THURSDAY, JANUARY 27, 1898.

THE HOPE DEPARTMENT AT OXFORD.

The Hope Reports. Vol. i., 1893-97. Edited by Edward B. Poulton, M.A., F.R.S., Hope Professor of Zoology in the University of Oxford. (Printed for private circulation.)

SINCE the death of Prof. Westwood and the appointment of his successor, the editor of the volume of Reports under consideration, the Hope Museum has gradually been undergoing expansion and regeneration. The collections are being overhauled and reclassified; the types are being identified as far as possible and carefully labelled, and the special British collections are being rearranged so as to preserve their historical interest. This development of the department under the care of Prof Poulton has been noted with satisfaction by those specialists who from time to time visit Oxford: and although the endowment, both for curatorship and equipment, is very limited, it must be conceded that the present Professor is doing his best to carry out the objects for which a museum of this kind exists, viz. to preserve specimens in such a way as to enable them to be available for use by students with the confidence which attaches to authentic records of date, locality and captor. This, at least, is the ideal which the Professor has set before himself, and it is only a matter of profound regret that the advanced years and declining health of the late distinguished occupant of the Rev. F W. Hope's foundation should have thrown upon his successor such an immense amount of purely mechanical labour. A good beginning has been made with the Lepidoptera with the co-operation of Colonel Swinhoe, Dr. F. A. Dixey, Prof. Sidgwick, and others; but many years must elapse before the other and less favoured groups are reduced to anything like the same degree of order.

The conditions attaching to such an endowment as that of Mr. and Mrs. Hope have with the advancement of science and the increase in the number of private collections undergone complete modification. Although as a collection of insects of all orders the museum as it exists is second only in rank to the National Collection, the means provided are barely sufficient for its maintenance and leave very little for its increase. With such competing forces as the British Museum, Mr. Walter Rothschild's museum at Tring, and the wealth of many other private collectors, it is hopeless to look for any substantial additions to the Oxford collections excepting through individual benefactors. It is very encouraging, therefore, to find in the two official reports of the Professor on the work of his department, that many valuable contributions have been made by entomologists since he came into office, and more particularly may be mentioned the magnificent addition to the butterflies presented by Messrs. Godman and Salvin, which is characterised as "the largest accession to the department during recent years," and which was formally accepted by a decree of Convocation on May 11, 1897, when a further decree conveying the thanks of the University to the donors was also passed unanimously.

The foregoing remarks relate to the work accomplished in the development of the museum as a museum; but there is another side to the work of the Hope Department which must not be lost sight of, and of this side we are reminded by the volume of Reports. This volume is most appropriately prefaced by the portraits of the makers of the department, Mr. and Mrs. Hope and the late Prof. Westwood. In his prefatory remarks the editor says:—

"In the present state of zoological science, it is impossible to make use of existing knowledge in the careful study of a large amount of material without adding to that knowledge. Research after the various kinds of knowledge which have been prized by mankind during successive ages was of old the prominent function of the University; and although obscured during the recent generations by excessive devotion to the examination system, may still be claimed as an academic duty and high privilege second to no other in importance."

With this statement every science worker in this country will agree, and the signs of activity displayed in this new departure on the part of the Hope Professor will be cordially welcomed. The papers composing this volume are sixteen in number, and are reprints of papers which have already appeared in the publications of various societies. For the most part these papers embody "researches" as distinguished from purely descriptive systematic work, and that is why we consider the issue of the volume to mark a new departure. The contents of the various papers are already before the scientific public, and need only be mentioned here. Prof. Poulton's contributions consist of his address to the Zoological Section of the British Association at Liverpool on the age of the earth, his address on "Theories of Evolution" to the Boston Society of Natural History, his paper on Dr. Prichard's anticipation of modern views of evolution, from *Science Progress*, papers on the courtship of European Acridiidæ, and on the sexes of larvæ emerging from successively laid eggs of *Smerinthus populi* from the *Transactions* of the Entomological Society of London, and a paper on the colours of Lepidopterous larvæ derived from plant pigments, from the *Proceedings* of the Royal Society. Dr. F. A. Dixey also presents us with most encouraging signs of scientific activity from the department. Five papers relating respectively to mimicry, to the phylogeny of the Pierinæ, and to the interpretation of Mr. Merrifield's experiments on temperature variation in Lepidoptera are contributed by him. Another set of contributions are from the pen of Mr. Garstang, who writes on the habits and respiratory mechanism of *Corystes*, on the function of the antero-lateral denticulations of the carapace in sand-burrowing crabs, and on the morphology of the Mollusca. Mr. Garstang's papers on Crustacea should be read by all who are interested in the question of the utility of specific characters. The only paper approaching systematism is by Mr. Schaus, who gives a list of Mr. Walker's American types of Lepidoptera in the museum, and for this lepidopterists on both sides of the Atlantic will be grateful.

It will be gathered from this notice that the Hope Professor has rendered a good account of his office since his appointment. The plan of issuing such Reports,

which has been adopted from the example set by the Linacre Professor, is an excellent one, and cannot but help to keep alive the public interest in the work of the department. With the lapse of time and the arrangement and coordination of the collections we may look for further contributions from Prof. Poulton himself in those branches of insect bionomics with which his name is so widely connected. R. M.

WEAPONS OF EARLY MAN IN BRITAIN.

The Ancient Stone Implements, Weapons, and Ornaments of Great Britain. By Sir John Evans, K.C.B. Second edition. Pp. xviii + 747. (London: Longmans, Green, and Co., 1897.)

FOR some years past it has been felt by students of anthropology that the limits of their science were being pushed so far in every direction by various enthusiastic workers in almost every country of the inhabited world, that it was high time for some competent hand to gather together the facts which lay scattered broadcast in the publications of learned societies and private students, so that they might be available for general use in a collected form. It seems that this idea also filled the mind of one, at least, of our veteran teachers, and the result of its existence is the second edition of Sir John Evans' famous work on the "Ancient Stone Implements, Weapons, and Ornaments of Great Britain." It is now some twenty-five years since the first edition of this valuable book saw the light, and the accuracy and plain statement of facts, which were its chief characteristics, secured for it at once a place of high authority. In those early days of the history of British stone-lore scientific collectors of facts were few, and men like the late Sir Wollaston Franks, the Rev. William Greenwell, and Mr. J. Anderson of Edinburgh, who attempted to arrange their specimens with a proper regard to hard facts, were looked upon with suspicion by a large mass of collectors and "antiquaries" whose chief interest in antiquities lay not in the objects themselves, but in the wonderful stories which they could tell about them. A visit to certain local museums not many scores of miles from London will to this day show what measure of learning was possessed by those who labelled and arranged them about thirty years ago, and we make bold to say that general ignorance and specific blunders in such matters can only be cleared away by the publication of good works, such as that before us, written in plain language and published at a reasonable price.

Sir John Evans' book is so well known that it would be a waste of the reader's time to attempt to describe it here, but it will not be out of place to note wherein the second edition differs from the first. Many of the excellent illustrations by Mr. Swain have been retained, but a number of new ones have been added; the text, which filled six hundred and twenty-two pages in the first edition, now fills seven hundred and nine. The indexes, which formed such a useful part of the first edition, are more than double as large, and many a reader will thank Mrs. Hubbard, who is responsible for them, for lightening his labours. In general form, size of type, &c., both editions are alike.

But in the quarter of a century which has passed since Sir John Evans issued the first edition of his work, many striking discoveries of stone weapons and other objects have been made. Excavations which have resulted in "finds" of great value have been carried on in many parts of England, whilst diggings in Egypt and elsewhere in the East have brought to light facts which in some cases have upset our most cherished and most ancient convictions. With new facts coming to hand continually, Sir John Evans has found it possible to generalise and to make deductions such as would, a few years ago, have been impossible; and a perusal of some of the chapters of his book reveals the startling fact that the inhabitants of parts of Asia, Africa, and Europe, situated at very remote distances from each other, made their weapons of the same materials, in the same shape, and in the same way. Indeed, it is very hard not to assume that such peoples either came from the same stock, or had some means of communication which until now has remained unsuspected.

In addition to well-known collections such as those of the Rev. W. Greenwell, General Pitt-Rivers, and certain public museums, Sir John Evans has drawn his facts from the examination of other collections in this country and on the continent which, fortunately, he has had time and opportunity to visit; besides these, he has been in communication with scholars and students in many parts of the world who have forwarded him antiquities which they have found or come across, and he has thus been in an excellent position to read, mark, and note the results of his observations for the benefit of the readers of the second edition. For the collector pure and simple the section of the book which ends on p. 639 will be more important than the rest, but for the general student who interests himself in the questions of the antiquity of man and the date of his appearance upon earth, and in theories of river-drift and flood-deposit, the chapters which follow will prove the greatest attraction. In only a few small points, in obedience to the authority of new information, Sir John Evans has modified the views which he expressed in his first edition; this fact, taken together with the number of discoveries made in the realm of British stone-lore during recent years, shows how carefully his work was conceived and executed. Our thanks are due to him for making available to each and all the stores of his mature learning and wide experience, and we can only hope that at some future period he may see his way to put on record some of the deductions which he must have made on many points, and the theories on difficult problems which he must have formed. Coming from him they would have a special value.

CLIMATOLOGY OF THE GLOBE.

Handbuch der Klimatologie. Von Julius Hann. Second edition. 3 vols. Pp. 1360. (Stuttgart: Engelhorn, 1897.)

THIS work, which belongs to the series of "Geographischer Handbücher" issued by Dr. Ratzel, will be welcomed by all meteorologists. It is the second edition of the work under the same title which appeared in 1883. That it has been entirely rewritten and enlarged

appears from the fact that while the original single volume contained 764 pages, the work has now grown to three volumes, numbering, in all, 1360 pp. On reading it one cannot but be astonished at the extent of erudition and research which is displayed on every page.

Naturally, in a work dealing with the climatology of the whole globe, we do not expect to find detailed tables of temperature or of rain for every country; what we do find are careful excerpts of data from typical stations, illustrated by frequent extracts from travels and other works describing personal experiences in distant regions. Thus, for Siberia we have copious citations from Middendorff and Adolph Erman, for Hindostan from Blanford, for Java from Junghuhn, and so on.

The first volume, 400 pp., deals with the main factors of climate, and then passes on to general climatology. It treats, firstly, of solar climate, or that which would result from the action of the sun alone; and, secondly, of physical climate under the two heads of (*a*) Land and Sea Climate and (*b*) Mountain Climate. On the latter subject Dr. Hann is, admittedly, the highest living authority, and his remarks on the effect of mountains, on such winds as the Scirocco, the Bora, and the Mistral, as well as on the various air movements, in different directions in different countries, which are all classed under the generic term of Föhn winds, are well deserving of careful study.

Dr. Hann points out that every spot along the northern Mediterranean shores, which is famed for the mildness of its winter climate, owes this entirely to the immunity from the access of cold winds afforded to it by a mountain range in close proximity.

Vol. i. closes with a brief notice of the various theories of climatic changes, cyclical and otherwise, which have of late been put forward by Croll, Brückner, and others.

Vol. ii., with 384 pp., is devoted to the climatology of the tropics. This is necessarily treated in a more or less incomplete manner, for while the data for the interior of tropical Africa are fragmentary, next to none are attainable for the entire tropical region of Brazil, and very little for the tropical Pacific Islands.

To show what knowledge we have already gained of the climates of the east and west coasts of Africa, respectively, in low latitudes, we may say that the east and west coasts each occupy some fifty pages, while the interior is but briefly discussed.

Vol. iii. is even fuller than its predecessors, mounting up to 572 pages. It deals with the meteorology of the temperate and frigid zones. For the former, at least, the literature is far more abundant than that for the tropical countries, and a careful selection has been made.

The sections on East Siberia and on the United States are especially interesting, as showing how the difference in the trend of the mountain chains affects the climate of each region. The chain in the west of the two Americas lies close to the coast, and sweeps westwards towards the Bering Straits, whereas in Europe the Norwegian mountain line turns to the eastward. Accordingly, in the New Continent the influence of the Pacific Ocean is reduced to a minimum, while in the Old that of the Atlantic extends far inland.

Comparing the United States with Eastern Asia, we find that the whole of the States are exposed to the visitation of icy northerly winds owing to the absence of cross-mountain ranges of any considerable altitude. In Asia high mountains and tablelands effectually check the outflow of chilled air from the Siberian centre of cold, about the valley of the Lena.

The notices of Chili, Argentina, and the whole southern part of South America are extremely interesting reading.

The account of Arctic and Antarctic meteorology is very full, and as the data from all the expeditions of the years 1882–83 have been utilised, the information afforded is much more complete than any before presented to the public. Dr. Hann expresses his regret that the only publication of the scientific results of the English expedition of 1875–76, under Sir G. Nares, has been in a Blue-book, and is therefore almost inaccessible to men of science.

The entire work is eminently what the Germans call "epoch-making," and it is only to be regretted that, as it is in German, readers in England will be but few.

OUR BOOK SHELF.

Natürliche Schöpfungs-geschichte; gemeinverständliche wissenschaftliche Vorträge über die Entwickelungslehre. Von Ernst Haeckel. Ninth edition. Pp. lxii + 831. Portrait and thirty plates. (Berlin: Georg Reimer, 1898.)

THIS well-known book has now reached its ninth edition. The original form is retained, but many corrections have been made, and the phylogenies have been brought up to date according to Prof. Haeckel's interpretation of newly-ascertained facts.

The author's aim is to simplify the enormous mass of observations, reasonings and theories which we call biology, and to show that it can all be explained by a relatively few general principles. The worker at any special group of plants or animals will often, perhaps usually, find it impossible to satisfy other specialists as to the systematic relations of all the forms on which he has been engaged, or to clear up those vestiges of remote history which some of them may present. Haeckel, however, does not hesitate to deal with the whole animal and vegetable kingdoms, placing and deriving all the chief groups. Most philosophical naturalists find it hard to explain any fact of nature adequately, and put forth their conclusions timidly, as those who look for a day of fuller knowledge. Haeckel offers us a theory of development, by which all the chief groups of biological phenomena can be "mechanically explained and understood" (p. 790). This cheerful conviction that we already hold the main clues to a philosophy of nature is very engaging to those who have no great sense of responsibility as teachers or writers; it rouses the most profound scepticism in those who have found by trial how little we can really explain. Haeckel's "Schöpfungs-geschichte" is based upon wide knowledge; it has been corrected many times; it is clear and persuasive. Nevertheless, there is no book of our own day of which we should more confidently predict that a future and not distant generation will find it grotesquely inconsistent with natural fact. There are books which after many generations still seem modern; Malpighi and Swammerdam have written such. There are also books which become antiquated in the life-time of the author, and to our mind the book before us is one. It wants altogether the reserve, scepticism and modesty which were the safeguards of Lyell and Darwin when treating subjects of such unfathomable complexity.

A special student, critically examining that one of Haeckel's phylogenies with which he is chiefly concerned,

would, we believe, find that it rests upon daring and gratuitous assumptions. The present writer distinctly affirms that this is true of the table of articulates on p. 575, and of the table of insects on p. 595. Unfortunately, the criticism by which this opinion might be justified would be too technical, and especially too lengthy, for the columns of NATURE. L. C. M.

Analytic Geometry for Technical Schools and Colleges. By P. A. Lambert, M.A. Crown 8vo. Pp. xii + 216. (New York: The Macmillan Company. London: Macmillan and Co., Ltd.).

THE great prominence given in the earlier chapters to curve-tracing, and the fact that the plotting of both algebraic and transcendental curves takes precedence of more purely mathematical treatments of the line, circle, and conic, renders this text-book peculiarly adapted in many respects to the requirements of engineering and other students whose main object is to obtain a thorough drilling in graphic methods. Such a student would do well to be guided by a teacher, as some early sections and examples are rather hard for first reading. In the later chapters the author has attempted to give an account of the properties usually treated in books on "Analytical Conics," together with the graphic representation of imaginaries, and an introduction to analytical geometry of three dimensions. With this portion, he can hardly be said to have been so successful. His treatment of such matters as tangents, diameters, asymptotes, and poles and polars, is very incomplete, and not calculated to bring into prominence those general properties which render such lines of importance in the geometry of conics; indeed, we might go further and say that even where no actual inaccuracies exist in the text, it would require a previous knowledge of the subject in order to enable a student to read between the lines sufficiently to avoid falling into error. Moreover, too little attempt is made at "graduating" the course, easy and difficult sections alternating with each other, and there being rather a lack of that sequence and arrangement which is so helpful to the beginner. Those who find life too short to learn conics up to examination standard will, however, be able, by the aid of the examples and a little outside help, to obtain a very fair superficial knowledge of the subject.

The Valley of Zermatt and the Matterhorn. A Guide. By Edward Whymper. With illustrations and maps. Pp. xvi + 212. (London: John Murray, 1897.)

THIS compact little volume in paper covers is designed on the same plan as the author's Guide to Chamonix, which was recently published. From so prominent a mountaineer much may legitimately be expected in a guide to one of the greatest climbing-centres in the Alps, but it is almost a surprise to find so very much which is available for the tourist whose bent does not incline towards feats of physical endurance. The first chapter is devoted to the early history and rise of Zermatt, then comes a history of the Matterhorn in four chapters, in which Mr. Whymper nerves himself to tell once more the terrible tragedy of his first ascent. The practical part of the Guide follows; hints as to the best way of reaching Zermatt, particulars regarding the valley and the village, and a carefully arranged series of excursions from that favourite centre. Excursions from the Riffelalp and other places are also described, and the opportunity is taken of sketching the mountaineering history of Monte Rosa. This blending of historical associations and anecdotes with practical hints and instructions is perhaps the most interesting feature of the Guide.

With the exception of some lists of altitudes of peaks and passes, and a geological section of the Matterhorn with an explanatory note in French by Signor F. Giordano, there is no special attention bestowed on the scientific aspects of nature-study.

The illustrations are examples of Mr. Whymper's own art, and no more requires to be said concerning them.

Practical Forestry. By C. E. Curtis. Second edition revised. Pp. viii + 124. (London: Crosby Lockwood and Son, 1898.)

NO doubt a forester might gain some advantage from a perusal of this book, provided he read it with caution. But he would encounter several statements with which he would have a difficulty in agreeing. For instance, the author deliberately says, "To purchase trees, or to plant by contract, are also means to ensure failure." If that were true, it would be small wonder that the results of forestry are not in all cases satisfactory in England, where quite 90 per cent. of the plantations have been formed in the ways that the book condemns. A most serious slip occurs in the statement of the rule for ascertaining the cubical contents of a tree, where "square of the girth" appears instead of "square of the *quarter* girth." This would not mislead a practical man, but it might lead to most unpleasant consequences in the case of a student who made use of the book in preparing for an examination.

Agriculture in some of its Relations with Chemistry. By F. H. Storer, Professor of Agricultural Chemistry in Harvard University. 3 vols. Pp. iv + 620, iv + 602, and vi + 679. (London: Sampson Low and Co., Ltd., 1897.)

WHEN a book has passed through seven editions in ten years, and has grown from two to three volumes, there can be no doubt that it has been appreciated. This bulky work deals in a discursive way with the subjects of soil, manures, and crops, and with many things connected with the management of land; the feeding of animals is not discussed. A great deal of information is brought together: one admires the extent of the author's reading; but after a lengthy perusal of his diffuse statements we rise with the feeling that we have not gained any really scientific grasp of the subject. The matter placed before the reader has, in fact, not been digested, or the experimental results correlated; the book is a miscellany by a very well-informed man. One good feature of the book is its practical character; the intelligent farmer will probably enjoy it better than the man of science. R. W.

Glimpses into Plant-Life. An Easy Guide to the Study of Botany. By Mrs. Brightwen, F.E.S. Pp. 351. (London: T. Fisher Unwin, 1897.)

