THURSDAY, MAY 24, 1888.

THE POLYTECHNIC INSTITUTE.

EVERY middle-aged inhabitant of the British Islands must recall more than one occasion when the mind of our country has been strongly stirred on the question of national defence. The adverse evidence of an expert, a rousing article in a newspaper, has often awakened general anxiety of more or less continuance, and followed by more or less adequate results. But it is far more difficult to awaken any widespread concern on behalf of those great abiding national interests which it is our charge and heritage to defend. And yet there are signs of no uncertainty which must to all thoughtful and instructed minds, from many directions, suggest the question whether that industrial leadership which has hitherto made our small and crowded country the world's workshop, and almost the world's mart, is not slipping from us. This is a question not of more or less wealth or luxury, but of very livelihood to the masses of the people under the special conditions of our national existence. If work ceases to come to a workshop, there is nothing for it but prompt dispersal of the workmen. All authorities seem agreed that the population of five or six millions inhabiting England and Wales in the time of Queen Elizabeth represents pretty nearly what their areas can sustain as agricultural, self-supporting countries. But the population of England and Wales alone was shown by the census of 1881 to have reached nearly twenty-six millions. So that seven years ago there was in the southern half of Great Britain an excess of twenty millions above what the country could reasonably support, except as a community of artificers and traders, and general carriers, by import and export, of the world's merchandise. It needs only a glance into past history to see that this, while an enviable position for a nation while prosperity lasts, is practical extinction when the channels of commerce are turned, or lost advantages have transferred production to new centres. Macaulay's fancy picture of the New Zealander sketching the ruins of St. Paul's from the broken arches of London Bridge seems of very little concern to the present citizen, whose ears are deafened with the ceaseless roar and traffic of the streets. And yet precisely that doom of silence and decay has befallen many a proud mother-city of which now "even the ruins have perished." It would far exceed present limits to show in detail how many articles of our own immemorial production we ourselves now largely import, because the foreign workman produces them better, or produces them at less cost. The evidence will be fresh in the recollection of the readers of this journal. Neither can they fail to recall with what persistence we have pointed out the remedy. There is but one real remedy: the better training of the workman; and—if we may be allowed to say it—of his employer too. Everyone who, without prejudice, has opportunity to watch a fair specimen of the British workman at his work must admit that the raw material is as good as ever it was; that in the quantity and quality of the work he can turn out in a given time, few of any nationality can equal, and none surpass him. But in the training he receives, and in the opportunities of his receiving it, there is much left to be desired. And, meantime, there is not only the grave fear, but, in many branches of industry, the accomplished fact, that other nations may and do outstrip us in the race.

Perhaps there is some belated merit in seeing that now; but all honour to those who, with heart and means to labour towards the better training of our artisans, devoted themselves to the endeavour when the need for it was less comparatively obvious. Honour especially to one man, Mr. Quintin Hogg, who, close upon a quarter of a century ago, at an age when most young men are concentrating their best energies on cricket, or football, or lawn tennis (all good things in their way), made it his life's task to raise the skilled workman of London, and furnish him more fully for his labour, for his own sake and for ours. Probably most of our readers know how that small enterprise has become a great one indeed, with the old Polytechnic for its present home and centre, and with a fuller variety of classes and branches, and with a greater comprehensiveness of scheme, than we can now attempt to describe. But all has hitherto rested on the shoulders, and been sustained by the purse, of Mr. Hogg himself, who, during the past six years, has spent, speaking broadly, some £100,000 in establishing and sustaining these admirable schools. But the time has now come when so great a burden, for the work's sake as well as for his own, should no longer depend upon the means and life of a single man; and there is now an opportunity of securing for the Institute something like an adequate endowment. The Charity Commissioners have offered to endow it with £2500 per annum on condition that the public find £35,000 as a supplementary fund. £18,000 have already been promised by the personal friends of the founder; but £17,000 still remain to be raised—a large sum no doubt, but a small one compared to our still unrivalled resources, and the national value of the Institute, not only for its own immediate results, but as a model for similar efforts in all the great centres of our industry. Those who believe in science—that is, in faithfully accurate and exact knowledge—as the only sure basis for any national prosperity that is to bear the stress of the fierce competition of our times, are earnestly invited to make themselves acquainted with the work of the Institute, and to contribute to its funds. Eighty-one thousand members and students have joined since it was moved to the Polytechnic, 309 Regent Street, in 1882. All donations or subscriptions will be thankfully received there, or by Mr. Quintin Hogg, 3 Cavendish Square, W.

THE GEOGRAPHICAL DISTRIBUTION OF THE FAMILY CHARADRIIDÆ.

The Geographical Distribution of the Family Charadriidæ; or the Plovers, Sandpipers, Snipes, and their Allies. By Henry Seebohm. (London: H. Sotheran and Co., 1888.)

THIS is a handsome volume of more than 500 pages, and it is illustrated by twenty-one coloured plates, drawn in Mr. Keuleman's best style. Mr. Seebohm has eschewed giving much information as to the habits of these families of wading birds, and has made a special point of the geographical distribution, a branch of the subject which cannot fail to attract the interest of every true naturalist. The introductory chapters treat of (1) the "Classification," and (2) the "Evolution" of Birds. Chapter III. details the author's views on the "Differentiation of Species," and Chapter IV. deals with the "Glacial Epoch." Chapters V. to IX. are devoted to the migration of birds, and end with a scheme of classification of the *Charadriidæ*. Here are, in fact, enunciated clearly all the articles of the Seebohm faith !

Evolutionists will probably join issue with Mr. Seebohm on many of his conclusions, and geologists may have something to say as to the possibility of glacial epochs causing all that the author claims for them, but ornithologists are scarcely likely to accept all his conclusions at once. If we are to believe Mr. Seebohm, there is very little progress being made in ornithological work in the Old World, his sympathies being evidently more with the American school of ornithologists, for whose method of nomenclature he has great respect. The non-adoption of trinomial principles Mr. Seebohm attributes to the "conservative views of British ornithologists," though he is mindful to add : "It is, however, only fair to remember that much allowance must be made for the narrow, because insular, views of British ornithologists." Shade of Darwin ! The author has singled out the present writer as one of those who seem to have had "no definite idea of what they meant by a sub-species" ; but we may assure Mr. Seebohm that in 1874 we did *not* use the term of *Gyps hispaniolensis* as a sub-species of *G. fulvus* "in an absolutely arbitrary manner," and we did not expect to find our nomenclature discussed under the heading of a "vague use of trinomials." Our object was to recognize evident facts, but at the same time to retain a binomial form of name for every bird, and the uncertainty which still surrounds the American method of trinomial names has not yet encouraged us to abandon the simpler and decidedly less clumsy way of expression. Surely Mr. Seebohm himself must admit that to have to speak of an Oyster-catcher as *Hæmatopus niger ater* (p. 311) is not an advantage, and this is only one result of pushing trinomial nomenclature to its extreme. There are not wanting signs that the advocates of the system are beginning to groan under the weight of the burden they have placed on their own shoulders ; and when the inevitable return to the old simple path of binomial nomenclature takes place, the only tangible result will have been to have weighted the already frightful list of ornithological synonyms with an additional number of long names. Even Mr. Seebohm tries to modify the task of quotation of books by simplifying some titles ; as, for instance, when he speaks of "Coues and Co., Check-List" (p. 427), as if the authors of the admirable A.O.U. "Check-List of North American Birds" had formed themselves into a Limited Liability Company for the manufacture of trinomials.

