chair.—Dr. Joachimsthal spoke on a supposed self-regulative process in muscles as based on the observation that the calf-muscles are long and thin in negroes, but short and thick in whites. This depends on the relative lengths of the calcaneum. In the negro the muscle is inserted on a longer arm of this bone, and this necessitates a more extended contraction of the muscle; in a white man the arm is shorter, but this requires a correspondingly greater force, and hence the muscle is shorter and thicker. An experiment had been made by Marey on rabbits with reference to the above, and the speaker described some recently made by himself on a cat in support of his views. In the subsequent discussion considerable objection was raised against the validity of the experiments, some of the results being attributed to muscular atrophy.—Prof. Zuntz reported on experiments made by Dr. Lewin, of New York, in which, using a dog, the stomach had been connected directly with the intestine so as

to exclude that portion into which the ducts of the liver and pancreas open. He then fed the animal on cream, and found that in no single case was any of the emulsified fat absorbed.—Dr. R. du Bois Reymond exhibited a number of Röntgen photographs.

January 24.—Prof. du Bois Reymond, President, in the chair.—Dr. Apolant spoke on the ciliary ganglion, which has at one time been regarded as a spinal, at another time as a sympathetic structure, these views being based on anatomical, morphological, embryological and physiological researches. Of late years it has been shown by stimulation that this ganglion is in the closest relationship to the oculomotor nerve, and the speaker had made experiments on cats and found that the degeneration set up by section of this nerve progresses only as far as the cells of the ganglion; whereas the latter, as well as the ciliary nerves which spring from them, remain intact. He hence concluded that the ganglion belongs to the sympathetic system.—Dr. Rawitz described how he had, by means of his new method of staining, investigated the attraction-spheres in the testicular cells of salamander maculosa during the first stages of division. He found that the sphere, which is stained dark by alizarin, becomes larger and stains less deeply, after which amœboid processes make their appearance on its surface. These then separate off in a globular form, whereby the sphere becomes divided up into some six or nine small dark spherules. Later on the central zone of the sphere becomes elongated, oval, and spindle-shaped, the spherules arranging themselves longitudinally in the axis of the spindle. After this the central spherules disappear, leaving only the two polar end particles, which then undergo the ordinary well-known later changes. These observations were made on salamanders caught in June; later in the year, the above phases were no longer to be seen.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, FEBRUARY 27.

ROYAL SOCIETY, at 4.30.—On the Spinal-Root Connections and Ganglion-cell Connections of the Nerve Fibres which produce Contraction of the Spleen: Prof. Schäfer, F.R.S., and B. Moore.—A Method for rapidly producing Diphtheria Antitoxines. Preliminary Note: Dr. C. Wood.

ROYAL INSTITUTION, at 3.—Some Aspects of Modern Botany: Prof. H. Marshall Ward, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electric Wiring Question: F. Bathurst.—Concentric Wiring: Sam. Mavor.—High-Voltage Lamps and their Influence on Central Station Practice: G. L. Addenbrooke.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 9.—Marine Organisms and their Conditions of Environment: Dr. John Murray.

PHYSICAL SOCIETY, at 5.—Experiments with Incandescent Lamps: Sir D. Salomons.—The Alternating Current Arc: Messrs. Fleming and Petavel.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Loughborough Sewage-Disposal Works: Arthur S. Butterworth.

SATURDAY, FEBRUARY 29.

ROYAL INSTITUTION, at 3.—Light: Lord Rayleigh, F.R.S.

MONDAY, MARCH 2.

SOCIETY OF ARTS, at 8.—The Chemistry of certain Metals and their Compounds used in Building, and the Changes produced in them by Air, Moisture, and Noxious Gases, &c.: Prof. J. M. Thomson.

SOCIETY OF CHEMICAL INDUSTRY (Burlington House), at 8.—Artificial Silk: Messrs. Cross and Bevan.

VICTORIA INSTITUTE, at 4.30.—Paper by Dr. Guppy.

TUESDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—The External Covering of Plants and Animals: Prof. Charles Stewart.

SOCIETY OF ARTS, at 8.—The Commercial Prospects of English East Africa and British Central Africa: G. Scott Elliot.