THIS is a pleasant little book, and will be read with interest by many who enjoy a country ramble or rural life from the naturalist's point of view. The authoress displays a first-hand acquaintance with the plants concerning which she discourses; and if there are occasional slips when she deals with matters physiological, they will be readily pardoned for the sake of the generally excellent character of the book. There are some errors, however, which might easily have been avoided, *e.g. aëroid* for *aroid*, on p. 62. Some of the photographs of trees and bark are decidedly good.

Premature Burial: Fact or Fiction? By Dr. David Walsh. Pp. 49. (London: Baillière, Tindall, and Cox, 1897.)

SO much news is published with the idea of creating a sensation, that Dr. Walsh's critical examination of some of the stories of premature burials is very welcome. The general conclusion arrived at is that "the theory of frequent premature burial is unsupported by exact evidence; in other words, it occupies the position of a mere popular belief or fable."

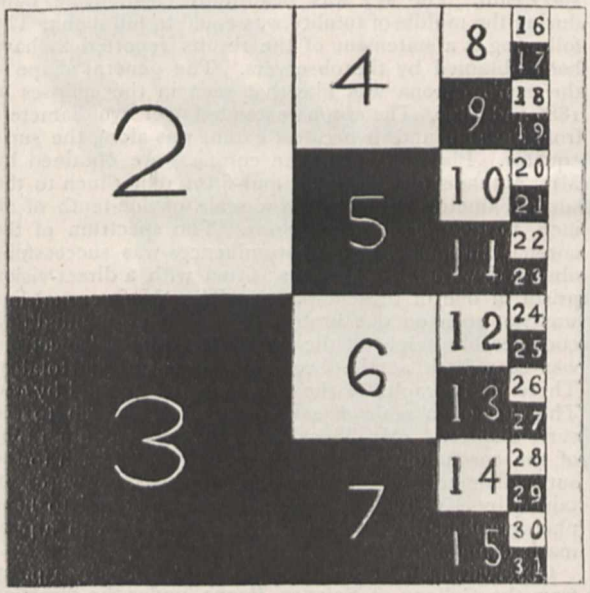
LETTERS TO THE EDITOR

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

A Diagram of Heredity.

THE law of heredity which was formulated by myself in a memoir entitled "The average Contribution of each several Ancestor to the total Heritage of the Offspring" (*Roy. Soc.*, June 3, 1897, and NATURE, July 8, 1897), and which, as I am exceedingly gratified to learn, is now strongly corroborated by an independent investigation, has recently been illustrated by a useful diagram. This was devised by Mr. A. J. Meston, of Allen Farm, Pittsburg, Mass., U.S.A., and communicated by him to the *Horseman* (Chicago, December 28), the leading American newspaper on horsebreeding, together with a popular explanation of the law in question. Believing, as I do, and I am not now alone in the opinion, that the law is a real advance in hereditary science, I think that Mr. Meston's diagram deserves a place in your columns, as conveying in a very intelligible form the chief features of the law.

These are that the total *heritage* of the offspring is derived as follows. The two parents between them contribute *on the average* one half of each inherited faculty, each of them contributing one quarter of it. The four grandparents contribute between them one quarter, or each of them one sixteenth; and



so on, the sum of the series $\frac{1}{2} + \frac{1}{4} + 1/8 + 1/16 +$ &c. being equal to 1, as it should be. It is a property of this infinite series that each term is equal to the sum of all those that follow: thus $\frac{1}{2} = \frac{1}{4} + 1/8 + 1/16 +$ &c.; $\frac{1}{4} = 1/8 + 1/16 +$ &c., and so on. The prepotencies or subpotencies of particular ancestors, in any given pedigree, are eliminated by a law that deals only with *average* contributions, and the varying prepotencies of sex in respect to different qualities, are also presumably eliminated. Corrections for these can of course be made in any particular pedigree, taking care that the corrected series still amounts to 1 exactly.

It should be borne in mind that the word "Heritage" has a more limited meaning than "Nature," or the sum of the inborn qualities. Heritage is confined to that which is inherited, while Nature also includes those individual variations that are due to other causes than heredity, and which act before birth. Now individual variation in a race that is stable, must have a destructive as often as a constructive effect. Consequently its effects balance one another in *average* results, and disappear from a law which deals only with these.

The area of the square diagram represents the total heritage of any particular form or faculty that is bequeathed to any particular individual. It is divided into subsidiary squares, each bearing distinctive numbers, which severally refer to different ancestors. The size of these subsidiary squares shows the average proportion of the total heritage derived from the corresponding ancestors. The distinctive numbers are the same as those which I employed many years ago in connection with the "Family Records" with which I was at that time engaged: they were found both then and subsequently to be very convenient. The Subject of the pedigree is numbered 1. Thenceforward whatever be the distinctive number of an ancestor, which we will call n, the number of its sire is $2n$, and that of its dam is $2n + 1$. All male numbers in the pedigree are therefore even, and all female numbers are odd. To take an example—2 is the sire of 1, and 3 is the dam of 1; 6 is the sire of 3, and 7 is the dam of 3. Or, working backwards, 14 is a male who is mated to 15; their offspring is 7, a female, who is mated to 6; their offspring is 3, a female, who is mated to 2, and their offspring is 1, the Subject. The connection of all this with the binary system of notation is obvious, and need not be further alluded to. [In Mr. Meston's own diagram, the number 1 is assigned to the sire, and 2 to the dam, and so on. This detracts from the simplicity of the nomenclature, and therefore I do not adopt that part of his diagram.] The distinction between the male and the female squares is made still more conspicuous by colouring the latter; but, yielding to the exigencies of printing, I have replaced colour by printers' ink. So all male squares in my version of Mr. Meston's diagram have white grounds and black numerals, and all female squares have black grounds and white numerals.

The numbered squares could be continued indefinitely: in this small diagram they cease with the fourth generation, which contributes a 16th part of the total heritage, therefore the whole of the more distant ancestry, comprised in the blank column, contribute 1/16th also. FRANCIS GALTON.

"Some Unrecognised Laws of Nature."

PRESSURE of important business has prevented me from writing ere this to claim space in your columns to enter a protest against the misrepresentations, as well as the whole tone, of the review—which appeared in your columns of the 9th ult.—of the above work, in which I have had the privilege of assisting during the past six years. Heretics have long learned not to expect mercy, or even to look for justice, at the hands of the orthodox. But from a reviewer who, oblivious of the proverb *Qui s'excuse s'accuse*, warned his readers that he at least was "not one to regard lightly the danger of summarily rejecting a germ of new discovery because it happens to conflict with orthodox opinions," we have a right to expect something very different from the venomous outpourings and direful warnings and threats that might flow quite naturally from an irate theologian when reviewing a work which strikes a blow at the very foundations of his dogmas and doxies. And this is the very head and front of our offending, that, heedless of authority, we regard "the whole doctrine of 'energy,' with all its astounding and contradictory corollaries," as absurd; as the product of the infantile, and necessarily anthropomorphic, imagination of primitive man; and that we have attempted to show how phenomena may be accounted for without having recourse to such figments of the imagination. In this we may have succeeded or not; the immediate verdict will largely, if not entirely, depend on the mental attitude of the judge, and for the ultimate verdict we must be content to wait. But your reviewer may find some comfort in the assurance that the *facts* of science, slowly accumulated through long ages, would not be affected, nor need the human race necessarily be plunged "once more into pre-Galilean ignorance," even if all the assumptions, the metaphysical conceptions—of ethers, "dead" matter, "animating" energy, &c.—on which current explanations of these same facts are based, were summarily consigned to the limbo of similar long-forgotten "working hypotheses." And it is these hypotheses we assail, not the facts.

Of his criticisms of the fundamental principles, or rather principle, on which all our explanations are based, I need say nothing, for I can safely leave them to the judgment of all who take the trouble to read our work. I may mention, however, that his review is itself a strong *a posteriori* verification of the law of persistence in its application to psychological phenomena. But I must protest against the, conscious or un-

conscious, misrepresentation involved in taking certain speculative conclusions—which in the light of current conceptions we know and point out must *appear* absurd—away from their context, and holding them up to ridicule as if they had been advanced as well-ascertained facts; and all these from a chapter the first words of which read—"This chapter will be mainly speculative."

In conclusion I would thank your reviewer for one useful piece of criticism in his eight-column notice—a notice, by the way, to say that the book is not worth noticing—in which he points out a loosely and badly worded paragraph on page 77, the real purport of which, however, is quite clear from what immediately precedes it. LEWIS H. BERENS.

Ilkley, January 15.

YOUR reviewer regrets an appearance of antagonism between himself and any one who has been genuinely endeavouring to improve natural knowledge, but he must point out that a great deal more study is necessary before a busy man like Mr. Berens can adequately inform himself what the present condition of scientific knowledge really is. O. J. L.

THE TOTAL ECLIPSE OF THE SUN.

IT will be some time before the complete results of the observations of last Saturday's eclipse can be made known, but it is extremely satisfactory that all the expeditions to India from this and other countries were favoured with perfect weather for the work. In places where the eclipse could only be partial the weather was not so favourable, for a telegram from Odessa (to the *Standard*) states that the observations of the solar eclipse in Southern Russia were not very successful owing to unfavourable weather. Only a few good photographs were obtained.

From a telegram received at Greenwich from Sohagpoor we learn that one of the official parties sent out by a joint Committee of the Royal Society and Royal Astronomical Society, consisting of the Astronomer Royal, Mr. W. H. M. Christie, and Prof. Turner, of Oxford, who were stationed at that place, were favoured with a perfectly clear sky, and were thus able to carry out completely the programme they had arranged; the same may be said of another official party, under the charge of Mr. Newall, of Cambridge, and Captain Hills, R.E., who were at Palgaon, near Wardha. The plates had not been developed, so it is impossible to say as yet how good the results are. Of Dr. Copeland, of Edinburgh, there is at present no news. As his station lay between those of the observers previously mentioned, it may be presumed that he also experienced a clear sky, and was, doubtless, equally successful.

A later telegram from Sir Norman Lockyer, who was at Viziadurg, on the West Coast, gives the results after developing the plates. It states: "Weather excellent, and all instruments satisfactorily employed with very good results except the integrating spectroscope. The temperature fell about 3° C. during the eclipse. It was not a dark eclipse, and very few stars were seen."

This news is expressed in fuller detail in the subjoined cablegram from Sir Norman Lockyer to the *Morning Post*:—

"The total eclipse of the sun was successfully observed at our Viziadurg station in the most perfect weather yesterday.

"At our station we had the invaluable assistance of one hundred and twenty-five officers, petty officers, and men from her Majesty's ship *Melpomene*, the observers being divided into twenty-one parties.

"As many as sixty photographs of the spectrum were taken, including four sets of ten instantaneous exposures at the beginning and at the end of the total phase.

"Some of these have been already developed, and are found to exhibit changes in the aspect of the chromosphere second by second at each of the four contacts.

"The corona was a very majestic spectacle, and it resembled that of 1896.

"As had been expected with so many sun-spots, there was no equatorial extension of the luminosity.

"A few stars were seen, but the darkness was not of sufficient intensity to necessitate the use of lamps.

"The longest streamer was a polar one, and had a length equal to four apparent diameters of the moon.

"This streamer was altogether a most exquisite structure.

"Mr. Eliot, the Meteorological Reporter to the Indian Government, and Mr. Pedler, of the Calcutta University, were members of our party.

"Mr. Pedler observed arc lines of iron in the lower corona.

"Lord Graham's cinematograph work has proved quite successful.

"The shadow of the moon on the earth was hardly seen in consequence of our atmosphere being too pure.

"The Collector at Ratnagiri and the officials of the Public Works Department attended, and rendered us every possible assistance."

The observations made at Talni by Mr. E. W. Maunder and Mr. C. Thwaites appear to have been very successful. The sky was beautifully clear. The light during the middle of totality was equal to full moon. The following is a statement of the results reported to have been obtained by the observers. The general shape of the sun's corona was like that seen in the eclipses of 1886 and 1896. The corona extended over two diameters from the sun, and its greatest extent was along the sun's equator. Photographs of the corona were obtained by Mrs. Maunder on a scale of four-fifths of an inch to the sun's diameter, and also on a scale of one-tenth of an inch, to get coronal extensions. The spectrum of the corona, chromosphere and prominences was successfully observed with an opera-glass fitted with a direct-vision prism in one of the eye-pieces. The chief coronal line was not seen on one limb of the sun, but extended to a considerable height at the other. The "flash" spectrum was seen both at the beginning and end of totality. Three photographs of the corona were obtained by Mr. Thwaites on a scale of seven-tenths of an inch to the sun's diameter. Mr. Thwaites also secured photographs of the corona on a scale of one-tenth of an inch to the sun's diameter. Good spectrum photographs were obtained by Mr. Evershed, who is also reported to have photographed the spectrum of the "flash" with a prismatic camera.

Observations of the eclipse were also made by a party from the College of Science, Poona, under the direction of Prof. K. D. Naegamvala, and by a party at Jeur, from the Lick Observatory, Mount Hamilton, U.S.A., under the direction of Prof. W. D. Campbell. It is reported that the sky was extremely clear, and that the observations were very successful. The light during the middle of totality is said to have been greater than that of full moon. The general shape of the corona was similar to that observed in 1886 and 1896. The corona extended to a distance of nearly two diameters from the sun, and its greatest extension was observed along the sun's equator.

A telegram from Dumroon states that the photographic observations made by the survey party there were entirely successful.

Seven good pictures of the corona were obtained during totality.

The following telegram was received from the Rev. J. M. Bacon, who was in charge of the British Astronomical Association party at Buxar:—

"On the Ganges weather perfect; observations satis-

factory all round." Mr. Bacon appears to have taken a successful series of photographs with the cinematograph.

Other information received *viâ* New York indicates that the spectroscopic work of Prof. Campbell was also successful.

With such perfect weather, and the numerous powerful instruments utilised, the results of this eclipse expedition will form a unique record. A short account of some of the larger instruments should, therefore, be of interest.

For photographing the corona the Astronomer Royal was provided with a telescope having an object-glass of eight inches diameter, presented to the Royal Observatory some years ago by Sir Henry Thompson. This instrument gave an image of the sun's disc three inches in diameter on a large-sized photographic plate; the plates employed were such as would be most likely to show the delicate detail of the cloud-like structure close to the sun's limb.

Besides the photographs of the corona, Mr. Christie's photographs of the sun and moon, before and after totality, will, no doubt, be of much value to the theory of the lunar motion.

Another large telescope for photographing the corona was Dr. Copeland's 40-foot coronagraph, fixed up on trestles and directed to the sun, the required movement during totality being secured by a correct motion of the plate. The diameter of the sun's image given by this telescope is 4 inches.

For spectroscopic observations, the prismatic cameras with Sir Norman Lockyer's party were the most powerful. Never before during an eclipse have spectroscopes with so large dispersion and aperture been used. The 6-inch prismatic camera used by Mr. Fowler had two large prisms of 45°, instead of the one prism with which the results of 1893 were obtained, the dispersion being thus nearly doubled (Fig. 1). This added power will tell in many ways. By drawing out the spectrum into a band of twice the length the accuracy of measurement will be greatly increased. Further, remembering that the sky was slightly hazy in 1893, when eight coronal rings were photographed, and that the use of a still greater dispersion, by spreading out the continuous spectrum of the corona, will increase the chances of registering the fainter coronal rings, it is not too much to hope that the photographs taken during the eclipse will add much to our knowledge of the chemical nature of the corona.

A 9-inch prismatic camera, in charge of Dr. W. J. S. Lockyer, although of larger aperture than the 6-inch prismatic camera, had only one prism of 45°, giving a slightly greater dispersion than the 6-inch with one prism.

Each of these prismatic cameras was used in conjunction with a siderostat, and pointed to the reflecting mirror in such a way that the arcs of the chromospheric spectrum at the beginning and end of totality were at right angles to the dispersion. The accompanying illustration (Fig. 2) shows the 9-inch prismatic camera in this position.

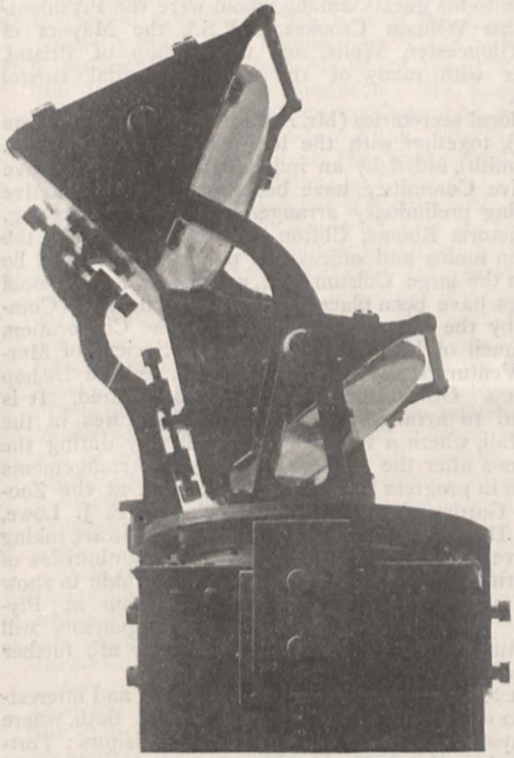


FIG 1.—Prisms of the 6-inch Prismatic Camera.

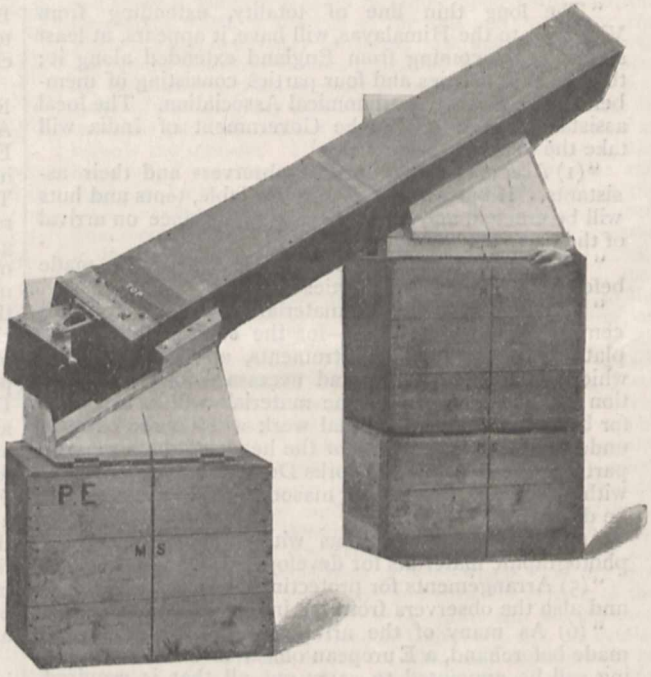


FIG. 2.—9-in. Prismatic Camera in position for the Eclipse.

Besides the prismatic cameras the eclipse camp at Viziadurg was equipped with other instruments for making a complete set of observations, and by the help of the officers, petty officers, and men from H.M.S. *Melpomene*, the whole of the instruments, including the coronagraph, with coelostat, integrating spectroscope, and other spectroscopes for visual work, have been used. Having previously been trained for all kinds of observations, these efficient volunteers have also made disc observations and drawings of the corona, and observed the effects of the eclipse on temperature, wind, landscape, and other natural phenomena.

The great interest taken in the eclipse in India

paved the way for all parties to make their observations and erect their instruments with almost as much ease and facility as if they had been at home. The following letter from Sir Norman Lockyer to the *Morning Post*, on the "Preparations for the Expedition," shows that the Government of India rendered very valuable assistance to all the eclipse parties; and astronomers may well congratulate themselves upon the interest thus officially manifested in their work.