Another point on which Mr. Seebohm may fairly be called to task is for the number of new names which his book propounds. On the back of the title-page he quotes wise saws from the writings of John Ray (1878), A. R. Wallace (1876), and Henry Seebohm (1883), concerning the necessity of having simple names for birds, and those generally understanded of the people. Here are his own words :—"I have adopted a scheme which appears to me to be the most practical method of any which have been suggested. It may not satisfy the requirements of poetical justice ; but it is at least consistent with common-sense. I adopt the name which has been *most used* by previous writers. It is not necessary for me to encumber my nomenclature with a third name, either to denote the species to which it refers, or to flatter the vanity of the author who described it : all my names are *auctorum plurimorum*." Either our author had forgotten that he had nailed this flag to the mast when he began the present book, or the system of *auctorum plurimorum* does not suit the *Charadriidæ ;* for the next student of these birds will find that for the 235 species enumerated by Mr. Seebohm, he is responsible for giving to sixty-five of them names not previously in vogue ; and the number would have been greater, had not Schlegel worked somewhat on the same line of ideas, while many of the trinomial combinations had been anticipated by "Coues and Co."

The book is profusely illustrated by woodcuts, showing the specific characters of the different species, and these will be invaluable to the student of these difficult birds. In fact, no work has ever been so remarkably treated in this respect, and it will be the book of reference for the *Charadriidæ* for many years to come. The "Keys to the Species" are also excellent, and Mr. Seebohm deserves every credit for having given us such a complete arrangement of some of the most tiresome of all the birds which it falls to the lot of the ornithologist to determine. Every naturalist who works out his facts as completely as the author has done is permitted to account for them by any theory which seems to him good ; and Mr. Seebohm's arguments as to the origin of the species and their distribution are not only examples of clever writing, but are plausible enough if once the absolute certainty of the *Charadriidæ* having been driven from the Polar Basin by successive glacial epochs is conceded. Many ornithologists, however, will think that he carries his theory a little too far, as, for instance, when he places the Avocets and Stilts in one genus, *Himantopus*. How they originally came from the north, were split up in bands, became some of them "semi-Stilts" and "semi-Avocets" ; how they thought nothing of emigrating (cause not hinted at) from the New World across the Atlantic to the Canary Islands and Spain, or from the Chilian sub-region across the Pacific to New Zealand and Australia—these and many other interesting theories of distribution will reward the student of Mr. Seebohm's book. Most ornithologists will be more grateful for small mercies than Mr. Seebohm is, and thank Dame Nature for having given them characters whereby in a few lines a genus can be written down. Take, for instance, the members of the genus *Esacus*, which Mr. Seebohm unites to *Œdicnemus*, and yet his woodcuts show that the former genus has an enormous bill, longer than the head itself—surely a genuine character of importance. Then, again, *Anarhynchus*, with its asymmetrical bill—confined to New Zealand—need not be united to *Charadrius ;*—and so on. With his theory of distribution strong in his mind, the Avocets, with up-turned bill, are united to the Stilts, with their straight bill, because Mr. Seebohm has no doubts as to their common origin in the distant past ; but looking at the present almost identical distribution of *Himantopus melanopterus* and *Recurvirostra avocetta*, *H. mexicanus* and *R. americana*, it would seem as if they had long ago been separated as distinct generic forms, as they would have no business to occupy the same areas, if Mr. Seebohm's theory were true. Is it not possible that they were developed as Avocets and Stilts in very remote times, and that similar causes have driven them to occupy the same areas of distribution? And may not both have had a *southern* instead of a northern origin? Thus *Cladorhynchus* in Australia, *Himantopus andinus* in the Andes (apparently, from Mr. Seebohm's illustration, belonging to a distinct genus), and the various species of Stilts in Australia, New Zealand, and Brazil, would remain as isolated species of a former stock, which probably inhabited a continuous area in the South Atlantic and South Pacific Oceans. Where circumstances were favourable to their stay, some may not have migrated northwards, and the differences in some of the southern species could be accounted for by their subsequent isolation, rather than by their inconsequent flight from Chili to New Zealand, as Mr. Seebohm supposes.

Besides the woodcuts of heads, tails, &c., and other specific characters, the present volume is crowded with woodcut illustrations by Mr. John Millais, Mr. Lodge, and Mr. Holding. They are mostly extremely well done, but Mr. Millais seems a little inclined to fashion his Waders on the model of a peg-top.

R. BOWDLER SHARPE.

THE MINERALS OF NEW SOUTH WALES.

The Minerals of New South Wales, &c. By A. Liversidge, M.A., F.R.S., Professor of Chemistry and Mineralogy in the University of Sydney. (London: Trübner and Co., Ludgate Hill, 1888)

IT was a very happy thought of Prof. Liversidge to celebrate the centenary of the foundation of the colony of New South Wales by the publication of this handsome and comprehensive volume. Giving, as it does, a very clear account of what is known of the mineral resources of the oldest of the Australian colonies, it brings clearly before the mind of the reader how much has already been accomplished in developing the subterranean resources of an important part of the British Empire, and how large is the promise for the future. The term "mineral," we may mention, is not employed in this work in its narrower scientific sense; coals and oil-shales, and even mineral waters, receiving a due amount of notice in it.

The basis of the present work is found in a paper published by the author in the Transactions of the Royal Society of New South Wales, in 1874, of which memoir a second edition was published by the Mining Department of the colony in 1882. Prof. Liversidge has added very largely to his original memoir; and the numerous analyses of minerals and rocks, made by himself, Mr. W. J. Dixon, F.I.C., and the Government Analyst of the Mining Department, greatly increase the value of the book. Owing to the absence of the author from the colony during the past year, the work has been printed and issued in this country; but, as a proof of the manner in which the book has been brought fully up to date, we may note the statement, on p. 185, of the discovery, by Mr. T. W. Edgworth David, of the Geological Survey of New South Wales, of the sparsely distributed mineral leucite in the Australian colony, the fact having only been announced to the Mineralogical Society so recently as October in last year.

A considerable amount of space is naturally devoted to discussions concerning the occurrence of the precious metals—the account of gold occupying 34 pages, and that of silver 13 pages. The interesting series of assays of New South Wales gold, and an account of the chief nuggets found in the colony, are of much interest. In connection with this subject, we have in the work before us a very clear and concise, but very carefully drawn up, statement concerning the often-disputed question of the original discoverer of gold in Australia. The author states his facts and sources of information, taking great care to give references in all cases, and those interested in the question will have little difficulty in arriving at a decision as to the relative merits of the claims which have been put forward on behalf of Count Strzelecki, the Rev. W. B. Clarke, Sir Roderick Murchison, and other less known individuals, to whom the discovery has been ascribed. One of the most interesting and instructive among the many tabular statements in this work is that which indicates the number of minerals which have yielded, on assay, larger or smaller quantities of gold and silver. This table seems to indicate that, even should the alluvial washings and quartz-reefs be exhausted of their auriferous contents, there still remain in Australia many available and very valuable sources of the precious metals.

Still more important in its bearing on the future welfare of the colony is the account of the common metallic ores, and of the coal, lignite, and oil-shale deposits. There are few, if any, of the metals used in the arts, of which abundant sources of supply are not found within the limits of the colony. The coal-fields are said to cover about one-half the area of those of Great Britain, and numerous analyses and other details enable us to judge of the quality of the fuels which they yield. In the discussion of this important question, Prof. Liversidge's great knowledge and experience as a chemist invest his opinions with the highest value.

Although the book is not a technical mineralogical treatise alone, mineralogists will find very careful descriptions of all the minerals, including the gem stones, which have been found within the colony. Their study of the subject will be much facilitated by the large coloured map which forms a frontispiece to the volume.

In concluding this notice we cannot but congratulate the author upon the enterprise and energy which have enabled him to prepare such a treatise as the present one. The objects aimed at in such books as Zepharovic's "Mineralogisches Lexicon für das Kaiserthum Oesterreich" may seem at first sight incompatible with those to which works like Mr. Albert Williams's "Mineral Resources of the United States" are devoted; but Prof. Liversidge has shown that this is by no means the case, and he has achieved the feat in the case of a young and rising colony, where the difficulties of the undertaking must have been more than usually great. The colony, too, is to be congratulated on its good fortune in having as an occupant of the Chemical Chair in its University, one who has shown himself so successful in attaining practical, while not losing sight of the scientific, results of his researches.

OUR BOOK SHELF.

Elementary Chemistry. By William S. Furneaux, F.R.G.S., Science Demonstrator, London School Board. (London: Longmans, Green, and Co., 1888.)