ZOOLOGICAL SOCIETY, at 8.—Remarks on the Divergences between the "Rules for Naming Animals" of the German Zoological Society and the Stricklandian Code of Nomenclature (to introduce a discussion on Zoological Nomenclature): P. L. Sclater, F.R.S.—On the Ornithological Researches of M. Jean Kalinowski in Central Peru: Graf Hans v. Berlepsch and J. Stolzmann.—On West Indian Terrestrial Isopod Crustaceans: Adrian Dollfus.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Littoral Drift in relation to River-Outfalls and to Harbour-Entrances: William Henry Wheeler.

PATHOLOGICAL SOCIETY, at 8.30.

ROYAL VICTORIA HALL, at 8.30.—A Visit to the Orkney Islands: J. Saxon Mills.

WEDNESDAY, MARCH 4.

SOCIETY OF ARTS, at 8.—Röntgen's Photography of the Invisible: A. A. Campbell Swinton.

BRITISH ARCHÆOLOGICAL ASSOCIATION, at 8.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—On the Estimation of the Diastatic Power of Malt: Dr. Walter J. Sykes and C. A. Mitchell.—Further Note on the Detection of Formalin: H. Droop Richmond and L. K. Boseley.—The Detection of Formalin: Otto Hehner.—Note on the Detection of Cotton-Seed Oil in Lard: E. J. Bevan.

THURSDAY, MARCH 5.

ROYAL SOCIETY, at 4.30.

ROYAL INSTITUTION, at 3.—Masters of Modern Thought. I. Voltaire: Rev. William Barry.

LINNEAN SOCIETY, at 8.—Segmentally-disposed Thoracic Glands in the Larvæ of Trichoptera: Prof. Gustav Gilson.

CHEMICAL SOCIETY, at 8.—On the Explosion of Cyanogen: H. B. Dixon, E. H. Strange, and E. Graham.—On the Mode of Burning of Carbon: H. B. Dixon.—On the Detonation of Chlorine Peroxide: H. B. Dixon and J. A. Harker.—The Constitution of a New Acid resulting from the Oxidation of Tartaric Acid: H. J. H. Fenton.

SOCIETY OF ANTIQUARIES, at 8.30.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Results of Rain, River, and Evaporation Observations made in New South Wales, 1894: H. C. Russell (Sydney).—Studien zu Methodenlehre und Erkenntnisskritik: F. Dreyer (Leipzig, Engelmann).—The Present Evolution of Man: G. A. Reid (Chapman).—Applied Magnetism: J. A. Kingdon (Alabaster).—By Tangled Paths: H. M. Briggs (Warne).—The Primary Factors of Organic Evolution: Prof. E. D. Cope (Open Court Publishing Company).—Calendar, History, and General Summary of Regulations of the Department of Science and Art, 1896 (Eyre).—British Moths: J. W. Tutt (Routledge).—Résultats de l'Examen de Dix Mille Observations de Hernies: Prof. P. Berger (Paris, Alcan).—The Methods of Microscopical Research: A. C. Cole, 2nd edition (Baillière).—Lehrbuch der Experimental Physik: Prof. E. Riecke (Leipzig, Veit).—Géométrie Descriptive: A. Gouilly (Paris, Gauthier-Villars).—Calendario del Santuario di Pompei, 1896 (Valle di Pompei).—Exercises in Physical Measurement: Drs. Austin and Thwing (Boston, Allyn).—Leçons sur l'Électricité et Le Magnétisme de E. Mascart et J. Joubert, deux edition. E. Mascart, tome premier (Paris, Masson).

PAMPHLETS.—The Ballarat Field (Robertson).—Geological Literature added to the Geological Society's Library during the Year ended December 31, 1895 (Geological Society).—Report of Observations of Injurious Insects, &c., 19th Report: E. A. Ormerod (Simpkin).—Realgymnasium des Johanneums zu Hamburg (Hamburg).

SERIALS.—Royal Natural History. Vol. v. Part 28 (Warne).—Beiträge zur Psychologie und Philosophie, i. Band, i. Heft (Leipzig, Engelmann).—Quarterly Journal of the Geological Society, No. 205 (Longmans).—The Aeronautical Annual, No. 2 (Wesley).—Princeton Contributions to Psychology, January (Princeton).—Psychological Review Index for 1895 (Macmillan).—National Geographic Magazine, February (Marlborough).—Bulletin de l'Académie Royale des Sciences, &c, de Belgique, 1896, No. 1 (Bruxelles).

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