PREPARATIONS FOR THE EXPEDITION.

"On arriving at Port Said I received an important letter and enclosure from Mr. John Eliot, C.S.I., F.R.S., the Meteorological Reporter to the Government of India, who has been unceasing in his labours to further the coming observations. From these documents the final arrangements made by the Government of India may be gathered, and it must be acknowledged that they have been most admirably thought out, and are altogether such as should give the greatest amount of satisfaction to the world of science.

"The long thin line of totality, extending from Viziadurg to the Himalayas, will have, it appears, at least seven parties coming from England extended along it; three official parties and four parties consisting of members of the British Astronomical Association. The local assistance rendered by the Government of India will take the following shapes:

"(1) Accommodation for the observers and their assistants. If bungalows are not available, tents and huts will be erected, and will be available at once on arrival of the parties.

"(2) Messing arrangements, which will also be made before the arrival of the parties.

"(3) Ample supply of materials—bricks, Portland cement, planks, huts, &c.—for the erection of stands, platforms, &c., for the instruments, and of the sheds, which will probably be found necessary for the protection of the instruments. The materials will be arranged for beforehand, but the actual work will have to be done under the superintendence of the heads of the observing parties. Hence a Public Works Department subordinate, with a sufficient number of masons and carpenters, will be deputed for the purpose.

"(4) Portable dark rooms with supply of ordinary photographic materials for developing plates, &c.

"(5) Arrangements for protecting the instruments, &c., and also the observers from the intrusion of natives.

"(6) As many of the arrangements will have to be made beforehand, a European officer of sufficient standing will be appointed to carry out all that is required, and will be given full authority to make the necessary arrangements with the district officers, and be authorised to obtain the services (1) of a Public Works Department subordinate and workmen, (2) of a sufficient number of guards or policemen."

The latter clause of Mr. Eliot's letter appears to have been taken advantage of at most of the eclipse stations, so that in no instance have the observations suffered from the natives, either by the lighting of fires, thereby causing clouds of smoke, or any other interference.

With such a list of successes we may safely say that this eclipse, as befitting the last one of the century, has surpassed all previous records; but unlike many eclipses at the beginning of the century, it cannot be truly said that the event of Saturday was over at the end of the two minutes of totality. To many the eclipse has yet to begin, and will last for many months, during which time each line in the spectrum, each streamer of the corona, each prominence on the sun, will be analysed, little by little, to discover if we have similar streamers in other coronas, or identical lines in our laboratories. It may be confidently expected that the results obtained on Saturday will enable us to solve some of the enigmas of solar phenomena and constitution.

THE FORTHCOMING BRISTOL MEETING OF THE BRITISH ASSOCIATION.

A SUCCESSFUL conversazione was given on Thursday last, in the Victoria Rooms, Clifton, by the Mayor and Mayoress of Bristol (Sir Robert and Lady Symes) and the Local Executive Committee, with the object of stimulating interest in the approaching meeting of the British Association, on September 7, in Bristol. A programme of music by the Royal Artillery (Mounted) Band was arranged and admirably carried out. The Mayor, in a short and effective speech, bade a hearty welcome to his guests, among whom were the President-elect (Sir William Crookes, F.R.S.), the Mayors of Bath, Gloucester, Wells, and the Bishop of Bristol, together with many of the most influential Bristol citizens.

The local secretaries (Mr. Arthur Lee and Dr. Bertram Rogers), together with the local treasurer (Mr. J. W. Arrowsmith), aided by an influential and representative Executive Committee, have been for some time active in making preliminary arrangements for the meeting. The Victoria Rooms, Clifton, will be secured for the reception rooms and offices, the public lectures will be given in the large Colston Hall, and rooms for sectional meetings have been placed at the disposal of the Committee by the Museum Committee of the Corporation, the Council of University College, the Society of Merchant Venturers, the Charity Trustees, and the Bishop of Clifton. Other suitable rooms will be secured. It is proposed to arrange an exhibition of pictures in the Drill Hall, where a military band will play during the afternoons after the sectional meetings. Arrangements are also in progress for a biological exhibit at the Zoological Gardens in Clifton, in which Mr. E. J. Lowe, F.R.S., Dr. Harrison and Prof. Lloyd-Morgan are taking an active interest. It is hoped that the authorities of the Marine Biological Association will be able to show living marine organisms from their station at Plymouth. A fuller account of these arrangements will be communicated to NATURE when they are further advanced.

The excursions promise to be both varied and interesting. As at present projected, they include Bath, where the Mayor and citizens will entertain the visitors; Tortworth, where Lord Ducie will entertain a small party of geologists, and afford them special opportunities of examining the Silurian beds in that neighbourhood; Aust Cliff, with its fine exposure of Keuper, Rhætic, and the lowest beds of the Lias; Stanton Drew, with its megalithic remains, the Cheddar Cliffs and Caves, the sources of the Bristol water supply, the Severn Tunnel, Cadbury Camp, Swindon, Avonmouth, Wells and Glastonbury, where the Mayor of Wells, the Dean and Chapter, and residents will entertain the visitors to lunch, and the Mayor of Glastonbury will provide tea in the old Abbot's Kitchen. Other excursions to Salisbury and Stonehenge, Nailsworth and Stroud, Longleat, and Raglan Castle are under discussion.

The handbook is in active preparation, and its several sections have been placed in the hands of local authorities on the various subjects with which it deals.

It would seem, therefore, that the meeting at Bristol bids fair to be an interesting one, and that every effort will be made to render it also a successful one.

THE REORGANISATION OF THE UNIVERSITY OF LONDON.

THE influential deputation which was received by the Duke of Devonshire at the Privy Council Office on Monday will serve to remind the Government that the scheme for the reconstruction of the University of London as a teaching body has the support of the leaders in all branches of learning. The deputation was thoroughly representative, and its constitution shows the strength of the plea for a measure of educational reform of pressing importance.

The deputation was introduced by the Vice-Chancellor of the University of London (Sir H. E. Roscoe), and included Prof. Michael Foster (representing science), the President of the Royal College of Physicians (Sir Samuel Wilks), the President of the Royal College of Surgeons (Sir William MacCormac), Dr. Frederick Taylor (chairman of the delegates of medical schools), Lord Reay, Principal Rendall (of Liverpool University College), Dr. Crosby (City Corporation), Mr. Sidney Webb (chairman of the Technical Education Committee of the London County Council), Mr. Ralph Palmer (City Guilds), Mr. Warren (President of Magdalen), Sir Wolfe Barry (President of the Institute of Civil Engineers), Mr. Cozens-Hardy, M.P. (chairman of the General Council of the Bar), Sir A. Rollit, M.P., Sir Joshua Fitch, Mr. Anstey, Mr. Haldane, M.P., Mr. Frank Heath (Assistant Registrar of the University of London), and others.

The Duke of Devonshire's sympathy with the objects of the deputation is known to all who are interested in higher education in London; and though the reply he gave to the deputation was cautiously expressed, it is sufficient to justify us in believing that the Government will give prominence in the next Session to the scheme for the reorganisation of the University. The Duke of Devonshire pointed out that the Government did not need to be convinced as to the importance of the question, and that there are no political obstacles in the way; but the effect of the meeting on Monday will be to furnish the Ministry with additional force in urging upon Parliament the expediency of giving such moderate provision of time as may be necessary to overcome the small amount of opposition which still exists to the Bill for the reconstruction of the University.

With regard to the question whether the Senate of the University of London should ask for a new charter, which would carry out the objects required without the interposition of Parliament, or the appointment of a Royal Commission, the consensus of opinion is distinctly in favour of proceeding by statutory commission rather than by new charter. It was, perhaps, just as well that the question was raised, for it enabled the deputation to express the conviction of those who are directly interested in the development of the University, that the only practicable solution of the problem lies in procedure by a Statutory Commission Bill. For the sake of learning and the advancement of science, it is devoutly to be hoped that such a Bill will soon pass through both Houses of Parliament. That there are grounds for entertaining the opinion that this desirable settlement of the problem is in sight may be gathered from the subjoined report abridged from the *Times*:—

Sir Henry Roscoe introduced the deputation, and Prof. Michael Foster, Sir S. Wilks, Sir William MacCormac, Dr. F. Taylor, Lord Reay, Dr. Rendall, the President of Magdalen, Dr. Crosby, Mr. Sidney Webb, Mr. Ralph Palmer, and Sir Wolfe Barry, representing a variety of interests, spoke in support of its object. In the course of his reply, the Duke of Devonshire said:—

I wish, in the first place, to express to you, gentlemen, my cordial thanks for the trouble which you have taken in coming here, for the purpose of repeating and confirming the representations which many of you have, in various other ways, already made as to your sense of the great importance of a reconstitution of the London University upon such lines and principles as will render it, not, perhaps, a teaching University of exactly the same character as the older Universities, but as an institution which will be recognised by all who are competent to form an opinion, and all who hold a leading position in scientific knowledge, as a real and genuine teaching University. The assistance which you have rendered to me in coming in such strength to repeat and confirm these representations will be very great. This deputation was not necessary, so far as the Government was concerned, in order to convince them of the importance of the subject. The fact that the Government has already in two Sessions brought forward a Bill to give effect to the recommendations of the Cowper Commission, has shown that they, at all events, have been convinced by that report of the necessity of such a measure. Neither was the deputation required in order to remove any political obstacles to the passing of such a measure. Politics, I am happy to say, political differences have never entered into this question at all, and a great many members of the present Opposition are as fully committed to the principle of this Bill as the members of the Government themselves. The value of this deputation in my opinion consists in the support which it will give to me in urging upon my colleagues, and which it will give to them in urging upon Parliament, the importance which is attached to the question by almost the whole of those in any way connected with any of the teaching institutions of this great metropolis, and in urging upon them the expediency and the necessity of making such moderate provision of Parliamentary time as may be necessary to remove or overcome the small amount of opposition which still exists as regards the measure. I have, however, little doubt that the more fully I can convince my colleagues of your resolute and determined attitude upon this question, the smaller will be the actual sacrifice of Parliamentary time which will be demanded from them. Much, gentlemen, as the delay which has occurred in dealing with this question is to be regretted, it has, I think, been accompanied by one compensating advantage. It is that the discussion and consideration which have been given to the subject during this period of delay have tended in the direction of removing almost the whole of the serious opposition which has ever been entertained to it. This delay has enabled certain concessions to be made by the advocates of the proposal and a compromise to be arrived at, which has, I believe, substantially removed, as I have said, any serious opposition which had to be encountered. The measure as now proposed cannot be regarded as a triumph of any section of opinion or of interests, but will be, I think, properly and rightly regarded as a fair and just compromise of every shade of opinion upon the University question. Due regard has been paid to the strong and conscientious objections—I will not say whether well-founded objections or not—which were felt by a certain number of gentlemen who undertook the defence of the character and reputation of the work which had already been performed by the existing London University, and the gentlemen who undertook the defence of what they considered to be the interest of external students and those who undertook the defence of independent teaching and the rights of the Convocation of the University. So far has the process of compromise and reconciliation of opinion been carried out, that I have heard that it is possible that the view may be urged that such general agreement has been arrived at that the appointment of a statutory commission is no longer required, and that it would be in the power of the Senate of the University of London itself now to frame such a scheme and ask for the grant of such a charter as would carry out all the objects desired without the interposition of Parliament or the appointment of a Royal Commission. That, perhaps, is a suggestion which has not come under the attention of gentlemen present. I observe that it has received no attention or observation to-day. I am not sufficiently acquainted with the details which will be necessary in order to carry out the report of the Cowper Commission to say whether such a suggestion is possible or not. But it would to some extent strengthen my hands in putting aside a course which may possibly be recommended with some plausibility if, before this deputation separates, I could receive the opinion of some gentlemen who are present. I am under the impression that, although upon vital points practical unanimity has to a great extent been arrived at, the details which would require to be elaborated are probably such that great obstacles would be found to arise in any course except

that recommended by the Commission. I should like, however, to receive an expression of opinion that notwithstanding the progress made towards unanimity in this matter, the course recommended by the Commission—the appointment of a statutory commission to frame the future statutes and to reconstitute the University—is the only one to insure the scheme from further delay and perhaps ultimate failure.

Sir H. Roscoe said that the matter had not been formally brought before the Senate, but he should be expressing the view of his colleagues if he said that the question whether this reorganisation was to take place by charter, or, under the recommendation of the Cowper Commission, by a statutory commission had engaged their attention for many years, and that they had come to the conclusion that in consequence of the complexity of the question the difficulty of drawing up in black and white any statement in the form of a charter would be extremely great. The suggestion that the Senate might act under powers as a statutory commission had not been brought before them, and he could say nothing about it. But as between a new charter and a statutory commission the consensus of opinion was in favour of the commission rather than the charter.

Mr. Anstey, as a long-standing member of the Senate and a member of the Cowper Commission, thought that a statutory commission was absolutely essential. The matter had never been presented to the Senate, but the difficulties were insuperable in dealing with the details.

The Duke of Devonshire: The suggestion which may still probably be made is that legislation has become unnecesary when the approach to unanimity is so nearly complete that everything which is required might be done by charter on the motion of the Senate and not under statutory powers. London University under its existing charter possesses powers to alter its statutes and regulations subject to the approval of Convocation, and the suggestion which I understand might be made was that that course might be adopted with a reasonable prospect of success. I understand, however, that Mr. Anstey has expressed the unanimous, or almost unanimous, opinion of those present that that is not the case, and that nothing short of a body armed with statutory powers, such as the proposed commission, would be sufficient.

Sir Joshua Fitch said the question had been amply discussed by the Royal Commission, and their deliverances were unanimous and unanswerable. The difficulty of submitting such a charter to a scattered body like Convocation was too serious for the attempt to be practicable.

Mr. Anstey explained that the unanimity was only on the point that there should be a statutory commission.

After thanking the Duke of Devonshire for his reception of the deputation, the members of it withdrew.

THE FORTHCOMING INTERNATIONAL CONGRESS OF ZOOLOGY.

ENGLISH zoologists ought to learn with satisfaction that the International Congress, which has already met in France, Russia, and Holland, will meet in this country next August. The first Congress took place in Paris at the time of the International Exhibition in 1889. For some reason—perhaps the cholera—the second meeting, held in Moscow in 1892, was not largely attended. The third meeting at Leyden, in 1895, was attended by 173 zoologists with their wives and other members of their families.

It is to be hoped and expected that the meeting at Cambridge will be still more largely attended, and there is every reason to hope that the German element, which has not been conspicuous at previous meetings, will be better represented in this country.

We have already stated that, unfortunately, owing to the condition of his health and his numerous and arduous official duties, Sir William Flower, K.C.B., F.R.S., who was naturally elected President for the fourth Congress at the meeting in Leyden, has felt constrained to resign his post. To the general satisfaction of zoologists the Right Hon. Sir John Lubbock, Bart., F.R.S., was appointed in his place. At Cambridge a strong Committee has been formed, which is now actively engaged making the necessary preparations for the coming together of zoologists, and for their suitable reception and entertainment.

It may be mentioned by the way that August 23 and the town of Cambridge are the date and place of meeting, not only of zoologists, but also of physiologists, who intend to hold a Congress in the same week.

The Executive Committee of the Congress, selected from the General Committee, has somewhat varied the mode of invitation which obtained at previous Congresses. The invitation to the Congress is signed solely by English zoologists, and, on the whole, the list may be said to be a representative one, although it is to be regretted that Mr. A. R. Wallace and Prof. Allman have felt the weight of years too heavy to justify them in taking any part in this Congress. Our fellow zoologists in the Colonies and India have been invited to join the General Committee, and steps are being taken to invite the Indian and Colonial Governments to send delegates to the Congress. The more eminent foreign zoologists have been invited to form the Committee of Patronage which is always established at these Congresses, and we are glad to hear that already more than sixty have agreed to become members of this Committee, and a number have declared their intention of being present at the meeting if they possibly can. Among these may be mentioned Prof. Milne-Edwards (of Paris), Prof. Hubrecht (of Utrecht), and Prof. Kowalevsky (of St. Petersburg).

Visitors to earlier Congresses always brought away an account of generous hospitality, and there can be no doubt that our foreign friends will be charmed at meeting in a place so strange and interesting to them as an English University town. If English zoologists are to keep up the high standard of previous Congresses, from the point of view of hospitality, it will be necessary for them to contribute handsomely to the funds of the Congress. It may be mentioned that Mr. P. L. Sclater, F.R.S., and Prof. Hickson, F.R.S, are the Treasurers for this meeting.

The Zoological Society has placed its house at the disposal of the Executive Committee, and all letters to the Treasurers or the Secretaries should be addressed to them at No. 3 Hanover Square.

We are requested by the Secretaries to say that they have taken every means in their power to send invitations and notices to all zoologists whom they have been able to reach; but Secretaries are not infallible, and the Post Office itself has been known to fail in its duties before now. Any zoologist therefore, whether foreign or English, who has not yet received notices with regard to the Congress, should put himself into communication with the Secretaries at the above address.

MODERN VIEWS OF THE RAINBOW.[1]

DESCARTES'S theory of the rainbow, which is still found in all optical text-books, is hardly even a rough approximation to the true theory. It does not fully explain the ordinary bows, and fails entirely as regards the "spurious bows," improperly so called. Any close observer will, under favourable conditions, notice certain colours on the inside edge of the primary bow which are not consistent with the simple series of spectrum colours demanded by the venerable theory which may be said to mark the birth of modern science. These additional colours, chiefly red and green, recall the colours seen in Newton's rings at some distance from the centre, and at once suggest a similar origin. In a paper on "the intensity of light in the neighbourhood of a caustic" (*Trans. Camb. Phil. Soc.*, 6, 1838, and 8, 1848), Airy has laid the foundation of an adequate theory of the rainbow which is gradually being worked out. With

[1] See a paper by J. M. Pernter, *Wien. Ber.*, 106, Part 2, a, 1897, and Abstracts of the Physical Society, No. 86.

a considerable amount of patience, Mr. J. M. Pernter has calculated the tints and the angular deviations of the rainbow colours for various sizes of rain-drops, and has devised experiments in support of his deductions. A parallel beam of sunlight after reflection and refraction in a spherical rain-drop does not emerge as a parallel beam, or as a bunch of parallel beams of various colours, but as a series of caustics of a somewhat complicated nature, in which the divergence of the colours, and hence their distinctness, separation, or coincidence depend upon the ratio of the radius of the drop to the wave-length of the light. The influence of size is very formidable in the smaller drops, say of 0·01 mm. radius. This would be a very fine spray. The actual size of rain-drops is supposed to vary between 0·1 mm. and 2·6 mm., but the heavy drops of tropical rains are said to attain diameters of 3·4 mm. Their size may be estimated by catching up and weighing a definite number, or by the more difficult method of diffraction. The tables drawn up by Pernter consider drops of twelve different sizes between 0·005 and 1 mm. radius. In order to determine the resulting colours, Pernter selects eight of Maxwell's twenty-two colour equations, which number he finds sufficiently accurate. The first set of his tables state, for a point source of light, the sequence of colours, their composition in terms of red, green, and violet, the relative intensity (admixture of white, after Abney) and position on the colour triangle of each shade for various deviations between 42° 20′ and 36°. These tables are then verified by experiments with cylindrical streams of drops, according to Babinet's method. With 1 mm. drops, Pernter observed red, orange-yellow, green, violet, blue' second violet, and then twenty-four secondaries or spurious colours, chiefly pinkish-violet and green or blue; after the twelfth violet came a whitish band, and then a reversal in the sequence of the colours. The 0·5 mm. drops gave 11 bows with 40 shades. The outer bow and its secondaries were also observed. Verifications in nature are hardly possible, as we cannot measure simultaneously the angles and the size of the drops producing the bow; it is striking, however, that so very few angular measures are extant.