THE main object of this little work is to assist young students intending to sit for the chemistry examination of the Science and Art Department in the new alternative elementary stage. It appears to be, in fact, an illustrated expansion of the detailed syllabus published by the Department in their Directory.

The want of such a work has possibly been felt by many teachers of this "alternative" or "natural" chemistry, which appears to be rapidly becoming more and more popular with young beginners. There is something truly fascinating in learning these mysteries of common things, and, what is still more important, the knowledge gained has its practical applications in every-day life. In order to afford teachers some idea of the methods recommended of performing the class experiments themselves, the Department have caused to be placed in the western galleries of the South Kensington Museum a complete set of apparatus, as simple and inexpensive as is compatible with the object in view, arranged under the personal direction of the examiners, to illustrate the method of performing each of the experiments indicated in the syllabus. It is to be hoped, therefore, that all who are interested in the teaching of the alternative elementary stage of chemistry, and who can conveniently do so, will avail themselves of this opportunity of comparing the experimental methods there recommended with those which they themselves have previously adopted. One cannot help thinking that many of the methods illustrated by Mr. Furneaux are much too complicated, and it is to be regretted that his book was in the press before the completion of the collection in the western galleries, which was accomplished about two months ago.

The majority of the theoretical explanations leave little to be desired. The ideas of the author, however, as to the nature of the Bunsen flame appear scarcely to accord with more recent investigations, the effect of mixture with an inert gas being entirely overlooked. A. E. T.

Companion to the Weekly Problem Papers. By the Rev. John Milne, M.A. (London: Macmillan and Co 1888.)

THE title of this work gives no adequate idea of its contents. It consists of some 340 pages, which, if about 60 pages be excepted, are devoted entirely to geometry. Besides the author, several other mathematicians are contributors, viz. Mr. R. F. Davis, Prof. Genese, Rev. T. C. Simmons, and Mr. E. M. Langley.

The object of the book seems to be to give prominence to what is here designated "The Modern Geometry of the Triangle." This is seen to consist of a group of pretty theorems which arise from a consideration of the "Brocard points" and the "Lemoine point" of a triangle. The successive chapters bear the titles, "Antiparallels, Isogonals, and Inverse Points," "The Brocard Points and Brocard Ellipse," "The Lemoine Point and Triplicate Ratio Circle," "The Brocard Circle and First Brocard Triangle," "The Tucker Circles," "The Cosine and Taylor Circles," "The Co-Symmedian and Co-Brocardal Triangles," and "Miscellaneous Theorems and Constructions." They comprise a good and almost complete account of the present knowledge of these subjects.

On p. 180 there is a *résumé* of the bibliography, which has evidently been carefully compiled by the knot of enthusiasts in this country who have followed in the footsteps of M. Lemoine M. Brocard, M. Vigarié, Prof Neuberg, M. Catalan, and others. To these investigators on the Continent most of the results here given were known prior to 1881; they were subsequently arrived at independently by mathematicians in England who were unacquainted with the work already accomplished, in the same field of research, abroad. In fact, in the *résumé*, discoveries, and rediscoveries, and rediscoveries of rediscoveries succeed one another in bewildering fashion. The reasons which have led to the nomenclature in certain cases are difficult to fathom. We find, for instance, a circle associated with the name of one mathematician, when, admittedly, the same circle had been examined by a Continental investigator some years previously, whose name, if name be necessary, it ought to bear.

The algebraic portions comprehend sections on "Theory of Maximum and Minimum," "Theory of Elimination," "Summation of Series," "Binomial Series," and "Algebraical and Trigonometrical Identities."

The book will be chiefly useful to those who take an interest in recent triangular geometry; it will enable them to refer to original sources in Continental mathematical publications, and to follow further developments in English magazines. They will also find collected here most of the leading propositions given in a form which is without doubt both judicious and attractive.

Elementary Hydrostatics, with Numerous Examples and University Papers. By S. B. Mukerjee, M.A. (Calcutta: Thacker, Spink, and Co., 1888.)

THE compiler of this handy little work is Assistant Professor of Mathematics in the Lahore College, who, having been, as is the wont of his order, unable to select from the numerous text-books in existence one which seemed fully to meet the wants of his classes, has culled his elegant extracts from them, and so got what he wanted. This proceeding is a good one for his pupils, and saves them the trouble and expense of purchasing and reading many text-books. The selection is well made, and the compiler suitably acknowledges his indebtedness to the English writers (especially to Dr. Besant's classical work). The subjects handled are definitions and first principles, density and specific gravity, equilibrium of fluids, total pressures and resultant pressures on immersed surfaces, floating bodies, on air and gases, determination of specific gravities, and the application of hydrostatical principles in the construction of instruments and machines. Then follow several papers of problems set in the Calcutta University Examinations from 1860 to 1884; and the book closes with an appendix of formulæ to be remembered, and another appendix which gives a short history of the growth of the principles of hydrostatics, taken for the most part from Whewell's "History of the Inductive Sciences." In the body of the work are given numerous illustrative examples, many of which have been carefully worked out. Putting on one side the manufacture of the book—and herein, perhaps, Mr. Mukerjee is only more honest in making known his indebtedness than many are in the writing of text-books—we can congratulate the students on having such a good work in their hands, and can indorse the favourable opinion expressed upon it by Prof. T. C. Lewis, Principal of the College.

Arithmetic for Beginners: a School Class-book of Commercial Arithmetic. By the Rev. J. B. Lock, M.A. (London: Macmillan and Co., 1888.)

IT is not necessary to report upon this little book at any length. It is founded upon the author's larger work, but modifications as to arrangement and treatment of some of the subjects and as to the examples have been introduced. Then, with an eye to the requirements of the examination for commercial certificates, a chapter on exchange and foreign money has been added (in a worked-out example on p. 151 there is an error of some pecuniary magnitude), and the chapter "On Recurring Decim ıls, not required by Commercials," finds a place at the close of the text. Mr. Lock is generally so careful in his explanations that we are surprised at his omitting all reference to brokerage in his account of the transferment of stock. Numerous examples are given in the text, and six examination-papers and answers to all questions complete a capital hand-book.

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.*]

Weight and Mass.

PROF. GREENHILL, in his letter which appears in NATURE of May 17 last (p. 54), has again repeated his views on the use of the word *weight.* He has not, however, replied to the criticisms of those who differ from him (see NATURE, vol. xxxvi. pp. 221, 317).

His opponents wish to know how practical engineers who use the word *weight* as synonymous with the physicists' mass, treat a problem involving inertia. Prof. Greenhill has not yet given us an example of such a problem taken from some modern text-book of the practical engineer; nor has he yet given us in simple language a definition of weight. Prof. Greenhill some time ago referred me to Kennedy's "Mechanics of Machinery" for such a definition, but I venture to say that there is no such definition to be found in that standard work.

My own idea is as follows: Matter has many properties—inertia, weight (the force with which the earth pulls it), volume, &c.—and Newton's great discovery consisted partly in seeing clearly that the universal property of matter by which it must be measured is its *inertia,* defined as its capacity for resisting change of velocity.

The *mass* of a body is that which can be ascertained by the operation of *massing;* such an operation, that is, as the following: To a given lump of matter apply some strain or force, and observe the acceleration produced in the matter by that force; then ascertain by experiment to how many lumps of matter called pounds this same force will communicate an equal acceleration.

The *weight* of a body is that which is ascertained by the operation of *weighing.* To weigh a body it is placed on a spring balance, and the force of the earth's attraction is observed by showing the compression of the steel spring of the machine.

It happens, however, that the mass of a body is proportional to its weight; consequently it is sufficient to ascertain whether the weights of two masses are equal in order to ascertain that their masses are equal. The weights of two masses are ascertained to be equal by putting them each on one side of a balance, and observing that the force of the earth's attraction on each is the same. Hence the very difficult operation of *massing* as described above is replaced by the easy operation of weighing.