The white or pale rainbows (fog or mist bows) around moon and sun may appear pale owing to (1) the feeble intensity of the light, (2) the uneven size of the drops, and (3) the mixture of colours. The first cause is probably a real one; the second Pernter is inclined to reject, since the accompanying, often well-defined features such as "glories," Brocken spectra, &c., and also his own tests require homogeneous conditions. As regards the third, Abney has proved that all colours of any shade disappear on being diluted with 75 parts of white, and Pernter's tables show that such cases may well occur. Further, Airy's theory renders white bands possible for all sizes of drops, and necessary for radii below 25 μ. As a stream of water of such fineness cannot be maintained, Pernter produced a mist spray by fixing a 0·5 mm. glass tube in a lead pipe connected with the Innsbruck water mains (pressure 5 atmospheres), and directing the jet against a metallic plate; the size of drops was derived from measurements of diffraction rings. Drops of radius 5 μ gave a yellow margin at 41° 59′, white between 41° 8′ and 38° 27′, and then blue to 37° 41′; larger drops were more difficult to manage. From measurements of fog-bows on Ben Nevis, J. McConnell had in 1890 already calculated the sizes of the respective drops. But some of these observations speak of a red outer margin, for which Pernter looked in vain, and which his calculations do not indicate; Crailheim-Gyllenskiöld (Swedish North Pole expedition, 1882) also describes the margin as of ochre colour. The classical white bows of Bouguer (1744) and of Scoresby (1821), however, do not fit into the theory at all, and were probably due, as the observers remarked, to ice-needles.

The general conclusions are interesting to meteorologists. The greater the drops, the more secondaries (spurious bows). A chief bow of intense pink and green (hardly any blue) indicates drops of diameters ranging from 1 to 2 mm.; intense red always speaks for big drops. Secondaries of green and violet (the blue is masked by contrast) without yellow, immediately joining the chief bow, correspond to drops of 0·5 mm., while five and more secondaries without white and without breaks mark drops of 0·1 mm. A partly white bow is produced by drops of 0·06 mm., and when the drops are still smaller, a real white bow with orange-yellow and blue margins is the result. The net result of these elaborate investigations will be to add a new interest to a natural phenomenon already endowed with many associations of magic and beauty.

EDUARD LINDEMANN AND OSCAR STUMPE.

THE last days of the old year witnessed the removal by death of two astronomers who have rendered valuable services in the respective positions in which they were situated, though not occupying prominent places in the history of the science. Both are mentioned by the authorities under whom they served with the utmost respect, and their loss is acknowledged with profound regret.

Dr. Eduard Lindemann, who died suddenly on December 21, was born in Nishni-Novgorod in 1842, and pursued his scientific studies in the Universities of Kasan and Dorpat. The latter University he left in 1868 to enter the observatory of Pulkova, wherein he filled the office of scientific secretary. In this capacity he had the management of the library, and the preparation of the second part of the "Librorum in Bibliotheca Speculæ Pulkovensis contentorum Catalogus systematicus" was entrusted to him, and very admirably did he fulfil the trust. The duties of his office did not permit him to take a great part in the astronomical observations there carried on; but his tastes led him to take great interest in the Zollner photometer, and the series of careful measures which he made with that instrument have led to his being regarded as an authority in its use. His paper on the "Brilliancy of Bessel's Stars in the Pleiades," published in tome xxxii. of the *Mem. de l'Acad. Imp. des Sci. de S. Petersbourg*, is well known, and he has further used his measures to determine the scale of magnitude employed in the Bonn Durchmusterung.

The second astronomer whose death (at the early age of thirty-five) we have regretfully to mention is Dr. Oscar Stumpe, well known for his contribution on the motion of the solar system. Dr. Stumpe's early life appears to have been one of great hardship and a severe struggle against adverse circumstances. When ten years old he lost his father, but, in face of all difficulties, he determined to win his way to the Berlin University as a student of science. This he accomplished in 1883, though he had had occasionally in previous years to interchange the parts of student and teacher in order to obtain a livelihood and be enabled to continue his career. Even at Berlin, his studies of mathematics and astronomy were interrupted by his duties as a shorthand writer in the Government and Law Courts. From Berlin he went to Bonn, and became a teacher in a private institution. Here he appears to have prepared the heavy calculations which he afterwards incorporated in his inaugural dissertation on the Solar Motion. In this work, Dr. Stumpe based his computations on 1054 stars, whose annual proper motion exceeded 0″·16 in the arc of a great circle. The peculiar feature in the treatment was the introduction of a term

depending upon a supposed orbital motion of the stars in the plane of the Milky Way. This term did not appear, however, to have a real existence. The stars were divided into four groups depending upon the amount of the annual proper motion, and the four solutions gave very accordant results in R.A. for the position of the apex of the solar system. The declination appeared less certain, but great confidence has been attached to the results of this particular investigation. Dr. Stumpe's talents as a computer have been generally recognised. He took some share in the calculations of the star places in the Bonn Zone Catalogue under Prof. Deichmuller, and afterwards, on repairing to Berlin in 1891, he was engaged in the preparation of the Zone Catalogue 15°—20° declination. Since that time he has assisted Dr. Auwers in the many researches with which that astronomer has been connected, and who loses in him an able co-operator and a devoted assistant.

NOTES.

AT the ordinary meeting of the Royal Society last week, Sir Nathaniel Lindley, Master of the Rolls, was balloted for and elected a Fellow under the special clause in the statutes which permits the admission of members of the Privy Council; and similarly, to-day it is proposed to ballot for Sir Herbert E. Maxwell. It may be recalled that Sir N. Lindley is a son of the late Dr. John Lindley, the famous botanist.

THE original lists of the subscribers to the Indian Section of the Pasteur International Memorial (British Division) have just been received from Surgeon-Major-General Cleghorn. On glancing down the columns where the profession of the donor is given, the first thing which strikes us is the very varied character of the generous contributors to this fund. We find, for example, members of the Indian Civil Service, the Indian Medical Service, officials in the opium department, in the salt department, forest officers and a number of native forest students, members of the legal profession (including a number of native pleaders), merchants (one of whom mentions having been a patient of Pasteur's), chaplains, medical and other missionaries, numbers of jailors and warders, an indigo planter, locomotive superintendents and assistants, the principal of a theological seminary at Insein in Burma, the superintendent of a Government lunatic asylum, civil apothecaries, bankers, revenue clerks, collectors and magistrates, numbers of "private gentlemen" (Indian), the Governor of Madras, the head-master of a missionary school, &c.; whilst the Army in India has also furnished a large contingent of subscribers. In one district we find a note saying that the inhabitants "are not willing to subscribe to the Pasteur Memorial, but will willingly subscribe towards the Pasteur Institute." The manner in which the fund has been supported in India not only reflects the greatest credit upon the subscribers, but also upon those who have so efficiently organised its collection.

AT the Royal Institution last week, Prof. E. Ray Lankester, F.R.S., in commencing his course of eleven lectures on "The Simplest Living Things," remarked that though of late years it had become the custom to use the term physiology as meaning the study of the chemical and physical properties of living things in contradistinction to the study of their structure, yet fifty years years ago it denoted their general study, and the Fullerian Professorship of Physiology—the chair to which Prof. Lankester has just been appointed—was intended for the furtherance of physiology in the broad sense now given to the term biology. It is proposed in a subsequent course to continue the consideration of the simplest living things by a detailed examination of the structure and activities of the different kinds of qacteria, and to give an outline of the science of bacteriology.

MR. CORNELIUS N. HOAGLAND has given to the Hoagland Biological Laboratory of Brooklyn a mortgage for 24,000 dollars.

ELECTRICITY is to be substituted for steam as the motive power of the elevated railroad system of New York City. Contracts for the new equipment have just been signed.

M. J. O. E. PERRIER, member of the section of anatomy and zoology of the Paris Academy of Sciences, has been elected *membre libre* of the Academy of Medicine, in succession to Dr. Magitot.

THE Council of the Sanitary Institute have accepted an invitation from the Lord Mayor and City Council of Birmingham to hold its seventeenth congress and exhibition in that city in September next.

AFTER sixteen years as professor of geography at the Royal University of Turin, Prof. Guido Cora has resigned his charge, in order to devote himself entirely to scientific researches in geography and related sciences. He has transferred his residence (and the direction of his periodical *Cosmos*) to Rome (Via Goito, 2).

THE death is announced of M. Bazin, the French engineer whose "roller-boat" has on several occasions been referred to in these columns.

THE unpublished manuscripts of the late Prof. Julius Sachs, of Würzburg, have, in accordance with his wish, been placed in the hands of Prof. Noll, of Brünn.

PROF. A. S. KIMBALL, for many years professor of physics in the Worcester Polytechnic Institute, and the author of a number of important papers on the subject of friction between sliding surfaces, as well as of other original contributions to physical science, died on December 2, 1897, after a long illness.

DR. DAWSON WILLIAMS, assistant editor of the *British Medical Journal*, who has been connected with the editorial department of the *Journal* for seventeen years, and has on many occasions discharged the duties of acting editor, has been appointed editor in succession to the late Mr. Ernest Hart. Mr. C. Louis Taylor, who has been sub-editor for the last eleven years, has been appointed assistant editor.

A CURIOUS incident in natural history is related by a correspondent of the *Aberdeen Journal* (January 22). While ferreting rabbits on the bank of a small stream, Mr. J. Robson, a gamekeeper who has for about sixty years been out with rod and gun between the Derwent and the Thurso rivers, states that on the ferret coming out of a hole and running up the edge of the stream, a trout leaped out of the water and fell on the gravel in front of the ferret. The ferret attacked the fish, and after considerable difficulty succeeded in capturing it. Mr. Robson sententiously adds: "I then creeled them both."

THE fifty-first annual general meeting of the Institution of Mechanical Engineers will be held in the rooms of the Institution of Civil Engineers, Westminster, on Thursday and Friday, February 10 and 11. The retiring president, Mr. E. Windsor Richards, will induct into the chair the president-elect, Mr. Samuel W. Johnson. The paper on "Mechanical Features of Electric Traction," by Mr. Philip Dawson, read at the last meeting, will be further discussed, and the following papers will be read and discussed, as far as time permits:—First Report to the Gas Engine Research Committee: description of apparatus and methods and preliminary results, by Prof. F. W. Burstall; steam laundry machinery, by Mr. Sidney Tebbutt.

THE death is announced from Halle of Dr. Ernst Ludwig Taschenberg, well known as an entomologist. Born in 1818, he was appointed in 1856 Director of the Zoological Museum at Halle. His entomological studies, begun after his connection

with the Museum, were devoted at first to the hymenopterous fauna of Middle Europe, on which his chief work was "Die Hymenopteren Deutschlands" (1866). These writings were largely compendiums of existing information, and his chief claim to recollection rests on the production of several valuable handbooks on the injurious insects of Germany, such as his "Entomologie für Gärtner und Gartenfreunde" (1871); "Forstwirthschaftliche Insektenkunde" (1874); "Praktische Insektenkunde" (1879-80); and "Die Insekten nach ihrem Schaden und Nutzen" (1882). His "Praktischen Insektenkunde," in particular, published in five parts, is an excellent account of the characters, bionomics and economy of all the more important injurious insects of Middle Europe, arranged according to systematic position, and not, as is generally the case, in relation to the nature of the damage they occasion. In the absence of any satisfactory general text-book on the subject published in this country, this work is indispensable to any serious study of injurious insects in Great Britain, as well as in Germany. Save for a single paper on Hymenoptera, which appeared in 1891, Dr. Taschenberg published nothing on entomology during the past fifteen years.

FOR some time past the weather has been unusually mild for the time of year, and the returns received by the Meteorological Office show that higher temperatures have occurred in parts of the British Islands during the past week than in any January during the last twenty-five years at least. At Wick a temperature of 60° was recorded on the 19th, which is 3° higher than any previous record in this month, and in other parts of Scotland almost equally high readings were observed. The *Weekly Weather Report* of the 22nd inst. showed that the temperature was 7° or 8° above the mean in all districts except the north of Scotland, where it was 5° above the average.

THE current-intensity of a lightning flash is difficult to determine, since we cannot well send it through a galvanometer and determine the magnetic field produced by it. But there are other lines along which we can approach the problem, as has recently been indicated by F. Pockels in the jubilee number of *Wiedemann's Annalen*. It has been noticed that some rocks found on the surface of the earth exhibit a magnetisation which is quite out of keeping with the earth's ordinary magnetism. The probability is at once suggested that their magnetisation may be due to lightning discharges in the neighbourhood. Herr Pockels cut some rods out of the basalt of the Winterberg in Saxony which showed such irregular magnetism, and found on testing them that the permanent magnetism they possessed could only be imparted to them by a current of at least 2900 amperes passing along the surface of the rock. If the discharge did not pass there, it must have been a good deal stronger, so that this is only a minimum value. Later on, he cut some basalt in the neighbourhood of a tree which had been damaged by lightning, a circumstance which gave him some clue to the distance at which the current passed. The value then obtained for the current strength of the lightning was 6500 amperes.

M. ARMAND VIRÉ contributes to the *Revue générale des Sciences* for December 30, a highly interesting paper on subterranean fauna, which he has made the subject of extended study, both in the catacombs of Paris and in the large caves of the Jura, the Pyrenees, and the central plateau of France. A number of illustrations are given of the cæcal forms of arthropods and crustacea discovered by M. Viré, several of which have been described as new species, though the author has endeavoured to refer them to existing forms which have become modified by environment. Most of these cave inhabitants are characterised by the extraordinary development of their tactile and auditory organs, their antennæ, legs, and even their bodies being covered with fine hairs highly sensitive to the slightest disturbance. In searching for transitional types, M. Viré has met with a fair measure of success. In the case of *Asellus aquaticus*, both normal and subterranean forms exist, the latter presenting marked differences in their antennules. The author considers that the subterranean genus of beetles, *Anophthalmus*, is probably referable to *Trechus*, and that the new species, *Niphargus virei*, is possibly a modified form of *Gammarus*. Finally, M. Viré suggests the desirability of an extended series of experiments on these transitional forms, with a view of ascertaining how far they tend to revert to the normal types on being restored to light.

THE transformation of Röntgen rays by metals forms the subject of a note contributed to the Société Française de Physique, by M. G. Sagnac (*Bulletin*, No. 106). When such rays are incident on a metal surface they are not perceptibly reflected, but the superficial layer transforms them into secondary rays capable of producing photographic impressions, of exciting fluorescent screens, or of discharging electrification. These secondary rays differ from ordinary Röntgen rays in that they are freely absorbed by aluminium, the absorption giving rise to a further kind of tertiary rays, still more readily absorbed by aluminium. M. Sagnac suggests that the secondary and tertiary rays may be intermediate between true Röntgen and Lénard rays.

AN important memoir on the magnetic properties of tempered steel has been communicated to the Société d'Encouragement pour l'Industrie Nationale, for publication in their *Bulletin*. The authoress, Madame Sklodowska Curie, discusses which are the best kinds of steel for the construction of permanent magnets. In the first series of experiments, bars and occasionally rings of steel were heated in an electric furnace the spiral current of which at the same time furnished the magnetic field. It was found that steel does not take the temper unless heated to a temperature superior to that at which its magnetic properties change. Among various steels, those containing 1·2 per cent. of carbon were found best suited for the construction of permanent magnets. Madame Sklodowska Curie has also considered the presence of different metals in steel. While these do not usually modify the residual magnetisation, they often considerably ncrease the coercitive field, *i.e.* the field required to cause demagnetisation; the addition of tungsten or molybdenum furnishing the best steel for magnets. The paper concludes with an examination of the stability of magnetisation in bars, the effect of blows and of variations of temperature being specially considered. The greater the coercitive field the less is the effect of blows; heating to 200° considerably affects good magnetic steel, even a temperature of 100° is detrimental, while the best permanent magnets are made by heating the steel to only 60° and partially demagnetising it after having magnetised it to the point of saturation.

THE *Journal de Physique* for January contains, in addition to abstracts, papers by M. A. Leduc, on the densities, molecular volumes, compressibility, and dilatation of gases at different temperatures and at mean pressures; by M. H. Pellat, on the variation of energy in isothermal transformations considered with special reference to electric energy; by MM. Pellat and Sacerdote, on contact phenomena; and by M. G. Sagnac, on diffraction of plane waves by slits and gratings.

AN atlas of the currents of the Pacific Ocean has just been published by the Hydrographer of the Admiralty from information collated and prepared in the Meteorological Office. This is the third volume of current charts for the great oceans that has recently been issued in the same way, with the view of providing the navigator with the best available information. The sources from which the observations were obtained being (1) logs received in the Meteorological Office, mainly from the Mercantile Marine, from 1854-96; (2) logs and

remark books of H.M. ships from 1830-94. Although charts for each month have been prepared, it has been thought advisable to publish four only, viz. for the representative months January, April, July and October, as the amount of information is still deficient in many places unfrequented by ships. The charts show the average direction of the currents and the maximum and minimum velocity which may be expected. In the case of the Japan Stream, which runs almost uninterruptedly to the north-eastward, the velocity sometimes reaches from seventy to seventy-five miles a day. It is seen that there is generally a south-easterly current down the west coast of North America, and a northerly current along the coast of South America, and that these two streams are deflected near the equator to form the equatorial current.

WE have just received the general report of the operations of the Survey of India Department for the year ending September 30, 1896. The report states that the most interesting and important feature of the year's work is the completion of the telegraphic determination of the difference of longitude between Greenwich and Karachi, undertaken with the view of obtaining a definite value for the longitude of Madras (see p. 284). The tidal observations appear to have been regularly and successfully prosecuted. Self-registering gauges are maintained at thirteen stations, and during the year a new tidal observatory was erected at Suez, while preliminary surveys have been made at Perim, Port Albert Victor, and Porbandar, with the view of adding these places to the list of stations. The error of predicted time of high and low water at those open coast stations which are provided with self-registering gauges did not exceed fifteen minutes in about 65 per cent. of the observed tides, while on about 95 per cent. the predicted height did not differ from the observed by more than eight inches. At the riverain stations, the same amount of accuracy in both time and height was reached in 57 and 60 per cent. respectively, but the time of low water was much less certain than that of high. The bulk of the volume is taken up with details concerning the progress of the various surveys, and the preparation of the results for public use. These surveys, of various kinds, extend over a wide area, and bring home to us the immense amount of work accomplished by the department. Here one may read some details of the delimitation of the frontier between British territory and Afghan, and a few pages further on trace the work of demarcation of the Burma-Siam boundary. The interests of the department are wide enough to embrace, and the machinery sufficiently elastic to produce, either a series of sun pictures or illustrations of the action of cobra poison on the blood.

THE remarkable shark, *Chlamydoselachus anguineus*, whose tricuspid teeth and other structural peculiarities render it unique among recent fishes, has been so rarely obtained that the discovery of a specimen in the Varanger Fjord is a matter of considerable interest. Up to the year 1889 only thirteen specimens of this reanimated Devonian fossil had been secured by naturalists, and all of these came from Japanese waters—the last abode of so many primitive oceanic types. In 1889, however, the Prince of Monaco captured a small *Chlamydoselachus* off Madeira, and now Mr. R. Collett provides a description of an unusually fine and complete specimen caught off the coast of Norway rather more than a year ago. His memoir contains a history of all previous records, and is illustrated by an excellent photograph of the fish taken soon after its capture.

THE reason why spiral growths in nature should sometimes take one direction and sometimes another, is often difficult to determine. Mr. George Wherry recently described a few of these puzzles in nature growth before the Cambridge Medical Society. Referring to shells he pointed out that the ancient whelk, now in fossil form (*Fusus antiquus*) is usually left-handed, while in the present generation of common whelks the shell is always right-handed. Nevertheless, among the right-handed shells there is occasionally found a specimen of a modern whelk of the ancestral type going a contrary curve. What was there at work in the whelk when the soft young creature began life to give it the twist to left or right? and why are the ancient whelks found going the "wrong" way? Similar questions may be asked of other natural torsions. For instance, spiral growth in plant-life is a subject of bewildering interest, and though worked at by so many great observers, from John Hunter to the Darwins and De Candolle and the modern Germans, there are still many phenomena wholly unexplained. The hop and honeysuckle take the form of a left-handed screw; the majority of twining plants, however, twine like a right-handed screw—*i.e.* from the left below to the right above when the plant and its support are looked at from the exterior. A twining plant will make its spiral curves without a support if the terminal be merely steadied by a thread and weight over a pulley so that the apex of the shoot is drawn vertically upwards, but a free horizontally sweeping shoot will make no spiral turns at all. There are also other spiral growths which present many points of interest, and sometimes the value of a twist in a particular direction can be easily understood. Mr. Wherry points out that the horns of the koodoo, for example, are twisted in a right-handed spiral on the left side and a left-handed spiral on the right side. The result is that when the animal rushes through the bush the horns thrown back act as a wedge and drive aside the branches as the koodoo dashes through the thicket. With regard to hoofs and nails, it is astonishing under the influence of moisture and absence of friction how these organs will curve and grow spirally.

THE cause of death by electric shocks has been experimentally investigated by Prof. T. Oliver and Dr. R. A. Bolam, who describe their methods and results in the *British Medical Journal*. The increasing employment of electricity within the last few years has demonstrated, by the accidents to workmen engaged in its generation and distribution, that danger is involved. Two opinions are held as to the cause of death in such cases, viz.: (1) that death is due to failure of the respiratory centre (d'Arsonval); (2) that it is due to sudden arrest of the heart's action. From the appearance presented by the internal organs after death, some physiologists have maintained that death is due to asphyxia. But other evidence suggests that death is not due to failure of the respiratory centre. In the experiments carried out by Prof. Oliver and Dr. Bolam, an alternating current was used, and death appears to have resulted from heart rather than respiratory failure. Whilst in some of the experiments death seemed to be due to contemporaneous cessation of the respiration and heart's action, yet in most there was ample demonstration that the organ first to be arrested was the heart, for breathing was observed to continue rhythmically for a brief period, and then irregularly and feebly before stopping. There is reason to believe that only in the case of very high voltages with currents considerably above the potential usually required to kill the animal is there simultaneous stoppage of heart and respiration. Primary cessation of the heart's beat is, without doubt, the general rule, while under no circumstances did the authors succeed in causing primary arrest of respiration followed by failure of the heart. It follows from this that resuscitation in apparent death from electric shock is made much more difficult than if the fatal result were brought about by respiratory failure. With reference to these experiments, Dr. Lewis Jones calls attention, in the *Electrical Review*, to a similar investigation carried out by him in 1895, using a continuous current.

THE first volume is announced of the new "Flora of the Pyrenees," by the late P. Bubani, edited by Prof. Penzig, of Genoa. It is published by Hoepli, of Milan, and will be followed by three other volumes.

AN amusing instance of the want of observation of the commonest phenomena of nature has come under our notice in a schedule of the "Language of Flowers" issued by a well-known firm of perfumers. The symbol for "assiduous to please" is "sprig of ivy with tendrils"!

DR. A. WAGNER, of Neuhaus am Inn, Bavaria, issues a list of fifty microphotographs at 1 m. and 1 m. 50 each, a reduction on a quantity. The subjects are entirely botanical, and include sections and microscopic organs of Phanerogams and Cryptogams.

DURING February the following science lectures will be given at the Royal Victoria Hall:—February 1, "Insects in a London Back Garden," Mr. F. Enoch. February 8, "The Problem of the Great African Lakes," Mr. J. E. S. Moore. February 15, "Brains," Mr. Hugh de Haviland.

MR. S. B. J. SKERTCHLY has a note, in the "Geological Survey of Queensland," on a plant which he calls the "copper plant," *Polycarpæa spirostyles*, belonging to the Caryophyllaceæ. He finds it always associated with copper lodes, and thinks it may be of use, on this account, from a practical point of view. Analysis shows the ash to contain an appreciable amount of copper.

DR. C. E. BESSEY republishes, in a separate form, his address as retiring president of the Botanical Society of America, entitled "The Phylogeny and Taxonomy of Angiosperms." A modification, to a not very large extent, is proposed of the systems of De Candolle and of Eichler and Prantl, by which it is thought that the phylogenetic relationships of the orders of Monocotyledons and Dicotyledons are more completely indicated.

WE have received the first three numbers of a new serial, the *Circular* of the Royal Botanic Gardens, Ceylon, intended to deal with agricultural, horticultural, and botanical topics, with special reference to the work carried on in the Botanic Garden. The chief subject treated in these numbers is the canker of the cacao tree, its cause, and the possible remedies, including a correspondence on the subject with the authorities at Kew.

MR. J. H. HART, the Superintendent of the Royal Botanic Garden, Trinidad, has commenced, in the *Bulletin of Miscellaneous Information*, the publication of a monograph of the Ferns of the British West Indies and Guiana, prepared by Mr. G. S. Jenman. Vol. iv. part 5 of the *Bulletin*, for January 1898, is entirely occupied by the two genera *Hymenophyllum* and *Trichomanes*, twenty-nine species being described of the former, and forty-two of the latter genus.

A LEAFLET on "The Advantages of Boiling Drinking Water and Milk" has just been published by the National Health Society. It is written by Mrs. Percy Frankland, and is intended for distribution amongst both rich and poor. It contains a brief account of the dangers which may attend the use of contaminated water and milk, and a few simple instructions are given for ensuring the removal of any noxious germs which may be present by the efficient boiling of these liquids. Copies for distribution may be obtained of the Secretary of the Society, 53 Berners Street, London, W.

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*) from South-East Africa, presented by Miss Rogers; a Smooth-headed Capuchin (*Cebus monachus*) from South-east Brazil, presented by Mr. W. S. Jay; a Chinese Goose (*Anser cygnoides*) from China, presented by the Rev. E. Hensley; a Beccaris Cassowary (*Casuarius beccarii*) from New Guinea, deposited.

IN the notice of Mr. Dodgson, the words "symbolically developing and popularising" should be inserted before "the study" in the seventh line from the end (p. 280).

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 3. 18h. 43m. to 19h. 10m. δ Geminorum (mag. 3·7) occulted by the moon.
5. 17h. 34m. Near approach of *o*′ Cancri to the moon.
6. Pallas 1° N. of τ Eridani.
9. 10h. 13m. Minimum of β Persei (Algol).
11. 6h. Mercury 1′ N. of Mars.
11. 17h. 26m. to 17h. 54m. 89 Virginis (mag. 5·2) occulted by the moon.
12. 7h. 2m. Minimum of β Persei (Algol).
13. 19h. 33m. to 20h. 37m. *b* Scorpii (mag. 4·8) occulted by the moon.
14. 10h. 23m. Moon in conjunction with α Scorpii (Antares).
14. Illuminated portion of Venus = 1·000.
,, ,, Mars = 0·981.
14. 17h. Saturn in conjunction with moon. Saturn 5° 30′ N.
15. Venus 1½° S. of the sun.
23. 8h. 52m. to 9h. 11m. Jupiter with only one visible satellite.

THEORY OF PERIODIC COMETS.—We have already called attention in this column (September 16, p. 473) to the recent work of M. Callandreau on the subject of disaggregation of cometary matter, and pointed out the lines he has followed in his research. In the *Annales de l'Observatoire de Paris, Memoires*, t. xxiii., he has collected the results of his recent work, and examined to what extent the theory is supported by recent observations. The circumstances favourable for disruption are—close approach to Jupiter, small relative velocity, and small excentricity of orbit. The question is, therefore, to what extent do the elements of comets which have given evidence of disintegration exhibit these peculiarities. It must be remembered, that it is only since the comet of 1882 was seen to be accompanied by faint nebulous matter that the neighbourhood of a comet has been regularly explored to detect the presence of companions. The most typical case yet noticed is that of the comet of 1889 V., which was very numerously attended, and of which it has been established that the orbit of at least one of the companions cuts the orbit of the principal comet near its aphelion. Since this comet, as Chandler has shown, made an approach to Jupiter in 1886, it seems likely that the disruption took place then, owing to the influence of that planet, since the conditions indicated as favourable to the theory are all present in this instance. The existence of the two distinct comets of Wolf and Barnard (1892 V.) can with probability be traced to the action of Jupiter, but the epoch at which the approach to the planet occurred cannot be decided.

The famous instance of Biela is inconclusive. A general investigation of the distance between the two nuclei shows that this is greatest about perihelion, and least at, or near, aphelion. The difficulty of identifying the two nuclei led Prof. Hubbard to make two hypotheses in his calculations, and he preferred that which gave the minimum distance between the two nuclei. But M. Callandreau shows that adopting the second hypothesis, which, though rejected by Hubbard, is by no means excluded by the result of his researches, the division of the comet into two parts would take place in Heliocentric Longitude 266°, while the longitude of the point of closest approach of the orbit of Jupiter and the comet is 268°.

The suggestion that a family of comets with aphelia near the orbit of Jupiter and with periods approximately half that of the planet, should be introduced into the solar system by the action of Jupiter, is not without its objections, based on the theory of probabilities; but the multiplication of comets by disruption is free from this objection, and would also tend to explain the faintness which is a feature of this class of comets.

PHOTOGRAPHIC MAGNITUDES.—In *Circular* No. 22, issued from the Harvard College Observatory by Prof. Pickering, the question of photographic magnitudes of stars is considered. It is pointed out that it is a matter of great importance to know how much the relative brightness of star images will vary on different plates, or on different portions of the same plate. It is especially important to determine the amount of this error, since it is not easily eliminated and has been supposed to be large by some persons not familiar with stellar photographs. A moment's investigation of photographs of the same portion of the sky shows that this source of error is small, so small

that it is not readily determined by direct measurement. The uniformity of different portions of the film is shown by allowing the stars to trail over the plate. A much more delicate test was found in the discussion of a series of measures of the variables discovered by Prof. Bailey in the cluster Messier 5. Sixty-three of these variables were compared on 41 plates by Argelander's method, with a sequence of comparison stars. Estimates were made of the difference in grades of each variable from the next brighter and the next fainter star of the sequence. The sum of these differences gives the interval between the comparison stars, and combining all the results gives, in general, several measures of each interval on each plate. Each comparison star in turn may then be regarded as a variable, and its changes in light determined from the next brighter and next fainter star of the sequence. Comparatively few measures were made of the six brightest and the three faintest stars of the sequence. The five intermediate stars were measured on 41, 39, 38, 30 and 30 photographs respectively. On the average, therefore, five stars were measured on 35 plates, which gave a range of 0·12 magnitudes and an average deviation of 0·02 magnitudes. The average deviation 0·02 includes: (1) the errors of observation; (2) errors due to neglecting hundredths of a magnitude; (3) errors due to irregularities in the film which enter with their full value into the result. Since the combined effect of these three sources of error is only ± 0·02, it is evident that neither of them can be large. The errors due to the film are in fact so small, that there is no evidence that they exist, and more delicate methods of measurements are required to render them perceptible.

THE COMPARATIVE PHYSIOLOGY OF THE SUPRARENAL CAPSULES.[1]

DR. SWALE VINCENT has in previous communications given certain experimental evidence in favour of the view that the paired suprarenal bodies and the inter-renal gland of Elasmobranch fishes correspond respectively to the medulla and the cortex of the suprarenal capsules of the higher Vertebrata. This evidence consisted in the utilisation of the discovery of Oliver and Schäfer that the medulla of mammalian suprarenal contained a substance which, when injected into the circulation, produced an enormous rise of blood-pressure. Dr. Vincent found that the paired bodies of Elasmobranchs contained this active substance, while the inter-renal gland in the same order of fishes and the known suprarenals of Teleosts did not. Thus it appeared that the medullary portion of the suprarenal was absent in Teleosts, the suprarenal bodies in this order of fishes consisting solely of cortex.

Since performing the above experiments his attention has been given to the general physiological effects of extracts obtained from suprarenal capsules. The extracts were made separately from cortex and medulla, and injected subcutaneously into various mammals. It was noted that the injection of medullary material was invariably fatal if a sufficiently large dose were administered, while the cortical extracts produced no appreciable physiological effects. The mode of preparing the extracts was usually by boiling for a short time in water or normal saline, and carefully filtering, as it had been found that boiling, if not too prolonged, did not destroy the active material. The symptoms usually observed were a characteristic progressive paralysis, with occasionally convulsions. Death probably occurred by respiratory paralysis.

Since these effects were only produced by medullary substance, there appeared now to be afforded a still further means of testing the above views concerning the homologies of the two kinds of suprarenal in Elasmobranchs and the corpuscles of Stannius in Teleosts with the two portions of the suprarenal capsules of the higher Vertebrata. Accordingly, in the present communication the hypothesis has been established on a still firmer basis by testing the effects of the two kinds of gland in Elasmobranchs and of the cortical suprarenals of Teleosts, where extracts of them are injected subcutaneously into small mammals. Naturally only very small quantities of material have been available for this purpose, but the effects upon mice have been quite definite. Material from *Gadus morrhua* produced no effects whatever. The paired bodies from *Scyllium canicula* and *Raja clavata* produced characteristic symptoms and a rapidly fatal result. Again, the inter-renal from these genera was found to be inactive. One of the mice certainly which was injected with an inter-renal extract was found dead on the following day, but Dr. Vincent thinks this result can reasonably be attributed to contamination with the paired bodies, and is analogous to the effect one sometimes obtains upon the blood-pressure when inter-renal extract is injected intravenously. The symptoms noted in the mice as the result of injection of the active material were quickened respiration at first, which afterwards became slower and slower, and paralysis commencing in the hind-limbs, and finally affecting the whole body. In one case there were convulsions. In fact, the results were typically those of poisoning by suprarenal medulla.

These experiments afford further positive evidence of the homology of the paired bodies of Elasmobranchs with the medulla of the mammalian suprarenal. The direct evidence in favour of the homology of the inter-renal with the cortex of the suprarenal is mostly morphological and histological, and this the author has detailed elsewhere.

[1] Abstract of a paper entitled "Further Observations upon the Comparative Physiology of the Suprarenal Capsules." By Dr. Swale Vincent. (Read before the Royal Society, November 25, 1897.

MIMICRY IN INSECTS.[1]

SHARING in the perplexity avowedly felt by many of my predecessors in this chair as to the choice of a subject for the annual address—perplexity arising rather from the redundancy than from the scarcity of entomological matter—I have been led to think, considering the wide-reaching importance of the questions involved and the unmistakeable interest shown in the recent discussion at two of our meetings, that some account of the mimetic relations existing among insects might not be out of place. Having for a considerable period devoted some attention to the matter, I propose to pass in review what has been placed on record; and if, in so doing, I traverse ground very familiar to most of us, my excuse must be the fascinating interest which attaches to the whole subject.

Early Contributions to Mimicry.

The application by Henry Walter Bates, our lamented President, of the great principle of natural selection in elucidation of the mimicries found among insects is too well known to require any detailed repetition here. It is sufficient to recall that, as the result of many years' experience in tropical South America, Bates established the facts that (1) among the abundant and conspicuous butterfles of the groups Danainæ, Heliconiinæ, Acræinæ, and some Papilioninæ were found very much rarer mimicing forms, chiefly of the group Pierinæ but partly belonging to other groups and some even to the Heterocera, which, departing very widely from the aspect of their respective allies, imitated with more or less exactness the abundant species in question; (2) the numerous and showy Danainæ, &c., although of slow flight, did not appear to be molested by the usual insectivorous foes; and (3) the members of these unassailed tribes possessed malodorous juices not found in the mimicking forms or their allies. From these data he argued that the explanation of these extraordinary resemblances was to be found in the great advantage it would be to species undefended by offensive secretions, and therefore palatable and much hunted down, to find escape in the disguise of species recognised and avoided as unpalatable; and traced the mimicries to the long-continued action of natural selection, perpetually weeding out by insectivorous agencies every occurring variation not in the direction of likeness to the protected forms, but as perpetually preserving, and so aiding the development by heredity of, every variation favourable to the attainment of the protective mimicry.

This sagacious application of the Darwinian theory in solution of one of the most difficult and baffling of the problems presented to zoologists, was of the greatest service and encouragement to all students of evolution. I retain to-day the liveliest recollection of the delight I experienced in the perusal of a copy of Bates's memoir received from himself; for his work was not that of the mere cabinet systematist, but came with all the force of face-to-face commune with the abounding life of the tropics.

Before two years had passed, Bates's explanation of mimicry was confirmed by his former companion in exploration, Alfred Russel Wallace, who, working with equal devotion in the

[1] Abstract of the presidential address delivered before the Entomological Society of London on January 19, by Mr. Roland Trimen, F.R.S.

Malayan Islands, had observed and was able to adduce a strictly analogous series of mimetic resemblances among Oriental butterflies, and gave his unreserved acceptance of the Batesian interpretation. Such support from the co-founder with Darwin of the theory of natural selection, and from a naturalist of the widest experience in both Western and Eastern tropics, was of the greatest weight with evolutionists generally.

My own contribution to the subject was read to the Linnean Society in March 1868. In the previous year I had made an entomological tour in Natal, and had enjoyed some precious opportunities of observing in nature several cases of mimicry between species not inhabiting the Cape Colony. There was no claim to originality in my paper; it simply rounded off the case by adding from Africa, the third great tropical region of the globe, a series of instances and observed facts confirmatory of those brought forward by Bates from the Neotropical, and by Wallace from the Oriental region. Of course I had had nothing like the extended field experiences of those great naturalists, and the African material then available was but scanty; but it so happened that perhaps the most striking and elaborate of all recorded cases of mimicry—that exhibited by the females of the *Merope*-group of *Papilio*—had come under my personal observation in South Africa, and I was thus in a position to describe satisfactorily a wonderful illustration of the Batesian theory.[1]

It will be remembered that Bates, in his memorable paper, also brought to notice the very close resemblances, or apparent mimicries, which unquestionably exist between species belonging to different groups or subfamilies of protected distasteful butterflies themselves; but neither he nor Wallace felt able to give any explanation of these instances, which obviously differed very materially from the cases of mimicry of an unpalatable protected species by a palatable unprotected one. Not until 1879 was there any elucidation of this side of the matter, but in May of that year appeared in *Kosmos*, Fritz Müller's notable paper on "*Ituna* and *Thyridia*," which was translated by Prof. Meldola, and printed in our *Proceedings* for the same year (p. xx.). In this memoir, Müller made the valuable suggestion that the advantage derivable from these resemblances between protected forms was the division between two species of the percentage of victims to the inexperience of young insectivorous enemies which every separate species, however well protected by distastefulness, must pay.

Prof. Meldola not only brought forward and supported, with all his wonted grasp and acumen, F. Müller's daring interpretation of this phenomenon, but in 1882, in a paper discussing the objections brought against Müller's view, made a distinct advance by showing how that view could justly be extended to explain the characteristic and peculiar prevalence of one type of colouring and marking throughout large numbers of species in protected groups—so especially noticeable in the sub-families Danainæ, Heliconiinæ, and Acræinæ.