Prof. Greenhill tells us that "now the invariable unit, the mass, is measured in terms of a variable unit." Is this so? Is it not a fact that those who use exclusively the force of the earth's attraction as the measure of matter, rarely if ever have any conception of the idea of inertia? When the practical engineer has to do with inertia, as in cases of "*centrifugal force,*" he works by formulæ or rule of thumb.

Prof. Greenhill's sentences, "a force equal to the weight of the mass of 10 pound weights," and "the weight of 32 pound weights on the Earth is at the surface of Jupiter a force of 71 pounds' weight," are entirely original.

I believe he means to express "the weight of 10 pounds," and the weight of 32 pounds on the earth is a force equal to the weight of 71 pounds on the surface of Jupiter.

Caius College, May 21. JOHN B. LOCK.

Work and Energy.

WHILE a discussion of the nomenclature of mechanics is going on in NATURE, I would venture to sugge t that an effort should be made to get rid of the practice of expressing energy in foot-pounds or foot-poundals. There are certain quantities of work, not of energy. To speak of a foot-pound of energy is quite as incorrect as it would be to speak of a pint of velocity, a yard of acceleration, an acre of momentum, or a pound of duration. There is great need of a short name for the unit of $\frac{1}{2}mv^2$.

Bardsea, May 21. EDWARD GEOGHEGAN.

On the Reappearance of Pallas's Sand Grouse (*Syrrhaptes paradoxus*) in Europe.

I BEG to add the following statements to my communication of May 12 concerning Pallas's sand grouse in Central Europe (see NATURE, May 17, p. 53):—

April 22, Cernozitz, Bohemia.
,, 26, Portitz, near Leipzig, Saxony.
,, 27, Güttmannsdorf, near Reichenbach, Silesia.
,, 27? near Hanover.
,, 27-28, near Hermannstadt, Transylvania.
,, 29, Marmarosch-Comitate, Hungary.
Last days of April: Alsofehér-Comitate, Transylvania.
Gebhardsdorf, Silesia.
Brod, Bohemia.
First days of May: Tullner-field, near Vienna.
Moravia.
Hungary.
Enzersdorf, near Vienna.
Anclam, Pomerania, Prussia.
May 6, Haida, Bohemia.
,, 6, Eidelstedt, near Hamburg.
,, 7? near Schweinitz, Silesia.
,, 7, Oederan, Saxony.
,, 7, 6.30 a.m., near Oederan, Saxony.
,, 8, Wiener Neustadt, Austria.
,, 8? Dalmatia.
,, 8? Grossvoigtsberg, Saxony.
,, 8? near Leipzig, Saxony.
,, 8? near Herrenhut, Saxony.
,, 9, Oederan, Saxony, and nearly every following day there.
,, 13, Selb, Saxony.
,, 13? Gro svoigtsberg, Saxony.
,, 13, Schluckenau, Bohemia.
,, 16, 5 p.m. Oederan, Saxony.

A. B. MEYER.

Royal Zoological Museum, Dresden, May 20.

A FARM in this neighbourhood was visited yesterday by a flight of about forty sand-grouse (pin-tailed). They were first seen about 6 p.m. feeding on a ploughed field. On rising they took a north-westerly course. A pair which were shot by a gamekeeper are in my posse sion. The presence of these birds in our country is, I believe, of sufficiently rare occurrence to justify me in asking whether they have been noticed in other districts during the last few days. F. M. CAMPBELL.

Rose Hill, Hoddesdon, Herts, May 21.

Tables of Reciprocals.

IN investigating spectral phenomena it is often necessary to convert wave-lengths in frequencies. Can any of your correspondents inform me if there exist in England tables of reciprocals, by which this may be done easily and with sufficient accuracy? V. A. JULIUS.

Delft, Holland, May 19.

On the Veined Structure of the Mueller Glacier, New Zealand.

THE Mueller Glacier, in the Mount Cook district, has a total length of between six and seven miles, with a breadth of one mile in its lower portion. Like most, if not all, of the New Zealand glaciers of the first order, the lower mile or two is so thickly covered with rock debris that the ice can only be seen in the crevasses. All through the lower portion of the glacier the veined or ribboned structure is well marked, running nearly in the direction of the glacier. But at the terminal face there are two systems of veined structure, with the same strike but crossing one another at angles between 15° and 20°. In one system the blue bands are small, from a half to one inch thick, and separated from each other by bands of white ice, with large airbubbles, about twice the thickness of the blue bands. The blue bands are irregular and sometimes anastomose. This system is similar to the veined structure found higher up the glacier.

The second system is formed by large and regular blue bands from three to six inches broad and from two to six or more feet apart. This coarser system is only occasionally developed. The finer system forms a well-marked synclinal curve on the terminal ice cliffs, which are from 250 to 300 feet high.

The ice here contains in places numerous angular stones, principally of slate, scattered irregularly through it, and these fragments always have their broad, or cleaved, surfaces parallel to the smaller system of veins. These stones have no doubt entered the ice through the numerous moulins and crevasses which are found higher up the glacier, but as they are not found in bands nor in pipes, they must have been moved in position by the flowing of the ice, consequently they must originally have been variously oriented, and their present parallelism to the veins is a decisive proof that the smaller system is due to pressure at right angles to the structure. The origin of the coarser system is not so clear. I did not notice it higher up the glacier, as I ought to have done if it had been an older system than the smaller veins. While, on the other hand, if it is a newer system the rock fragments would probably have been oriented parallel with it instead of with the finer system.

The clear blue ice is generally supposed to resist melting better than the white ice, and to stand out in ridges; but I observed nothing of this on the Mueller Glacier. Both kinds of ice melt here with about equal rapidity. The grooving of the ice, by runlets of water, is certainly parallel to the structure when that structure is vertical or highly inclined; but the grooves are formed in several layers of both kinds of ice, and it seemed to me that the blue ice melted rather more rapidly than the white ice. I cannot suggest any cause for this difference between the ice of the Mueller Glacier and that of the Swiss glaciers. F. W. HUTTON.

Christchurch, New Zealand, March 22.

On the Rainfall and Temperature at Victoria Peak, Hong Kong.

THE first column of the following table shows the month of the year; the second, the mean rainfall at the Observatory (about 100 feet above the sea) from ten years' records; the third, the mean of the past four years' fall; the fourth, same for Victoria Peak (about 1800 feet above the sea); the fifth, the proportion between the figures in the two preceding columns; the sixth, the height of ascent in feet for one Fahrenheit degree of decrease of temperature (mean of the past four years):—

I.	II.	III.	IV.	V.	VI.
January	1·47	2·97	4·63	1·56	288
February	1·66	2·30	3·56	1·55	305
March	3·53	3·41	3·60	1·06	489
April	6·55	7·89	9·19	1·16	407
May	9·82	4·86	6·29	1·29	309
June	12·67	14·42	16·71	1·16	259
July	16·41	16·55	20·29	1·23	274
August	16·93	15·27	17·53	1·15	289
September	9·89	7·98	7·01	0·88	283
October	5·06	2·57	2·06	0·80	281
November	1·04	0·77	1·19	1·54	267
December	0·49	0·97	1·21	1·25	278
Year	85·52	79·96	93·27	1·17	310

The rainfall at the Peak exceeds the record at the Observatory by about one-sixth of the whole amount, and this appears to be due to the circumstance that the mountain presents an obstacle to the wind from whatever side it blows, in consequence of which the air is forced to rise, and being thereby cooled it precipitates more moisture in the form of rain. Even when the air is moderately dry at sea-level its temperature may be decreased below the dew-point in the course of such a rise. The comparatively great rainfall in hilly districts must be attributed to this, for a hill must of course exercise its influence at a distance all round. Our rainfall would therefore be smaller if there were no hills in this neighbourhood. But during the months of September and October less rain is collected at the upper level. This is explained by the circumstance that most of the rain in those months is due to typhoons, when the air is everywhere ascending, even above the open sea; and the defect at the Peak is most noticeable during the raging of a typhoon. The fact that less rain is measured above must, however, be further investigated. It is very doubtful whether it would not be as well to expose the funnels of the gauges 4 feet above the ground, where they would not be so much affected by the rain drifting along the surface of the earth in typhoons, as to have them 1 foot above the grass, as is the case here.

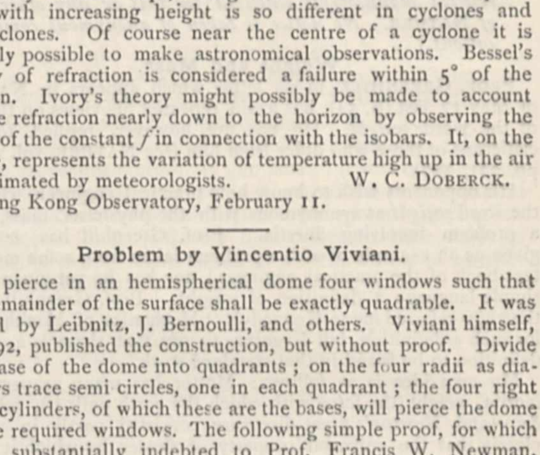
The last column of the table proves the great variability of the fall of temperature with increasing height. It depends upon the humidity of the air. The astronomical refraction near the horizon must be affected by this, but it is rather doubtful whether the effect should be ascertained by comparing observed refractions with meteorological registers kept on mountains on account of the condensation of moisture which tends to raise the temperature on the top of the hill. But it would appear to be time that some astronomer studied the refraction in connection with daily weather-maps, seeing that the variation of temperature with increasing height is so different in cyclones and anticyclones. Of course near the centre of a cyclone it is scarcely possible to make astronomical observations. Bessel's theory of refraction is considered a failure within 5° of the horizon. Ivory's theory might possibly be made to account for the refraction nearly down to the horizon by observing the value of the constant f in connection with the isobars. It, on the whole, represents the variation of temperature high up in the air as estimated by meteorologists. W. C. DOBERCK.

Hong Kong Observatory, February 11.

Problem by Vincentio Viviani.

To pierce in an hemispherical dome four windows such that the remainder of the surface shall be exactly quadrable. It was solved by Leibnitz, J. Bernoulli, and others. Viviani himself, in 1692, published the construction, but without proof. Divide the base of the dome into quadrants; on the four radii as diameters trace semi circles, one in each quadrant; the four right semi-cylinders, of which these are the bases, will pierce the dome in the required windows. The following simple proof, for which I am substantially indebted to Prof. Francis W. Newman, would probably interest many readers of NATURE:—

OXYZ is quarter of dome; AB, generator of cylinder meeting dome in B; BCD, plane parallel to base. Radius of dome = R = OX = OB; angle CDB = XOA = θ; DC = DB = OA = R cos θ; OB . cos BOA = OA = R . cos θ; ∴ BOA = θ; ∴ arc EB = Rθ;



arc BC = θ . R cos θ. Element of surface of window is BC . d(EB) = $R^2\theta \cdot \cos \cdot \theta \cdot d\theta$; ∴ surface of window is the integral of this from $\theta = 0$ to $\theta = \frac{1}{2}\pi$. Integrating by parts, and taking limits, surface of window = $R^2 (\frac{1}{2}\pi - 1)$; ∴ the remainder of the surface XYZ is R^2, which is exactly quadrable. Q.E.D.

Cor. The quadrable part of the quarter-dome is equal to the surface of the semi-cylinder which is within the dome. For, if AB = z, and arc XA = s = Rθ, element of surface of the cylinder is $z \cdot ds = R^2 \cdot \sin\theta \cdot d\theta$; ∴ the entire surface within the dome is the integral of this from $\theta = 0$ to $\theta = \frac{1}{2}\pi$, viz. R^2.

A general discussion of Viviani's problem may be seen in Lacroix, "Traité du Calcul Differentiel et du Calcul Intégral," tome ii. pp. 219–22. EDWARD GEOGHEGAN.

Bardsea, May 2.

SUGGESTIONS ON THE CLASSIFICATION OF THE VARIOUS SPECIES OF HEAVENLY BODIES.[1]

VI.

ON THE CAUSE OF VARIATION IN THE LIGHT OF BODIES OF GROUPS I. AND II.

I. General Views on Variability.

In my former paper I referred to the collision of meteor-swarms as producing "new stars," and to the periastron passage of one swarm through another as producing the more or less regular variability observed in the case of some stars of the class under consideration.

I propose now to consider this question of variability at somewhat greater length, but only that part of it which touches non-condensed swarms; *i.e.* I shall for the present leave the phenomena of new stars, and of those whose variability is caused by eclipses, aside.

It is not necessary that I should pause here to state at length the causes of stellar variability which have been suggested from time to time. It will suffice, perhaps, that I should refer to one of the first suggestions which we owe to Sir I. Newton, and to the last general discussion of the matter, which we owe to Zöllner ("Photometrische Untersuchungen," 76 and 77, p. 252).

Newton ascribed that special class of variability, to which I shall have most to refer in the sequel, as due to the appulse of comets.

"Sic etiam stellæ fixæ, quæ paulatim expirant in lucem et vapores, cometis in ipsas incidentibus refici possunt, et *novo alimento accensæ pro stellis novis haberi.* Hujus generis sunt stellæ fixæ, quæ subito apparent, et sub initio quam maxime splendent, et subinde paulatim evanescunt. Talis fuit stella in cathedra Cassiopeiæ quam Cornelius Gemma octavo Novembris 1572 lustrando illam cœli partem nocte serena minime vidit; at nocte proxima (Novem. 9) vidit fixis omnibus splendidiorem, et luce sua vix cedentem Veneri. Hanc Tycho Brahæus vidit undecimo ejusdem mensis ubi maxime splenduit; et ex eo tempore paulatim decrescentem et spatio mensium sexdecim evanescentem observavit" ("Principia," p. 525, Glasgow, 1871).

With regard to another class of variables he makes a suggestion which has generally been accepted since.

"Sed fixæ, quæ per vices apparent et evanescunt, quæque paulatim crescunt, et luce sua fixas tertiæ magnitudinis vix unquam superant, videntur esse generis alterius, et revolvendo partem lucidam et partem obscuram per vices ostendere. Vapores autem, qui ex sole et stellis fixis et caudis cometarum oriuntur, incidere possunt per gravitatem suam in atmosphæras planetarum et ibi condensari et converti in aquam et spiritus humidos, et subinde per lentum calorem in sales et sulphura et tincturas et limum et lutum et argillam et arenam et lapides et coralla et substantias alias terrestres paulatim migrare."

Zöllner, in point of fact advancing very little beyond the views advocated by Newton and Sir W. Herschel, considers the main causes of variability to be as follows. He lays the greatest stress upon an advanced stage of cooling, and the consequent formation of scoriæ which float about on the molten mass. Those formed at the poles are driven towards the equator by the centrifugal force, and by the increasing rapidity of rotation they are compelled to deviate from their course. These facts, and the meeting which takes place between the molten matter, flowing in an opposite direction, influence the form and position of the cold non-luminous matter, and hence vary the rotational effects, and therefore the luminous or non-luminous appearance of the body to distant observers.

This general theory, however, does not exclude other causes, such as, for instance, the sudden illumination of a star by the heat produced by a collision of two dark bodies, variability produced by the revolution of a dark body, or by the passage of the light through nebulous light-absorbing masses.

If the views I have put forward are true, the objects now under consideration are those in the heavens which are least condensed. In this point, then, they differ essentially from all true stars like the sun.

This fundamental difference of structure should be revealed in the phenomena of variability; that is to say, the variability of the bodies we are now considering should be different *in kind* as well as in degree from that observed in bodies like the sun or α Lyræ, taken as representing highly condensed types. There is also little doubt, I think, that future research will show that, when we get short-period variability in bodies like these, we are really dealing with the variability of a close companion.