In 1887 was published Prof. Poulton's most interesting memoir entitled "The Experimental Proof of the Protective Value of Colours and Markings in Insects in reference to their Vertebrate Enemies," which dealt in great detail with the actual results of numerous experiments conducted by himself and other naturalists with the object of ascertaining to what extent highly conspicuous (almost always distasteful) larvæ and perfect insects are rejected or eaten by birds, lizards and frogs. The conclusions given at the close of this paper cover a wide range in connection with the subject of warning coloration, and among them I would call special attention to No. 5, in which the author points out that "In the various species in which a conspicuous appearance is produced by colour and marking, the same colours and patterns appear again and again repeated," and adds that "In this way the vertebrate enemies are only compelled to learn a few types of appearance, and the types themselves are of a kind which such enemies most easily learn." This generalisation certainly had the merit of first detecting a great additional advantage derivable from the common aspect exhibited by a number of protected forms in the extended "Müllerian" associations indicated by Prof. Meldola; and it was applied by Wallace to the case of the Heliconiidæ in the comprehensive survey of warning coloration and mimicry generally given in "Darwinism." We are further indebted to Prof. Poulton for the discussion and summary of all extant data up to 1890 in his "Colours of Animals"— a work which abounds in pregnant suggestion, and indicates with justice and clearness how far the evidence forthcoming was valid, and in what directions evidence still lacking should be sought.

Wallace well observed that "to set forth adequately the varied and surprising facts of mimicry would need a large and copiously illustrated volume; and no more interesting subject could be taken up by a naturalist who has access to our great collections and can devote the necessary time to search out the many examples of mimicry that lie hidden in our museums." A work ostensibly of this character was issued in 1892–93, in two parts, from the pen of the late Dr. Erich Haase, under the title of "Untersuchungen über die Mimicry auf Grundlage eines natürlichen Systems der Papilioniden"; and last year an English translation of the second part was published, and has quite recently been reviewed by Prof. Poulton (NATURE, November 4 and 11, 1897).

Recent Contributions to the Subject.

Among recent contributions to the subject, we shall, I think, all agree in assigning a high place to the memoirs with which Dr. F. A. Dixey has enriched our *Transactions*. In 1894 he read before the Society his elaborate paper "On the Phylogeny of the Pierinæ, as illustrated by their Wing-markings and Geographical Distribution," and took occasion to discuss the wide divergence from the primitive or typical pattern of the group caused by mimicry in such genera as *Euterpe*, *Pereute*, *Dismorphia*, &c. Adopting the Müllerian interpretation as expanded by Meldola, he proceeded to offer the original suggestion that, in the acquisition of closer resemblance between two or more protected forms, it was not necessary that in every instance the process of adaptation should lie solely in the imitation of one particular form as model, but that there might very well exist *mutual* convergence of the forms concerned, thus accelerating the attainment of the common beneficial resemblance. This "reciprocal mimicry" the author further explained in a paper read in 1896 "On the Relation of Mimetic Patterns to the Original Form" (pp. 72–75), by a consideration of certain mimetic sets of Heliconii, Pierinæ, and Papilioninæ which present features and relations of pattern and colouring explicable apparently in no other way than by the hypothesis in question. This paper also gave a lucid demonstration, traced through corresponding series of existing forms of both mimetic and non-mimetic Pierinæ, of "the successive steps through which a complicated and practically perfect mimetic pattern could be evolved in simple and easy stages from a form presenting merely the ordinary aspect of its own genus," and further adduced reasons for holding that "it is not necessary that the forms between which mimicry originates should possess considerable initial resemblance." In his latest memoir, "Mimetic Attraction," read on May 5 last, Dr. Dixey expanded a suggestion he had previously (1896) made respecting divergent members of an inedible group to point out—still from evidence in the Pierine subfamily to which he has devoted so much fruitful study—"how the process of gradual assimilation starting from one given point may take not one direction only but several divergent paths at the same time," with the result that a more or less intimate mimetic relation was brought about with several protected forms of quite different affinities, though each connected in their colouring and aspect with some group of distasteful associates. He further set forth very fully the distinction which exists between the mimicry of inedible by edible forms, which could only be in one direction and was of advantage to the mimicker alone, and the assimilation among inedible forms themselves, where the mimetic attraction acts reciprocally, to the advantage of all participators.

Another of our Fellows, Colonel C. Swinhoe, distinguished for his wide and intimate knowledge of Oriental Lepidoptera, read before the Linnean Society, in 1895, a most interesting paper "On Mimicry in Butterflies of the genus *Hypolimnas*." In this memoir, as the author points out, a small group of wide-ranging mimetic insects is followed throughout its geographical distribution; and the process of mimetic modification is traced through the female, from the amazing instability of that sex of *H. bolina* (local form) in the Fiji Islands, where the male is stable and of the normal ancestral pattern and colouring, to the opposite extreme in Africa, where (with the exception of *H. misippus*) both sexes of the known allied forms of the genus

[1] At various subsequent dates I was enabled, through the valuable aid of Mr. J. P. Mansel Weale and Colonel J. H. Bowker, to make known to science conclusive evidence of the species-identity of the three mimetic females of *Papilio cenea*, and of the pairing of the widely-differing sexes of that species.

are equally mimetic.[1] The singular contrast between the numerous modifications of the female of the *Bolina* type, and the absolutely constant imitation of *Danais chrysippus* alone by the ♀ *H. misippus* is well brought out, and the different courses thus pursued by the respective females are shown to depend on the range, variation, and abundance of the model that is mimicked. Colonel Swinhoe had previously (1887) published a good account of mimicry in Indian butterflies, and in it made special reference to the remarkable series of close likenesses between species belonging to different subgenera of the great protected genus *Euplœa*.

Mimicry in Various Orders of Insects.

So much prominence has naturally been given to the very conspicuous development of mimicry among the Lepidoptera, that it is not uncommon to hear the matter spoken of as if limited to butterfles and moths, and even entomologists need to be reminded of the prevalence of the phenomenon among other orders of insects. The stinging *Hymenoptera* furnish the most numerous models to members of other orders, being closely mimicked by numerous Diptera, by many heterocerous Lepidoptera, by various Carabid, Heteromerous, and Longicorn Coleoptera, and by some Hemiptera; while certain ants are well imitated by spiders. As regards *Coleoptera*, mimicry is mainly found within the limits of the order itself—*e.g.* Cicindelids by Heteromera and Longicorns, Carabids by Heteromera, Malacoderms by Longicorns, and Rhynchophora by Longicorns; but certain Cicindelid and Rhynchophorous beetles are closely copied by Orthoptera, belonging respectively to the genera *Condylodeira* and *Scepastus*. *Lepidoptera* do not seem to find mimickers beyond their own order, unless the case quoted by Haase from E. Hartert, of the resemblance of a large Cicada to the Indian *Thaumantis aliris* (Morphinæ) be one of actual mimicry. Nor do *Diptera* appear to be models for imitation, except in the case of the hunting spiders, which mimic the Muscidæ they chase; although the neuropterous *Bittacus* certainly bears a strong likeness to Tipula, and may possibly find the advantage of that harmless aspect in approaching its prey. It cannot be denied that some of the inter-ordinal mimicries are even more impressive and striking than those so notable among butterflies, the excellence of the superficial disguise of general outline, proportion of parts, colouring, and markings being so great as to throw into obscurity the really vast structural discrepancies. Such cases as the imitation of the South American wasps of the genera *Polybia* and *Synœca* by moths of the genera *Sphecosoma* and *Myrmecopsis*, of the Bornean sand-wasp *Mygnimia aviculus*, by the beetle *Colobothrombus fasciatipennis*,[2] or of the Philippine tiger-beetle *Tricondyla*, by the cricket *Condylodeira*, are absolute marvels of deception, all belonging to that special phase of mimicry where the obvious advantage to the unarmed mimic lies in being mistaken for the armed and formidable model.

Returning to the general aspects of the subject, it is of importance to consider more closely how the evidence stands in relation to (*a*) persecution by insectivorous foes, (*b*) possession of malodorous and distasteful juices by certain groups of insects, (*c*) rejection or avoidance by foes of the insects provided with offensive juices, and (*d*) loss occasioned to distasteful species by the attacks of young and inexperienced enemies; for it is admittedly on the co-operation of these factors that the theory of mimicry depends.

(*a*) Persecution by Insectivorous Foes.

As regards the first point, the broad fact of insects generally constituting the food of countless devourers, vertebrate and invertebrate, is beyond dispute; immense and incessant persecution is universally at work. But when we proceed to examine this world-wide persecution more in detail, and to ask in what special directions it works, or what groups or species are the particular prey of certain groups or species of enemies, we very soon discover how little is exactly known. Birds, for instance, are such notorious and apparently indiscriminate insect-eaters, and some of them are so active and demonstrative in their hunting, that it seems but reasonable to regard them as the chief pursuers on the wing of the abundant and defenceless butterflies. Yet in the discussion which followed the reading of Dr. Dixey's last paper already referred to nothing was more noticeable than the very scanty testimony to such persecution on the part of birds that could be brought forward by the very competent well-travelled entomologists present. In fact, the poverty of observed cases of such attack has induced the opinion among some entomologists that birds very rarely chase butterflies at all, and the published expression of this view by Pryer, Skertchley, Piepers, and other experienced collectors cannot be overlooked. But I am persuaded that in this instance, as in so many others where the life-history of animals is concerned, the dearth of evidence is due to the neglect of well-directed and sustained observation. Little can be gained by merely noting such cases as happen to force themselves on the collector's attention; the collector must resolutely set himself to search out and keep watch upon what really takes place. Considering that there is no record of any naturalist's having seriously taken up the investigation of this matter in the field, I think that very much positive evidence could hardly be expected, and that what has been published goes far in the direction of proving that birds must still be reckoned among the principal enemies of butterflies.

(*b*) Possession of Malodorous and Distasteful Juices by Certain Insects.

The presence of malodorous juices in many insects is a matter of common observation, and is a protective property possessed by several entire groups, especially among the Lepidoptera and Coleoptera. There is abundant evidence as to the prevalence of these secretions, and among the Lepidoptera they are particularly developed in the butterflies of the groups Danainæ, Neotropinæ, Acræinæ, and Heliconinæ, and also in some Papilioninæ, as well as in many moths of the groups Agaristidæ, Chalcosiidæ, Arctiidæ, Lithosiidæ, &c. The strength of the disagreeable odour emitted is in some species very great; Seitz, for instance, mentioning that the smell of the South-American *Heliconius beschei* and *Eueides aliphera* extends over a radius of several paces, and Woodmason and De Nicéville testifying to the same effect as regards the Indian *Papilio philoxenus* and allied forms. When molested many of these offensively-smelling species exude drops of a yellow or whitish fluid which leave on anything they touch a stain and odour difficult to remove, as I have experienced in the case of the Mauritian *Euplœa euphone*, the South-African Danainæ and Acræinæ, and various South-African Agaristidæ, Glaucopidæ, and Arctiidæ.

The origin and manner of acquisition of these unsavoury secretions have yet to be discovered; the suggestion (so much insisted on by Haase) that these juices are directly derived from those of similar quality in the food-plants of the larvæ arising from the long-known circumstance that some of the food-plants of species in the protected groups are of an acrid or poisonous character, such as (*e.g.*) Asclepiads in the case of many Danainæ, and Aristolochia in that of the inedible forms of Papilioninæ. No doubt, too, the fact that the unpleasant qualities are very often fully developed in the larvæ of the distasteful species—as I have found with *Danais chrysippus* and various Acræinæ—lends some weight to the suggestion; but at present nothing approaching sufficient data can be brought forward respecting the actual food plants to which the protected groups, in contrast to the unprotected, are thought to be restricted. It cannot be gainsaid, as Prof. Poulton has pointed out (*Proc. Zool. Soc. Lond.*, 1887, pp. 198, &c., and NATURE, November 4, 1897, p. 3), that the food-plants of many of the distasteful European moths do not belong to any poisonous or acrid category; and his own and Mr. Latter's papers on *Dicranura vinula* alone amply demonstrate what powerful acids can be elaborated by a larva which finds its food in such innocuous plants as poplar and willow. The supposed direct derivation of the nauseous juices from the plants consumed is thus plainly a matter that awaits investigation from both biological and chemical standpoints.

(*c*) Avoidance or Rejection of Insects by Insectivorous Animals.

The avoidance or rejection as food by insectivorous animals of the insects possessing malodorous or distasteful juices no longer rests merely on the negative evidence given by Bates, Wallace, Belt, and other competent observers, to the effect that in nature such distasteful forms are habitually neglected and unmolested; there is now much positive experimental evidence

[1] It should be noted that in the African *H. salmacis* and the Malagasy *H. dexithea* the sexes are alike and non-mimetic, and that therefore these species probably most closely approximate to the primitive appearance of the genus.

[2] See Pryer, *Trans. Ent. Soc.*, 1885, p. 369, pl. x., who in the same place also figures another most striking case from Borneo, in which the hymenopterous *Triscolia patricialis* is mimicked by the lepidopterous *Scoliomima insignis*.

as to the manifest avoidance or disgust with which such species are left untouched, or thrown aside after tasting, when offered to domesticated or captive vertebrate animals that devour ordinary insects with avidity. The numerous experiments of this kind recorded by Butler, Jenner Weir, Weismann, Poulton, and Lloyd-Morgan, as regards both larvæ and imagos of European species, are supported by a few made by Belt with Heliconiinæ in Central America, by D'Urban and myself with Danainæ and Acræinæ in South Africa, and by Haase with Danainæ in Singapore.

It is manifest, of course, that even the most distasteful forms cannot enjoy complete immunity from persecution; in ordinary circumstances they are doubtless mainly kept down by parasitic insects, and during any scarcity of more palatable prey it is certain that they will be devoured *faute de mieux* by vertebrates and invertebrates alike.

(*d*) Losses due to Inexperience of Enemies.

As regards the important point whether the protected forms have to suffer a certain percentage of loss from the attacks of young and inexperienced birds and other animals, it must be admitted that the evidence at present forthcoming is exceedingly scanty; and I have long felt considerable doubt as to the sufficiency of this factor to account for the mimetic resemblances, often remarkably close, between members of associated protective groups. But on reviewing carefully the recorded observations which appear to bear on the question, I have found reason to think that there is enough support to justify the provisional acceptance of the Müllerian explanation. We have in the first place Fritz Müller's own capture of Heliconii and Acræinæ with a notched piece bitten out of the wings, and Distant's (*l.c.*, p. 65) of a *Danais chrysippus* whose wings had been bitten unsymmetrically, apparently by a bird. Then there is the significant record of Skertchley, who, among twenty-three species of Bornean butterflies taken with both hindwings mutilated in the same manner, notes no less than four Danainæ, viz. *Hestia lynceus*, *H. leuconoe*, *Ideopsis daos*, and *Euplœa midamus*. Moreover, it is very remarkable that several of those entomologists who have specially emphasised the small part played by birds in attacking butterflies mention, among the few cases of such attack as they witnessed, instances of protected forms being assailed, Sir G. Hampson remarking that in South India the Euplœæ and Danaids were caught as often as any others, and M. Piepers that in two of the four cases which he had seen in Sumatra and Java, the species seized were Euplœæ.

The question underlying this is manifestly whether insect-eating animals have an instinctive inherited discernment of what species are unfit for food, or whether, on the contrary, each individual has to acquire this necessary knowledge by personal experience, aided in some vertebrate groups by parental guidance. So numerous and so marvellous are the instinctive or congenital activities of animals—especially in the insect world, where past experience or parental instruction is almost always non-existent—that there has been a very general disposition on the part of naturalists to incline to the former view in a matter so all-important as suitable food. Yet, as far as experiment has hitherto gone in this direction, there seems good ground for holding that—at any rate in such specially insectivorous vertebrate groups as birds, lizards, and frogs—the young possess no such hereditary faculty of discrimination, but have to discover individually what to avoid. This appears not only from Mr. Jenner Weir's and especially Prof. Poulton's careful and often-repeated experiments with lizards and frogs, but also from Prof. Lloyd-Morgan's study of newly-hatched birds of different orders, which indicates clearly with what complete want of discrimination every object of suitable size is at first pecked at and tasted, but how soon experience tells and is acted upon. Prof. Lloyd-Morgan made special trial of these young birds with many distasteful insects and their larvæ, and states in conclusion that he did not find a single instance of instinctive avoidance, but that the result of his observations is that "in the absence of parental guidance, the young birds have to learn for themselves what is good to eat and what is distasteful, and have no instinctive aversions."

In concluding what I feel to be a very incomplete outline of what has been done in this most important branch of zoological research, I cannot refrain from expressing the gratification I find in noting how by far the chief part in the investigations pursued and in the deductions derived from them has from the outset been borne by Fellows of this Society. It is work on which we may with justice be congratulated, and which should encourage perseverance in the same and kindred lines of inquiry.

Need of Observations of Living Organisms.

Here, as in many other biological researches, it cannot be too strongly insisted on that no result of lasting value can be hoped for without resort to the living animals among all the natural conditions and surroundings. It was not a stay-at-home theorist, familiar only with the dried specimens of the cabinet, that detected the meaning of mimicry and gave to science a rational explanation of the mystery, but an ardent explorer and naturalist, who devoted many of the best years of his life to field-work in tropical lands. I am the last to undervalue the knowledge of the systematist, which is absolutely indispensable to all intelligible record, and I fully recognise that no naturalist can be properly equipped for his work without a fair amount of systematic training; but philosophical discovery in any direction such as we are now considering can never be truly advanced without unflagging observation and experiment among organisms living in their natural environment. How but by the closest and most exact attention to the entire life-history of animals in their native haunts can we expect to deal satisfactorily with such questions as this of mimicry, of protective resemblances generally, of seasonal dimorphism, sexual selection, local variation, and the like? Admitting gratefully the good work of this kind which has been carried on in Europe, and especially in our own country, one cannot but regret that from tropical regions, where alone the abundance, complexity, and incessant activity of life afford full prospect of the adequate reward of such research, we have little more than isolated notes and unconnected and incomplete observations, mere indications—precious as they are—of the rich harvest that lies unreaped for lack of resident workers devoted to the task.

It is on this account that I earnestly renew the plea put forward from this chair on May 5 last, for the establishment, in tropical countries, of biological stations for the study of the terrestrial fauna; where, as in the existing marine biological stations, naturalists could follow, during a succession of seasons, special lines of observation and experiment under favourable conditions of laboratory and other equipment, free from the hindrances and distractions of ordinary collecting travel, and with all the advantages of mutual help and encouragement. The living expenses, for men of the simple tastes of the naturalist, would not be great; and I feel certain that, with the increasing facilities for swift transport, it would not be long before many students of biology would embrace the opportunity so provided for the effectual prosecution of researches of the utmost value to science.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The usual courses in the Scientific and Medical Departments are being continued this term. Prof. Ray Lankester is lecturing on the "Structure and Classification of Fishes," and Prof. E. B. Poulton on the "Natural History and Classification of Insects." Prof. Tylor purposes to lecture on "Ancient and Barbaric Stages of Culture compared with Advanced Civilisation." The Regius Professor of Medicine (Prof. J. Burdon-Sanderson) proposes to continue his Pathological Lectures of last term by discussing the "Nature and Causes of Tuberculosis."

The examination for the Radcliffe Travelling Fellowship will begin on March 1. Candidates must have passed all the examinations for B.A. and B.M. in the University, and must either have been placed in one of the First Class in one of the Final Honour Schools, or have taken some University prize open to all.

Cambridge.—Mr. R. H. Biffen, of Caius, has been appointed Demonstrator of Botany; Mr. F. C. Kempson, also of Caius, Demonstrator of Anatomy; and Mr. H. W. Pearson, of Christ's, Assistant Curator of the Herbarium.

The honorary degree of M.A. has been conferred on Dr. H. A. Giles, Professor of Chinese, and on Dr. W. H. R. Rivers, of St. John's, Lecturer in Experimental Psychology.

Two Shuttleworth Scholarships in Botany and Comparative Anatomy will be awarded at Caius College in March. Candi-

dates must be medical students of not less than eight terms' standing. The value of the scholarships is 55*l.* a year for two or three years. Applications are to be made to the tutors by March 1.