II. On the Variability in Group I.

That many of the nebulæ are variable is well known, though so far as I am aware there are no complete records of the spectroscopic result of the variability. But bearing in mind that in some of these bodies we have the olivine line by itself, and in others, which are usually brighter, we have the lines of hydrogen added, it does not seem unreasonable to suppose that any increase of temperature brought about by the increased number of collisions should add the lines of hydrogen to a nebula in which they were not previously visible.

The explanation of the hydrogen in the *variable* stars is not at first so obvious, but a little consideration will show that this must happen if my theory be true.

Since the stars with bright lines are, as I have attempted to show, very akin to nebulæ in their structure, we might, reasoning by analogy, suppose that any marked variability in their case also would be accompanied by the coming out of the bright hydrogen lines.

This is really exactly what happens both in β Lyræ and in γ Cassiopeiæ. In β Lyræ the appearance of the lines of hydrogen has a period of between six and seven days, and in γ Cassiopeiæ they appear from time to time, although the period has not yet been determined.

III. On the Variability in Group II.

This same kind of variability takes place in stars with the bright flutings of carbon indicated in their spectra, o Ceti being a marvellous case in point. In α Orionis, one of the most highly-developed of these stars, the hydrogen lines are invisible; the simple and sufficient explanation of this being that, as I have already suggested, the bright lines from the interspaces now at their minimum and containing vapours at a very high temperature—*teste* the line-absorption spectrum now beginning to replace the flutings—balance the absorption of the meteoritic nuclei.

Anything which in this condition of light-equilibrium will increase the amount of incandescent gas and vapour in the interspaces will bring about the appearance of the hydrogen lines as bright ones. The thing above all things most capable of doing this in a most transcendental fashion is the invasion of one part of the swarm by another one moving with a high velocity. This is exactly what I postulate. The wonderful thing under these circumstances then would be that bright hydrogen should *not* add itself to the bright carbon, not only in bright-line stars, but in those the spectrum of which consists of mixed flutings, bright carbon representing the radiation.

[1] The Bakerian Lecture, delivered at the Royal Society on April 12, by J. Norman Lockyer, F.R.S. Continued from p. 60.

I now propose to use this question of variability in Group II. as a further test of my views.

The first test we have of the theory is that there should be more variability in this group than in any of the

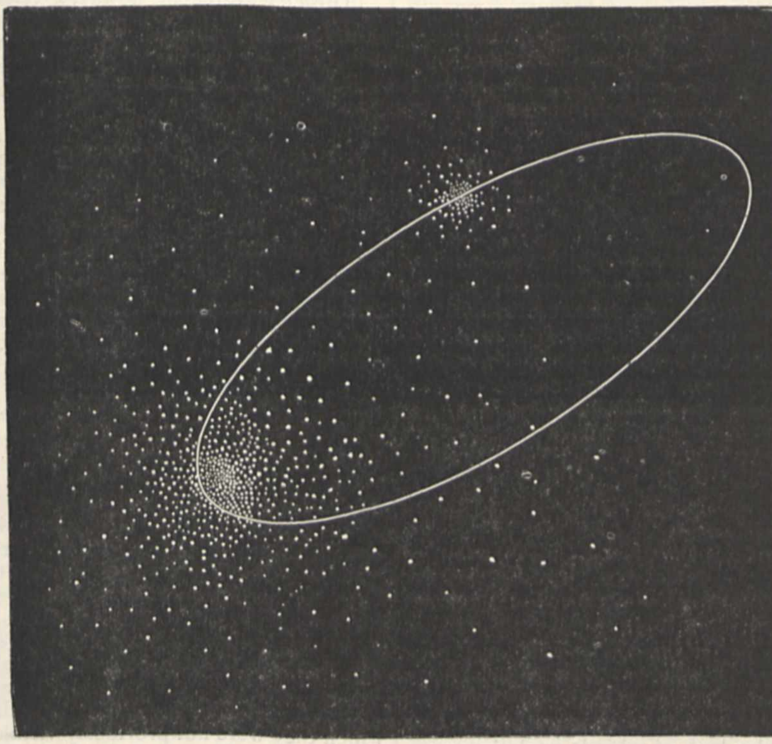


FIG. 11.—Explanation of the variability of bodies of Group II. (1) Maximum variation. The ellipse represents the orbit of the smaller swarm, which revolves round the larger. When the variation is great, the orbit of the revolving swarm is very elliptical, so that at periastron the number of collisions is enormously increased.

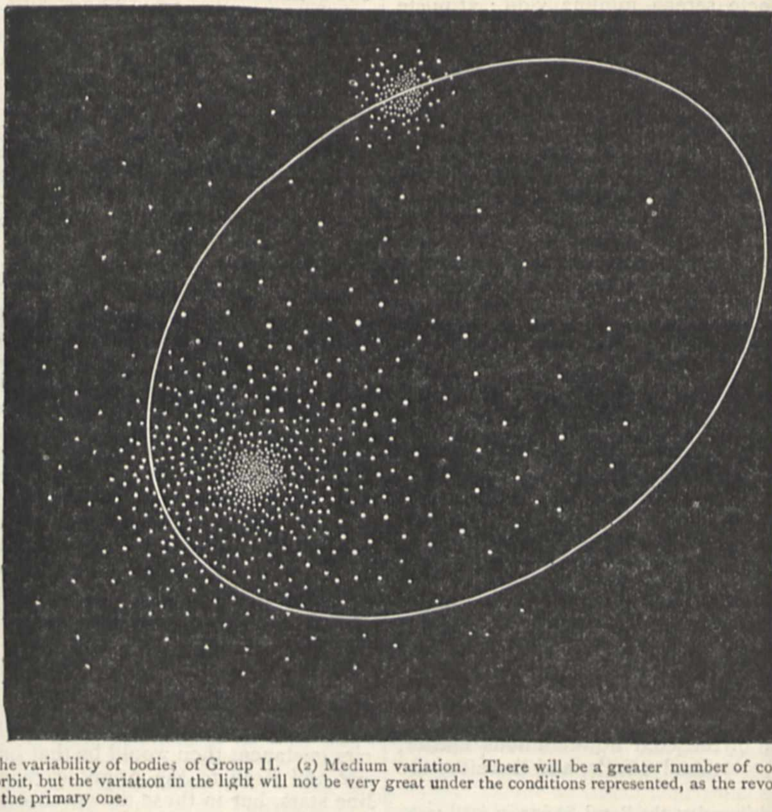


FIG. 12.—Explanation of the variability of bodies of Group II. (2) Medium variation. There will be a greater number of collisions at periastron than at other parts of the orbit, but the variation in the light will not be very great under the conditions represented, as the revolving swarm never gets very near the middle of the primary one.

others. Others are as follows. (2) When the swarm is most spaced, we shall have the least results from collisions, but (3) when it is fairly condensed, the effect at periastron passage (if we take the simplest case of a double star *in posse*) will be greatest of all, because (4) condensation may ultimately bring the central swarm almost entirely within the orbit of the secondary (cometic) body, in which case no collision could happen.

In the light of what has gone before it is as easy to test these points as the former ones.

I will take them in order.

The Frequent Occurrence of Variability in Group II.

The total number of stars included in Argelander's Catalogue, which deals generally with stars down to the ninth magnitude, but in which, however, are many stars between the ninth and tenth, is 324,118. The most complete catalogue of variables (without distinction) that we have has been compiled by Mr. Gore, and published in the Proceedings of the Royal Irish Academy (series ii. vol. iv. No. 2, July 1884, pp. 150–63). I find 191 known variables are given, of which 111 are in the northern hemisphere and 80 in the southern hemisphere.

In the catalogue of *suspected* variable stars given in No. 3 of the same volume (January 1885, pp. 271–310), I find 736 stars, of which 381 are in the northern and 355 in the southern hemisphere.

Taking, then, those in the northern hemisphere, both known and suspected, we have the number 492.

We have then as a rough estimate for the northern heavens one variable to 659 stars taken generally.

The number of objects of Group II. observed by Dunér, and recorded in his admirable memoir, is 297 of these, forty-four are variable.

So that here we pass from 1 in 657 to 1 in 7.

Of the great development of variability-conditions in this group then there can be no question.

To apply the other tests above referred to, I have made a special study of the observations of each variable

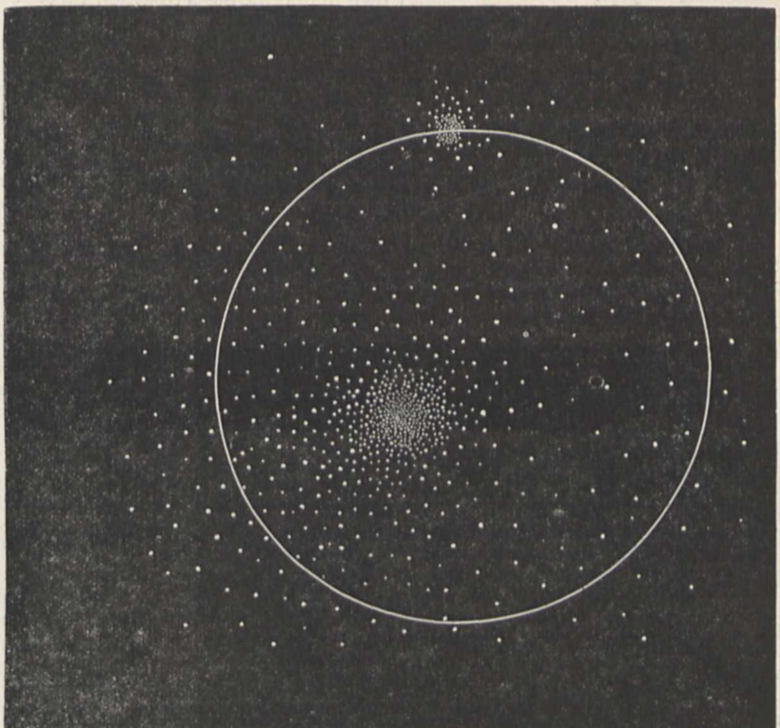


FIG. 13.—Explanation of the variability of the bodies of Group II. (3) Minimum variation. Under the conditions represented, the smaller swarm will never be entirely out of the larger one, and at periastron the number of collisions will not be very greatly increased; consequently the variation in the amount of light given out will be small.

recorded by Dunér. I find they may be grouped as follows:—

1. *All bands visible but narrow.*

No. in Dunér Cat.	Name.	Max.	Min.	Period.
269	μ Cephei ...	4?	5?	irreg.

2. *Bands well marked, but feebler in Red.*

No. in Dunér Cat.	Name.	Max.	Min.	Period.
186	W Herculis (? V)	>8	<12	290?
222	R Sagittarii	7	12	270
81	S Hydræ ...	7·8	<12	256

3. *Bands wide and strong, especially 7 and 8.*

No. in Dunér Cat.	Name.	Max.	Min.	Period.
23	T Arietis ...	8	9–10	324
37	R Tauri......	7·8	<13	326
68	S Canis Min.	7	<11	332
76	R Cancri ...	6	<11–12	360
91	R Leonis Min.	5	10	313
100	R Urs. Maj.	6	12	303
106	R Crateris...	>8	<9	160?
118	R Corvi......	7	<11–13	319
159	R Boötis ...	6	12	223
165	S Libræ......	8	12–13	190?
170	R Serpentis.	5·6	<11	358
181	U Herculis..	6·7	11–12	408
192	S Herculis...	6	12	303
195	R Ophiuchi.	7·8	12	302

4. *All bands markedly wide and strong.*

No. in Dunér Cat.	Name.	Max.	Min.	Period.	
18	*o* Ceti	2–5	8–9	(331)	
20	R Ceti ...	8	<13?	167	
29	ρ Persei ...	3·4	4·2	irreg.	Many lines.
92	R Leonis ...	5	10	313	
141	R Hydræ ...	4·5	4·0?	(437)	
158	V Boötis ...	—	—	—	
166	S Coronæ ...	6	12	361	
184	*g* Herculis ...	5	6	irreg.	Nearly circular orbit.
196	α Herculis ...	3	4	irreg.	
217	R Lyræ ...	4·3	4·6	46	
221	R Aquilæ ...	6·7	11	345	
239	χ Cygni ...	4	13	406	
293	R Aquarii ...	6	11	388	

5. *Bands wide, but pale.*

No. in Dunér Cat.	Name.	Max.	Min.	Period.	
3	T Cassiopeiæ	6·7	11	436	
125	T Urs. Maj.	7	12	256	
127	R Virginis...	6·7	11	146	
157	R Camel ...	8	12?	266	
231	R Cygni ...	6	13	425	
281	β Pegasi ...	7	12	382	
210	T Herculis	7	12	165	
4	R Androm.	5·6	<12–13	405	

6. *Bands thin and pale.*

No. in Dunér Cat.	Name.	Max.	Min.	Period.	
50	α Orionis ...	1	1 4	irreg.	
128	S Urs. Maj.	7·8	11	225	
187	R Draconis	6·7	11–12	247	
238	S Vulpec. ...				
261	R Vulpec....	7·8	13	137	

A glance at the above tables will show that the kind of variability presented by these objects is a very special one, and is remarkable for its great range. The light may be stated in themost general terms to vary about six magnitudes, from the sixth to the twelfth. This I think is a fair average; the small number of cases with a smaller variation I shall refer to afterwards. A variation of six magnitudes means roughly that the variable at its maximum is somewhere about 250 times brighter than at its minimum.[1]

I have already indicated that, with regard to the various origins of the variability of stars which have been suggested, those which have been always most in vogue consider the maximum luminosity of the star as the normal one; and indeed with regard to the Algol type of stars of short periods, which obviously are not here in question, there can be no reasonable doubt, that the eclipse explanation is a valid one; but in cases such as we are now considering, when we may say that the ordinary period is a year, this, explanation is as much out of place on account of period, as are such suggested causes as stellar rotation and varying amount of spotted area on a stellar surface, on account of range.

[1] Obtained by the formula $L_m = (2{\cdot}512)^n \cdot L_{m+n}$. For differences of 5, 6, 7 and 8 mag. we get

$$L_m = 100{\cdot}02 \cdot L_{m+5}$$
$$= 251{\cdot}24 \cdot L_{m+6}$$
$$= 631{\cdot}11 \cdot L_{m+7}$$
$$= 1585{\cdot}35 \cdot L_{m+8}$$

L_m = light of a star of magnitude m.
L_{m+n} = " " n magnitudes fainter

We are driven, then, to consider a condition of things in which the minimum represents the constant condition, and the maximum a condition imposed by some cause which produces an excess of light; so far as I know the only explanation on such a basis as this that has been previously offered is the one we owe to Newton, who suggested such stellar variability as that we are now considering was due to conflagrations brought about at the maximum by the appulse of comets.

How the Difficulty of Regular Variability on Newton's View is got over in mine.

It will have been noticed that the suggestion put forward by myself is obviously very near akin to the one put forward by Newton, and no doubt his would have been more thoroughly considered than it has been hitherto, if for a moment the true nature of the special class of bodies we are now considering had been *en évidence*. We know that at their minimum they put on a special appearance of their own in that haziness to which I have before referred as having been observed by Mr. Hind. My researches show that they are probably nebulous, if indeed they are not all of them planetary nebulæ in a further stage of condensation, and such a disturbance as the one I have suggested would be certain to be competent to increase the luminous radiations of such a congeries to the extent indicated.

Some writers have objected to Newton's hypothesis on the ground that such a conflagration as he pictured could not occur periodically, but this objection I imagine chiefly depended upon the idea that the conflagration brought about by one impact of this kind would be quite sufficient to destroy one or both bodies, and thus put an end to any possibilities of rhythmically recurrent action. It was understood that the body conflagrated was solid like our earth. However valid this objection might be as urged against Newton's view, it cannot apply to mine, because in such a swarm as I have suggested, an increase of light to the extent required might easily be produced by the incandescence of a few hundred tons of meteorites.