M. GERNEZ, *maître de conferences* at the Paris Normal School, has been nominated director of the chemical research laboratory, in succession to the late M. Joly.

PROF. FRANK CLOWES has been elected Emeritus Professor of Chemistry in the University College, Nottingham, on accepting the position of chief chemist and chemical adviser to the London County Council. He will thus retain his professorial title and status, though no longer performing professorial duties. The following is the resolution of the College Committee:—"Resolved that in recognition of the valuable services rendered to the College by Prof. Clowes, first in organising the Chemical Department, and afterwards for sixteen years discharging the duties of Chemical Professor, and for three years the duties of Principal, an honorary position of Emeritus Professor of this College be conferred upon him."

THE Somerset County Education Committee assists technical education in the county in a number of ways, but no branch of its work is likely to prove of more permanent value than the system of aids to public secondary schools, for the purposes of securing efficient teaching of scientific and technical subjects. These grants usually take the form of capitation grants, with the provision that, if made at all, the minimum amount will be 100*l.* per annum. Schools receiving the grants are open at all times, without previous notice, to inspection by Mr. C. H. Bothamley—the Director of Technical Instruction—or other officer appointed for the purpose by the County Committee. It is satisfactory to find that the increased efficiency of the schools which has resulted from the aid and supervision of the County Committee has led in several instances to a marked increase in the number of pupils attending them. In addition to annual grants the Committee has aided schools by grants for building and equipment. There are, however, still considerable areas of the county in which a supply of efficient secondary education is almost entirely wanting. But the report of the County Committee points out that until local authorities receive the wider powers which it is hoped may be given to it by a Secondary Education Act, it will be almost impossible to provide for boys and girls that adequate supply of secondary education of a modern type, which, it cannot be too often repeated, is the only foundation on which it is possible to rear a system of higher technical education such as will bring the higher sections of the industrial community in this country up to the same level of knowledge of their work as their competitors in foreign countries. It is also now becoming generally recognised that secondary education of the kind referred to is rapidly becoming indispensable to every one who desires to occupy a position of control and responsibility in his particular calling in life, whether he afterwards endeavours to add any higher technical training to his general education or not. The Somerset Committee fully recognise this educational principle, and their report shows that they act upon it so far as teey are able.

SCHOOLS of Science carried on in connection with the Department of Science and Art are schools in which systematic courses of instruction are followed. When these conditions are fulfilled, and a fair proportion of students take advanced courses, a special grant is made to the schools in addition to the ordinary grants. Recently, the Inspectors of the Department were given instructions to report on all cases of Schools of Science where the students leaving at the end of the first year, or at the end of the second year, exceeded twenty-five per cent., the idea being that such schools had no claim to be recognised as true Schools of Science, for a sufficient proportion of the students did not continue the systematic course of work laid down. This action of the Department has met with considerable opposition from teachers and school authorities who wish to obtain the special grant without being qualified for it. Numerous schools which do not fulfil, and never expect to fulfil, one of the essential conditions upon which the institution of a special grant to Schools of Science was originally approved, are yet claiming the special grant for such schools instead of the ordinary grant. The Department has now issued a second memorandum stating that it is not desired to press unduly, by any hard and fast rule of percentage, on those schools which may, if time be allowed them, establish themselves as Schools of Science, when it is clear that there is a *bonâ fide* effort to make them such. More than this cannot very well be conceded, for grants can be earned for instruction in any ordinary science or art school or class, without the creation of a School of Science, in the same form as in a School of Science, *i.e.* on attendance. These grants are large, though not on so high a scale as in a School of Science. The Departmental Circular points out that the only justification of a grant higher than the ordinary one is that the school which receives it should fulfil conditions which are not required from ordinary schools and classes. Whether the conditions required should be in any way modified can only be properly considered when the information called for by the Department has been obtained.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, December 1897.—In accordance with the amended by-laws of the Society (May 29, 1897), by which it was arranged that four New York meetings annually should be held instead of eight, as previously, viz. on the last Saturdays of October, February and April, and an annual meeting in the last week of December, a meeting was held on October 30. The object of the change is to secure greater prominence and interest for each meeting, and to afford the members of the Society a better opportunity for scientific and social intercourse. Each meeting now extends through two sessions, held in the morning and afternoon. Forty-one persons (thirty-seven members) were present, and this after the recent successful meeting at Toronto. Nine papers were read, of which abstracts are given here. Some of the papers are printed in the present number, and others will be published in journals whose titles are given.—Note on hyper-elliptic integrals, by Prof. A. S. Chessin, is one of the papers. If X_r is a polynomial in x of degree r; and $P_m(x)$, $Q_n(x)_1$ . . . polynomials in x of degrees m, n, . . . , we know that the integration of

$$\int f(x, \sqrt{X_r})dx,$$

where

$$f(x, \sqrt{X_r})$$

is a rational function of x and $\sqrt{X_r}$, is reduced to the integration of

$$\int \frac{R(x)dx}{\sqrt{X_r}} \quad (i),$$

where $R(x)$ is a rational function of x. Prof. Chessin gives a practical rule for the integration of (*i*).—Certain classes of point transformations in the plane, by Dr. E. O. Lovett, was read at the May meeting. It is proposed to apply the transformations to plane curves (spirals) in a subsequent note. The properties discussed and the points of view differ sufficiently (in the author's opinion) from the forms discussed by Laisant (*Nouvelles Annales*, 1868, p. 318) to warrant its publication.—Prof. H. B. Newson in a paper, read at the April meeting, entitled "Continuous groups of circular transformations," has for his object the presentation of the outlines of a fairly complete theory of the continuous groups of linear fractional transformations of one variable. His method differs from the methods of Lie.—Dr. C. A. Scott, in her review of "Julius Plücker's Gesammelte Mathematische Abhandlungen" (edited by A. Schoenflies, 1895), gives a very interesting sketch of this first volume, which contains thirty-nine memoirs by Plücker and Clebsch's "Gedächtnissrede" from the sixteenth volume of the *Göttingen Abhandlungen*. From the "Notes" we learn that Prof. Newcomb, the President of the Society, had chosen the philosophy of hyperspace as the subject of his address at the annual meeting (December 29, 1897).—The valuable list of new publications covers a wide field of mathematical work.

Bulletin de l'Académie des Sciences de St. Pétersbourg, 1896, Tome v. No. 3.—Report of the work of the Russian Archæological Institute at Constantinople, by Th. Ouspensky. The chief work of the Institute is the collection and the study of antiquities; excursions to Trebizonde, Samsun, Sinope and Athens were organised for this purpose. A library and a small museum have been opened.—The declinations of fourteen stars which were observed at Pulkova for the study of the variations of latitude at Kazan, by A. Ivanof.—On vinil-trimethylene and ethylidene-

trimethylene, by G. Gustavson.—Short report of a journey to Novaya Zemlya in 1896, for the observation of the eclipse of the sun, by Prince B. Galitzine. The eclipse observations, as is known, were made under fairly favourable conditions, through a light veil of cirrus clouds. After the eclipse, the expedition made an excursion inland in the high mountain region which covers the island in the north-east of Karmakuly. The excursion lasted only nine days. A glacier, two miles long, was discovered at the head of Karmakulka River; very large *neves* are a characteristic feature of this part of the highlands.

No. 4.—Study of the anatomy of *Acanthobdella peledina*, by A. Kowalevsky (in French), with six engravings.—Report of O. Backlund on his journey to Paris and Odessa, for the unification of the constants accepted in astronomical ephemerides.—On the testing of glycerine and the analysis of wax, by F. Beilstein and R. Rinne (in German).—Note on a dry fog observed in Samara.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, January 19.—Annual Meeting.—Mr. R. Trimen, F.R.S., President, in the chair.—The balance-sheet for the past year, showing a balance in the Society's favour and an improvement in the financial position, was read by Mr. A. H. Jones, one of the auditors. The Secretary then read the Report of the Council, from which it was seen that during 1897 the Society had lost 7 Fellows by death and 5 by resignation, and had elected 24, the total number now on the list being 398. The *Transactions* for the year contained 19 memoirs, illustrated by 11 plates, and extending to 434 pages. As a mark of respect to the late Mr. J. W. Dunning, the Council had decided to present his portrait as a frontispiece to the volume of *Transactions* for 1897. It was announced that the following Fellows had been elected as Officers and Council for 1898:—President: Mr. R. Trimen, F.R.S. Treasurer: Mr. R. McLachlan, F.R.S. Secretaries: Mr. W. F. H. Blandford and Mr. F. Merrifield. Librarian: Mr. G. C. Champion. Other Members of Council: Mr. W. Bateson, F.R.S., Dr. T. A. Chapman, Sir G. F. Hampson, Bart., Mr. M. Jacoby, Mr. A. H. Jones, Dr. P. B. Mason, Mr. O. Salvin, F.R.S., Mr. J. W. Tutt, Mr. G. H. Verrall, and Mr. C. O. Waterhouse. The President nominated as Vice-Presidents Sir George Hampson, Mr. McLachlan, and Mr. Verrall, and his address was then read on his behalf by the Secretary. After briefly reviewing the position of the Society, and referring to the losses sustained by deaths during the past year, especially those of Dr. Fritz Müller, Mr. J. W. Dunning, and Captain E. Y. Watson, the President proceeded to review the subject of mimicry. (An abstract of his address is printed in another part of this issue of NATURE.) On the motion of Lord Walsingham, seconded by Mr. F. D. Godman, a vote of thanks to the President for his able and exhaustive summary of the subject, and for his services during the past year, was carried by acclamation.

Geological Society, January 5.—Dr. Henry Hicks, F.R.S., President, in the chair.—On the structure of the Davos Valley, by A. Vaughan Jennings. Evidence was brought forward to show that the level area, about four miles in length, near Davos, is occupied by superficial deposits, and that the lateral talus-fans there have been cut through at a relatively recent date since their accumulation; that the northern end towards Wolfgang is blocked by moraine-material of great thickness, but for which the Davoser See would drain north to the Landquart, carrying with it the waters of the Fluela and Dischma; that the contour-lines suggest the former existence of a far larger lake stretching south towards Frauenkirch, and that in that part there is proof of the previous existence of a great detrital fan sufficient to account for the existence of the lake in question.—Sections along the Lancashire, Derbyshire, and East Coast Railway between Lincoln and Chesterfield, by C. Fox-Strangways. The portion of the line considered in this paper occupies a distance of about forty miles, and runs nearly at right angles to the strike of all the beds from the Lias to the Coal Measures.

Royal Meteorological Society, January 19.—Mr. E. Mawley, President, in the chair.—The Secretary read the report of the Council for the year 1897, showing that there had been an increase in the number of Fellows and that the finances were satisfactory.—The President, Mr. Edward Mawley, then gave an address on weather influences on farm and garden crops, in which he pointed out the intimate connection between meteorology, agriculture and horticulture. He explained the special characteristics of the climate of the British Isles as regards temperature, rainfall, &c. Of all the influences brought to bear on vegetable life by the atmosphere, he considered temperature to be the most powerful and far reaching, and only second to this came rainfall. The leading effects of snow, wind and sunshine, as well as of prolonged droughts, severe frosts and persistent rains, were also described. He then dealt with the influence of different important weather changes on such farm crops as wheat, roots, grass, &c., as well as on fruit trees, vegetables, and flowering plants in the garden. In his concluding remarks he called attention to the great want of experimental farms in conjunction with meteorological stations being established in this and other countries in Europe. For it was only by the examination of meteorological observations, together with weekly records of the extent and character of the growth made by our leading crops, that the close connection existing between weather changes and their influences on such crops could be clearly traced.—Mr. F. C. Bayard was elected President for the year.

Zoological Society, January 18.—Dr. Albert Günther, F.R.S., Vice-President, in the chair.—The Secretary exhibited, on behalf of Prof. Robert Collett, a specimen of a supposed hybrid between the Fieldfare (*Turdus pilaris*) and the Redwing (*T. iliacus*).—Mr. W. E. de Winton exhibited and made remarks on a skin of a zebra from British East Africa, belonging to a form described by Herr P. Matschie as *Equus burchelli böhmi*, obtained by Captain S. L. Hinde at Machakos.—Mr. L. W. Byrne read a paper on the general anatomy of the fishes of the order *Holocephali*. The paper contained a brief account of the anatomy of the soft parts of *Chimæra monstrosa* and *Callorhynchus antarcticus*, and a comparison of them with a typical Elasmobranch such as *Scyllium*.—Dr. W. G. Ridewood read a paper on the development of the hyobranchial skeleton of *Alytes*, in which he showed that of the two axial cartilages present in the larval hyobranchial skeleton of this Batrachian the anterior one disappears completely, while the posterior, which is remarkable in extending back to the laryngeal sinus, persists as the central part of the body of the hyoid.—Mr. F. O. Pickard-Cambridge read a paper on the Cteniform Spiders of Africa, Arabia, and Syria, which contained a list of the species already described from these countries, with notes on their identities, and descriptions of nine new species.—Mr. L. A. Borradaile gave an account of the Crustaceans of the order Stomatopoda represented in the collections made by Messrs. J. S. Gardiner and Dr. A. Willey in several of the South Pacific Islands. Ten species were enumerated, of which three, viz. *Gonodactylus espinosus*, *Pseudosquilla oxyrhyncha*, and *Squilla multituberculata*, were described as new.

EDINBURGH.

Royal Society, January 17.—Rev. Prof. Flint in the chair.—Dr. Hugh Marshall read a note on the axes of symmetry which are crystallographically possible. In this paper the author gave a proof simpler than that of Gadolin ("Mémoire sur la déduction d'un seul principe de tous les systèmes crystallographiques avec leurs subdivisions"), namely, that if the law of rational indices be assumed, only digonal, trigonal, and hexagonal axes are possible with crystals. The proof rests on the assumptions, that an axis of symmetry is necessarily a possible edge or zone axis, and that there are possible edges perpendicular to any axis of symmetry, *i.e.* that the plane to which it is normal is a possible face. These assumptions are formally proved, and then the proposition that an axis of symmetry of the nth order is crystallographically possible only when $\cos 2\pi/n$ is rational, is proved generally. The value of n is limited by the laws of rational indices to those cases where $\cos 2\pi/n$ is rational. Further, from the nature of an axis of symmetry, n must be a whole number. It is shown by N. Boudaief, in the appendix to Gadolin's paper, that the only values of n which satisfy these two conditions are 2, 3, 4, and 6. Consequently only digonal, trigonal, and hexagonal axes of symmetry are possible with crystals.—Prof. Geikie communicated a paper, by Mr. John S. Flett, on the Old Red Sandstone of the Orkneys.—Dr. R. H. Traquair, F.R.S., had a paper on the fossil fishes of the Orcadian series of the Old Red Sandstone of Scotland. As many as fifty-eight species of fossil fishes had been, up to 1888, named and described from the Orcadian rocks of the Moray Firth area, of Caithness, and

of Orkney; but Dr. Traquair showed that their nomenclature had fallen into a state of chaos, principally by the unnecessary multiplication of species upon deceptive characters, as well as, to some extent, by the confusion of forms which actually were distinct. The previous list was accordingly reduced from fifty-eight to twenty-four, while, during the past ten years, Dr. Traquair has added nine new species, making the entire number up to thirty-three. Of these new species, three are described for the first time in the present paper, namely, *Homocanthus crassus* and *Asterolepis orcadensis*, from Orkney; *Cheiracanthus striatus*, from Caithness. The rest of the paper consisted of an enumeration of the genera and species of Orcadian fossil fishes, their synonymy, and the localities in which they are found in the three areas—Moray Firth, Caithness, and Orkney. No fishes have been found as yet in the Orcadian beds of Shetland. Of the thirty-three species, twenty-seven occur in Caithness, twenty-four in Orkney, and seventeen in the Moray Firth beds, the small number in the last-named area being apparently due to the absence of certain geological horizons, which are represented both in Orkney and in Caithness. The paper was illustrated by limelight pictures of the principal forms of Orcadian fossil fishes, both as they occur in the rock and as restored by the author.

Mathematical Society, January 14.—Mr. J. B. Clark, President, in the chair.—The trisection of a given angle, by Mr. Lawrence Crawford.—The centre of gravity of a circular arc, by Mr. G. E. Crawford.—A demonstration of the apparatus used in practical skiagraphy by the Röntgen rays was given by Dr. Harry Rainy.

PARIS.

Academy of Sciences, January 17.—M. Wolf in the chair.—Notice of the life and works of M. d'Abbadie, by M. Hatt.—On some results relating to the phenomena discovered by M. Zeeman, by M. A. Cornu. Further improvements in the methods of observation give results not altogether agreeing with those of the original experiments. The action of the magnetic field upon the period of vibration of the radiations from a luminous source appears to depend not only upon the chemical nature of the source, but also on the nature of the group of rays in the spectrum to which each radiation belongs, and on its function in this group. If the direction of the field observed is normal to the lines of force, each ray becomes four, and not three as originally announced by Dr. Zeeman.—Remarks by M. Henri Becquerel on the preceding communication.—On the separation and estimation of iodine, bromine, and chlorine, by M. Ad. Carnot. The separation is based upon the removal of iodine by carbon bisulphide after acting upon the mixture with nitrous vitriol; the bromine is then set free by chromic acid at 100°, and removed by the same solvent. Fairly satisfactory analytical results are appended.—On the decimal hour system, the divisions of the day and the circle, and the geographical table, by M. Henride Sarrauton.—Occultation of the Pleiades by the moon, January 3, 1898, observed at the University of Paris, by M. G. Bigourdan.—Occultation of the Pleiades group, observed at Lyons, by M. Ch. André.—On the four large planets, by M. Émile Anceaux. Certain simple numerical relations have been found to exist between the masses and major axes of orbits of Jupiter, Neptune, Saturn, and Uranus.—On the representation of uniform analytical functions, by M. Paul Painlevé.—On the convergence of series representing the integrals of differential equations, by M. Paul Staeckel.—On the irregular integrals of linear differential equations, by M. J. Horn.—On the existence of integrals of a partial system, determined by certain initial conditions, by M. Riquier.—On the systems of triply orthogonal surfaces where the surfaces of a family admit of the same spherical representation of their lines of curvature, by M. Maurice Fouché.—On the basis of projective geometry, by M. H. G. Zeuther.—On the problem of the cooling of a heterogeneous bar, by M. W. Stekloff.—On gas mixtures, by M. A. Leduc. The author proposes to replace Dalton's law, that the pressure of a mixture of gases is equal to the sum of the pressures that each would occupy in the same receptacle, by another, that the volume occupied by a mixture of gases is equal to the sum of the volumes that the component gases would occupy under the conditions of pressure and temperature of the mixture, the two statements being only identical when Boyle's law holds exactly.—Determination of the density of gases on very small volumes, by M. Th. Schlœsing, jun. The method described gives very fair results with quantities of gas as small as 6 c.c., and requires neither the use of a barometer nor a balance. A column of the gas whose density is to be determined is balanced hydrostatically against a column of gas of known density and absorbable by caustic potash, such as carbon dioxide. The manipulation and calculation are extremely simple. Further details and numerical results will be given in a later paper.—On an apparatus called the hermetical pourer, by M. R. Personne de Sennevoy. With the apparatus in question, a diagram of which is given, a portion of a liquid contained in a hermetically closed vessel can be extracted without introducing any other fluid into the vessel.—On the thermodynamic potential, by M. A. Ponsot.—On the spectrum of the kathode rays, by M. Birkeland.—On the spectrum of cadmium in a vacuum tube, by M. Maurice Hamy. The wave-lengths of the ten principal lines were measured with an accuracy of six significant figures.—On the absolute value of the magnetic elements on January 1, 1898, by M. Th. Moureaux. The calculations are made for the elements at Paris, Nice and Perpignan.—Contribution to the study of the electric furnace, by MM. Gin and Leleux.—New method for measuring the intensity of a magnetic field, by M. E. Bouty. A liquid conductor is allowed to flow normally to the lines of force in the field to be measured. The constant electromotive force induced in the liquid vein is measured by means of the capillary electrometer. It was found that tap water served very well for the conducting liquid, and by increasing the velocity of flow the sensitiveness of the method can be increased almost indefinitely. The fields measured were of the order of 0·5 C.G.S. units.—On a thermometric mercury ammeter, by M. Ch. Camichel. A thermometer bulb is placed in a glass tube slightly larger, and the narrow annular space filled with mercury through which the current is passed. The instrument described measures up to 2 amperes with an approximation of 1/200th.—Discharge by the Röntgen rays. Secondary effect, by M. Jean Perrin. The hypothesis provisionally put forward of a superficial phenomena is now shown to be improbable.—On the electrical resistance of crystallised silicon, by M. Fernand Le Roy. The resistance of silicon is about 1300 times that of electric light carbon, and diminishes on heating, a decrease of about 40 per cent. corresponding to a rise of 800° C.—On some new compounds of the cerite metals, by M. Andre Job.—On aldehyde ammonia, by M. de Forcrand. Calorimetric data of the solutions of this substance.—On β-isopropyl-γ-acetylbutyrate of ethyl and on the stereoisomeric acids derived from it by condensation, by MM. Ph. Barbier and V. Grignard.—On the oxidation of ammonia compounds by the ferments of the soil, by M. E. Demoussy. Under the influence of the bacteria of the soil the amines are oxidised to ammonia, and this goes to nitrite and nitrate in the usual manner. The more complex the amine the slower is the course of oxidation.—Bacilli of beriberi, by M. Gustave Nepveu. Three forms of bacilli differing in size (8 μ, 3 μ for the two larger) were found, but it is not quite certain that these are distinct forms.—On the structure of the cirrophore in the Polynoïdia, by M. G. Darboux, jun.—On the elongations of the anterior portion of the body of the Prosobranchia and their influence upon the corresponding region of the digestive tube, by M. Alex. Amaudrut.—On a cœlomic gregarian presenting a phase of asporulic multiplication in the evolutive cycle, by MM. Maurice Caullery and Félix Mesnil. The new species is a parasite in the general cavity of *Dodecaceria concharum*, and is named *Gonospora longissima*.—Sex and molecular dissymmetry, by M. Félix Le Dantec.—Some remarks by M. Edmond Perrier on the preceding paper.—On the supposed chloragogenesis of the general cavity of the Opheliæ, by MM. J. Kunstler and A. Gruvel.—On the existence of a malacological polybathic fauna at great depths in the Atlantic and Mediterranean, by M. Arnould Locard. Outside the well-defined littoral zones there exists both in the Atlantic and Mediterranean a fauna capable of living and developing at depths of over 2000 metres, to which the name polybathic is given. This fauna contains many Gastropods, and is especially rich in Scaphopods and Lamellibranchs.—On the origin of the double sheath of the root of *Tropæolum*, by M. Camille Brunotte.—On the preparation of gentianose, by MM. Ed. Bourquelot and L. Wardin.—On the germination and hibernal fructification of the truffle, by M. A. de Gramont de Lesparre.—On the mineral layers of oolitic iron of the new basin of Briey, by M. Georges Rolland. Complete geological sections of these important beds of Meurthe-et-Moselle are given.—On the caverns of Sauve (Gard), and the form of the reservoirs of springs and calcareous

soils, by MM. E. A. Martel and A. Viré.—Considerations on the oceanic circulation in the Bay of Biscay, by M. I. Thoulet.—Observation of a double meteor, at Vannes, on January 3, 1898, by M. Georget.—Remarks by M. Callandreau on the preceding note.

In the abstract of the *Comptes rendus* of the meeting of the Paris Academy of October 26, a paper by M. Gaston Séguy on a new method of reducing the time of exposure in radiography was referred to (November 4, 1897, p. 24). Dr. Max Levy writes from Berlin to call attention to the fact that the method described originated with him, and that M. Séguy acknowledged such to be the case in the course of the paper communicated to the Paris Academy.

NEW SOUTH WALES.

Linnean Society, November 24, 1897.—Prof. J. T. Wilson, President, in the chair.—The President formally announced the death of Prof. T. Jeffery Parker, F.R.S., of Dunedin, a corresponding member of the Society, on November 7. It was resolved that an expression of sympathy from the Society should be tendered to Prof. Parker's family.—The President commended to the favourable notice of the members the report of a meeting held at Melbourne, for the purpose of forwarding the movement to establish some permanent memorial of the late Baron von Mueller. It was resolved that it was desirable that steps should be taken to commemorate in some suitable way the late Baron's work, and an influential committee was appointed to carry out the proposal. It is hoped that a sufficient sum of money will be forthcoming to provide for a bust or medallion of the Baron, as well as for the endowment of a medal or prize to be associated with the Baron's name, and to be awarded from time to time in recognition of botanical, pharmaceutical, or horticultural work in the various Australasian Colonies. Subscriptions in aid of this project may be sent to Prof. Baldwin Spencer (The University, Melbourne), one of the hon. secretaries.—Plants of New South Wales, illustrated. Part ix., by R. T. Baker. The species figured and treated of are *Acacia gladiiformis*, A. Cunn., *A. obtusata*, Sieb., *A. rubida*, A. Cunn., and *A. triptera*, Benth., var. nov.—On some New South Wales Fungi, by D. McAlpine. Seven species occurring on the leaves or bark of indigenous trees are recorded. Of these four are described as new, and two are recorded from this Colony for the first time.—Observations on the Eucalypts of New South Wales. Part iii., by Henry Deane and J. H. Maiden. In this third contribution the species dealt with are *Eucalyptus hæmastoma*, *E. Sieberiana*, *E. stricta*, *E. obtusiflora*, and some allied forms.—On some Australian *Eleotrinæ*. Part ii., by J. Douglas Ogilby. Five additional species of Australian eleotrins are described.—On two new Australian fishes, by J. Douglas Ogilby. The two species described are *Harengula stereolepis*, from Torres' Straits, and *Decapterus leptosomus*, a mackerel-scad which annually visits Port Jackson but has hitherto escaped notice.—A contribution to the zoology of New Caledonia, by J. Douglas Ogilby. After alluding to the meagreness of our knowledge of the biology of the island, the author gives a list of the fresh-water fishes referable to six species brought back by Mr. Hedley, with observations thereon.—On Australian *Termitidæ*. Part iii., by W. W. Froggatt.—Eleven species of *Termes*, of which ten are new, and seven species of *Eutermes*, of which five are new, are described. In most cases some account of the nests is also given.—On new Marine Mollusca from the Solomon Islands and Australia, by John Brazier. The Volute described at last meeting from an imperfect specimen is redescribed from a perfect example which subsequently became available. Descriptions also are given of a new cone from Flinders, Victoria, of two from the Solomon Islands, and of a species of *Axinæa* from the Gippsland Lakes Entrance, Victoria.—Observations on Papuan land and fresh-water shells, with descriptions of new species from New Guinea and Western Australia, by C. F. Ancey. From Western Australia the new species *Trachia Froggatti*, *T. orthocheila* and *T. monogramma* are described and figured from material collected by Mr. W. W. Froggatt. New Papuan shells from German New Guinea are *Sulcobasis leptocochlea* and *Chloritis Möllendorffi*, with which is figured *Pupina Beddomei*, described in an earlier volume of the Society's *Proceedings*. Critical observations on sundry Australian and Papuan shells conclude the paper.—Mr. R. T. Baker exhibited specimens of camphor and camphor oil obtained from the leaves of *Cinnamomum Oliveri*, Bail. The yield of camphor is about ½ per cent. It resembles in odour and appearance the ordinary camphor of commerce. Its melting point was between 173·5 and 175, the melting point of ordinary camphor being given as 175° C. Its specific rotation is also almost identical with that of common camphor. The camphor oil was obtained with the camphor, both floating on the surface of the water, and was separated by pressure. The amount of oil was equal to ·364 per cent., but still retained some camphor in solution.—Mr. R. Etheridge, jun., exhibited some drawings of undetermined leaves, presumably of Tertiary age, from Rollo's Shaft, Coolgardie, forwarded by the Government Geologist of West Australia to Mr. H. Deane. Also specimens of leaves, at present undetermined, from a quarry on the Diamantina River, near Birdsville, a little over the Queensland and S. Australian border, in the former Colony, lat. 25° 55′ S., and long. 138° 25′ E. approximately. Mr. R. L. Jack states that Birdsville is "a Lower Cretaceous locality, but it is quite possible that there are desert sandstone tablelands in the neighbourhood, and the plants may come from one of these."—Mr. Edgar R. Waite exhibited (1) examples of *Typhlops aluensis*, Blgr., from Wai Obi, Vuna Pi, Fiji, where they are known to the natives as "Naota." This species was previously known only from the Solomon Islands, and the new record supplies further evidence of the similarity of the faunas of the two Archipelagoes. (2) A New Zealand fish (*Neptotichthys violaceus*, Hutton) recently caught in Port Jackson, and the first recorded occurrence in Australian waters. (3) Two photographs taken at Layson Island (Hawaiian Islands); one exhibits an immense concourse of albatrosses (identified by Mr. A. J. North as *Diomedea immutabilis*, Rothschild) incubating their eggs, and the other the method of collecting and transporting the eggs. This photograph shows, in addition to wheelbarrows and boxes, two railway trains, the wagons of which are literally piled up with eggs. (4) A block of limestone from the Jenolan Caves polished by Rock Wallabies (*Petrogale penicillata*, Gray).—Mr. Fred. Turner sent for exhibition a series of specimens of the grass *Danthonia pilosa*, R.Br., from near Finley, Riverina, with the inflorescence affected with a parasitic fungus. Fifteen other species of Australian grasses were known to him as subject to similar attacks. The subject of the effects produced upon stock by feeding on diseased grasses was one well worth investigation.—Mr. Palmer showed a specimen illustrating what he thought might be considered an undoubted case of root-grafting. Also a clump of the galls of *Brachyscelis duplex*, Schrader, from the Blue Mountains; and a quartz crystal or sacred stone presented to his father by an aboriginal of the Port Stephens tribe, fifty years ago.—Mr. North exhibited the sexes of the rare White-vented Wood Swallow, *Artamus albiventris*, which he had shot on Tyreel Station on the Gwydir River; also the nest and eggs of these birds found at the same time in the top of a hollow stump by Mr. E. Stirton, of Moree. Also some siliceous stones, land-shells, berries, pieces of coloured glass, and a galvanised iron screw procured from a play-house of the Spotted Bower-bird (*Chlamydodera maculata*, Gould) on Weebollabolla Station; the parallel walls of the bower were wholly constructed of dried "spear or corkscrew-grass (*Stipa setacea*) set upright in a slight foundation of fine twigs. Likewise, two sets of the eggs of the Pied Honey-eater (*Certhionyx leucomelas*, Cuvier), procured in Western New South Wales near the South Australian border; and the eggs of another Honey-eater, presumably an undescribed species.

AMSTERDAM.

Royal Academy of Sciences, December 24, 1897.—Prof. van de Sande Bakhuyzen in the chair.—Prof. van Wijhe, on an automatic injector for Teichmann's substance, and presented a paper on it for publication in the *Proceedings*.—Prof. van de Sande Bakhuyzen presented, for publication in the *Proceedings*, (*a*) a paper by J. Stein, of Katwijk, on elements of the planet 424=1896 DF, and ephemeride for 1898; (*b*) on behalf of C. Easton, a paper on the grouping of the stars in the Milky Way; and (*c*) made some remarks on the distribution of stars in space, which will be inserted in the *Proceedings*.—Prof. Schoute continued a communication, presented on his behalf by Prof. Darboux to the Academy of Sciences of Paris, extending his theory, given there, of the determination of focal curves of plane curves in possession of an axis of symmetry to that of the focal surfaces of surfaces, that admit of a plane of symmetry.—Prof. van der Waals presented, on behalf of Dr. P. Zeeman,

measurements concerning radiation phenomena in the magnetic field. Photographs have been taken of the outer components of the magnetic triplet. Measurements of the distance of the components for lines in the violet and ultra-violet parts of the spectrum are communicated. In the cases of the metals examined—viz. zinc, cadmium, copper, and tin—the magnetic change is of the same order of magnitude in all of them, and independent of the atomic triplet. Some lines are not affected by magnetism.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 27.

ROYAL SOCIETY, at 4.30.—Mathematical Contributions to the Theory of Evolution. On the Law of Ancestral Heredity: Prof. Karl Pearson, F.R.S.—On the Zoological Evidence for the former Connection of Lake Tanganyika with the Sea: J. E. S. Moore.—(1) The Kelvin Quadrant Electrometer as a Wattmeter and Voltmeter; (2) The Magnetic Properties of almost Pure Iron: E. Wilson.

ROYAL INSTITUTION, at 3.—The Halogen Group of Elements: Prof. J. Dewar, F.R.S

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on the Electro-Chemical Treatment of Ores containing the Precious Metals: Major-General Webber, C.B.

FRIDAY, JANUARY 28.

ROYAL INSTITUTION, at 9.—Instinct and Intelligence in Animals: Prof. C. Lloyd-Morgan.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Condensing Apparatus: H. Williams.

MONDAY, JANUARY 31.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Through Somaliland to Lake Rudolf: H. S. H. Cavendish.

INSTITUTE OF ACTUARIES, at 5.30.—Some Remarks on the Valuation of Endowment Assurances in Groups: George J. Lidstone.

TUESDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—The Simplest Living Things: Prof. E. Ray Lankester, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On a Collection of Fishes from the Rio Jurua, Brazil: G. A. Boulenger, F.R.S.—On the Anatomy of an Australian Cuckoo (*Scythrops novæ-hollandiæ*): F. E. Beddard, F.R.S.—On a Collection of Lepidoptera made by Mr. F. V. Kirby, chiefly in Portuguese East Africa: Dr. A. G. Butler.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be further discussed: Reservoirs with High Earthen Dams in Western India: W. L. Strange.

MINERALOGICAL SOCIETY, at 8.—Canfieldite from Bolivia; Specific Identity of so-called "Crystallised Brongniartite" and Canfieldite: G. T. Prior and L. J. Spencer.—On Atacamite from Sierra Gorda, Atacama: G. F. Herbert Smith.

ROYAL VICTORIA HALL, at 8.30.—Insects in a London Back Garden: F. Enoch.

WEDNESDAY, FEBRUARY 2.

SOCIETY OF ARTS, at 8.—The Cinematograph: Jules Fuerst.

GEOLOGICAL SOCIETY, at 8.—Contributions to the Glacial Geology of Spitsbergen: Dr. J. W. Gregory and E. J. Garwood.—On a Quartz-rock in the Carboniferous Limestone of Derbyshire: H. H. Arnold-Bemrose.

ENTOMOLOGICAL SOCIETY, at 8.—On the Larva of Pelophila: Rev. W. F. Johnson and G. H. Carpenter.—New Species of American Rhopalocera: F. D. Godman, F.R.S., and O. Salvin, F.R.S.

THURSDAY FEBRUARY 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Comparison of Oxygen with the Extra Lines in the Spectra of the Helium Stars β-Crucis, &c.; also Summary of the Spectra of Southern Stars to the 3½ Magnitude and their Distribution: F. McClean, F.R.S.—The Intimate Structure of Crystals. Part I. Crystals of the Cubic System with Cubic Cleavage—Haloid Salts of the Alkalies: Prof. Sollas, F.R.S.—Researches in Vortex Motion. Part III. On Spiral or Gyrostatic Vortex Aggregates: Prof. W. M. Hicks, F.R.S.—The Pharmacology of Aconitine, &c., considered in relation to their Chemical Constitution: Prof. Cash, F.R.S., and Prof. Dunstan, F.R.S.

ROYAL INSTITUTION, at 3.—The Halogen Group of Elements: Prof. J. Dewar, F.R.S.

LINNEAN SOCIETY, at 8.—On the Muscular Attachment of the Animal to its Shell in some Fossil Cephalopoda (Ammonoidea): G. C. Crick.—The Comparative Anatomy of certain Genera of Cycadaceæ: W. C. Worsdell.

CHEMICAL SOCIETY at 8.—Effect of the Mono-, Di-, and Tri-chloracetyl Groups on the Rotatory Power of Methylic, and Ethylic Glycerates and Tartrates: Percy Frankland, F.R.S., and Dr. Thomas Stewart Patterson.—The Rotation of Ethylic and Methylic Di-monochloracetyltartrates: Percy Frankland, F.R.S., and Dr. Andrew Turnbull.—The Volumetric Estimation of Sodium: H. J. H. Fenton.

FRIDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 9.—Some New Studies in Kathode and Röntgen Radiations: A. A. Campbell Swinton.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—Palæolithic Man: E. T. Newton, F.R.S., President.

SATURDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 3.—Cyprus: Prof. P. Geddes.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Nature Study in Elementary Schools: Mrs. Wilson (Macmillan).—Complete Perspective Course: J. H. Spanton (Macmillan).—Practical Electricity and Magnetism: J. Henderson (Longmans).—Ignorance: M. R. P. Dorman (K. Paul).—United States Geological Survey: Atlas to accompany Monograph xxviii. on the Marquette Iron-bearing District of Michigan: Van Hise, Bayley, and Smyth (Washington).—Sewer Gas and its Influence upon Health: H. A. Roechling (Biggs).—Traité de Zoologie Concrète: Y. Delage and E. Herouard. Tome v. Les Vermidiens (Paris, Reinwald).—Le Rationnel; G. Milhaud (Paris, Alcan).—Floods of the Mississippi River: P. Morrill (Washington).—Calendario del Santuario di Pompei, 1898 (Valle di Pompei).—Marcello Malpighi e l'Opera Sua (Milano, Dr. F. Villardi).

PAMPHLETS.—Étude sur la Théorie des Comètes Périodiques: M. O. Callandreau.—A Mechanical Cause of Homogeneity of Structure and Symmetry geometrically investigated: W. Barlow (Royal Dublin Society).—A Paper on the Foundations of Projective Geometry: E. T. Dixon (Cambridge, Deighton).—Harmonic Curves of Three Frequencies: Prof. C. S. Slichter (Wisconsin).

SERIALS.—The Garden, Orchard and Woodland, January (Southampton Street).—Engineering Magazine, January (222 Strand).—Journal of the Royal Statistical Society, December (Stanford).—Proceedings of the Physical Society of London, December (Taylor).—Psychological Review, January (Macmillan).—Essex Institute Historical Collections, Vol. xxxiii. (Salem, Mass.).—West Australian Settler's Guide and Farmer's Handbook, Parts 1 to 4 (Perth, W.A., Wigg).—Astrophysical Journal, December (Chicago).—Quarterly Review, January (Murray).—English Illustrated Magazine, February (198 Strand).—The Home University, No. 1 (West).—Zoologist, January (West).—Journal of Anatomy and Physiology, January (Griffin).—Journal of the Chemical Society, January (Gurney).—Bulletin of the United States Geological Survey, Nos. 87, 127, 130, 135 to 148 (Washington).—Proceedings of the Royal Society of Edinburgh, Vol. xxi. No. 6, Pp. 473–549 (Edinburgh).—Journal of the Sanitary Institute, January (Stanford).—Bulletin of the American Mathematical Society, January (New York, Macmillan).—L'Anthropologie, Tome viii. No 6 (Paris, Masson).—Journal of the Franklin Institute, January (Philadelphia).—Neudrucke von Schriften und Karten über Meteorologie und Erd Magnetismus, Nos. 10 and 11 (Berlin, Asher).—Himmel und Erde, January (Berlin, Paetel).—Monthly Weather Review, October (Washington).

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