I have already referred to the fact that the initial species of the stars we are now considering have spectra almost cometary, and this leads us to the view that we may have among them in some cases swarms with double nuclei—incipient double stars, a smaller swarm revolving round the larger condensation, or rather round their common centre of gravity. In such a condition of things as this, it is obvious that, as before stated, in the swarms having a mean condensation this action is the more likely to take place, for the reason that the more the outliers of the major swarm are drawn in, the more likely is the orbit of the smaller one to pass clear. The tables show that this view is entirely consistent with the facts observed, for the greater number of instances of variability occur in the case of those stars in which, on other grounds, mean spacing seems probable.

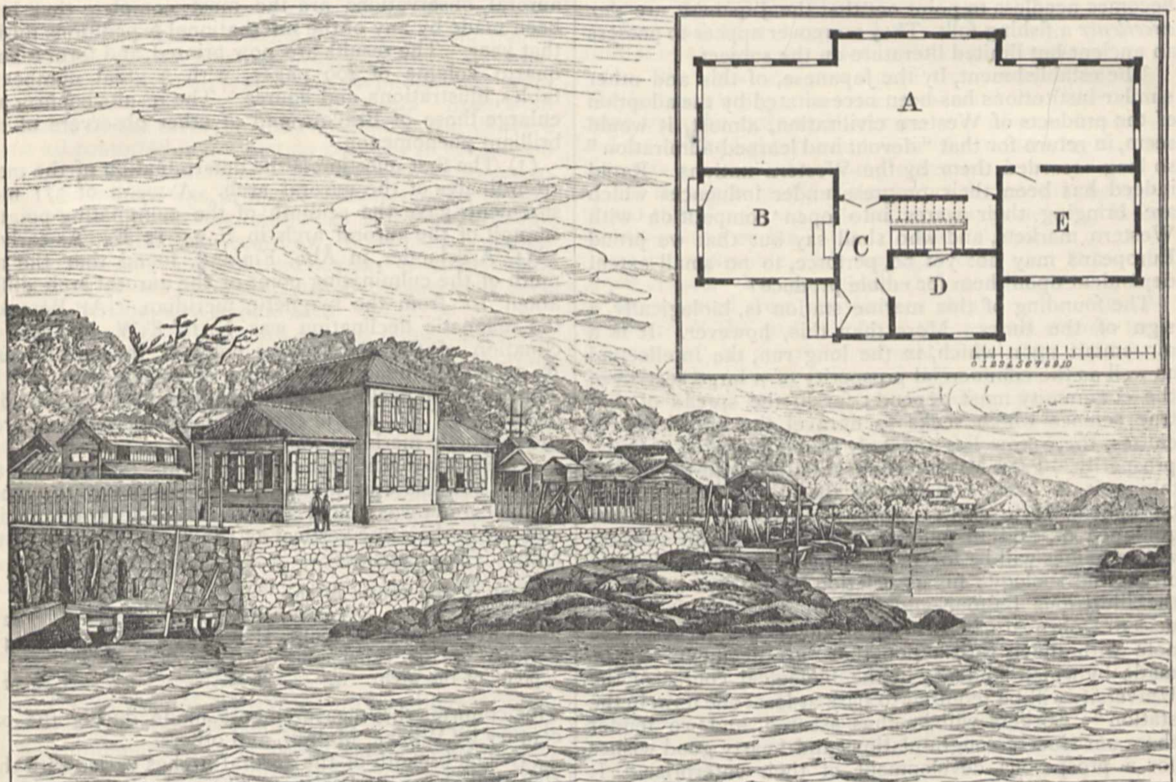
The Cases of Small Range.

So far, to account for the greatest difference in luminosity at periastron passage, we have supposed the minor swarm to be only involved in the larger one during a part of its revolution, but we can easily conceive a condition of things in which its orbit is so nearly circular that it is almost entirely involved in the larger swarm. Under these conditions, collisions would occur in every part of the orbit, and they would only be more numerous at the periastron in the more condensed central part of the swarm, and it is to this that I ascribe the origin of the phenomena in those objects—a very small number—in which the variation of light is very far below the normal range, one or two magnitudes instead of six or seven. Of course, if we imagine two subsidiary swarms, the kind of variability displayed by such objects as β Lyræ is easily explained.

NATURAL SCIENCE IN JAPAN.

WITH the close of our eventful Jubilee year there was completed the first volume of a new journal of science which is destined to play a very important part in the advance of knowledge. We refer to the Journal of the College of Science of the Imperial University of Japan, already noted in these pages.

This periodical is issued under the joint editorship of four professors in the College whence it originated. These gentlemen, one only of whom is an Englishman, constitute a publishing committee: they have adopted the wise plan of issuing all communications on all subjects recognized within the one cover, and under their supervision there have already appeared a series of original papers of considerable interest, so far at least as those biological are concerned. The work is being well done: authors, editors, publishers, and craftsmen appear to be working harmoniously in the production of a journal which, while it reflects the utmost credit on all, leaves nothing to be desired. Twenty-one original monographs have been set up, three of them in German, the rest in English. Of these five are biological, while six are devoted to physics, four to chemistry, three to seismology, and two to geology proper. It is to the first-named that we wish now to refer. The first paper published deals with the life-history of a parasite (*Ugimya sericaria*) which works fearful havoc among the silkworms in Japan: this monograph is in itself interesting, apart from its intrinsic merit, as showing that our Eastern friends are fully alive to the so-called practical application of their work. This and other valuable papers which we might name testify most satisfactorily to the thoroughness of, at any rate, one side of the undertaking; others there are which show that



The Marine Biological Station of the Imperial University at Misaki.

these investigators are fully prepared to face some of the most formidable problems now exercising the mind of the zoologist, and in dealing with such problems they display a diligent attention and cautious generalization, such as are occasionally looked for in vain in writings nearer home. If this excellent beginning is, in these respects, indicative of that which is to follow, only results of the greatest value can ensue.

Of the zoological communications two are exceptional—we refer to those contributed by Prof. K. Mitsukuri, of the Imperial University, Tokio. One of these, on the germinal layers in Chelonia (produced in conjunction with his assistant, Ishikawa), has previously appeared in our own *Journal of Microscopical Science*. The other is deserving of especial comment, for it brings tidings of the establishment of a marine biological station of the Imperial University, at Misaki.

Misaki is a fishing settlement to the west of the Bay of Tokio, easily accessible, we are told, from Tokio or Yokohama in a day. Its waters have a direct interest for Western zoologists, in the fact that they have given birth to most of those museum specimens of Hyalonema, with which the skilful Japanese so long duped the rest of the world. Geographically, the relations of Japan to Asia may be appropriately compared with those of Britain to Europe: in their greater climatic variations, however, the Easterns have an advantage, if only by way of variety in the fauna and flora thereby induced. Again, Misaki, says Prof. Mitsukuri, has "long been a favourite collecting ground for naturalists; almost every group of animals is represented in this region in more or less abundance," and he gives it as his opinion that zoologists have by no means "become acquainted with even a small part of all the interesting animals to be found." When we reflect upon this, mindful of the climatic features of the district, and in view of the enumeration given of known inhabitants of its waters, great expectations are conjured up, and the importance of the enterprise upon which our friends have embarked becomes self-evident.

The station has been founded by the Department of Education and the authorities of the Imperial University, as a special adjunct to the biological laboratories of the latter. As it is fair to assume that the governmental body will, like all others, expect "something practical" for its money, we anticipate that attention will early be given to questions of economic importance. The Japanese have a fishing population of more than 1,500,000 active workers, while it is computed that 36,000,000 persons, in all, are more or less dependent upon fish as food. When, in view of the total area and population of our own islands as compared with those of Japan, it is remembered that our own fishing population numbers little over 540,000, it becomes needless to point out that the Japanese are *par excellence* a fishing folk. They moreover appear to possess an ancient but limited literature on the subject.

The establishment, by the Japanese, of this and other similar institutions has been necessitated by the adoption of the products of Western civilization, almost, it would seem, in return for that "devout and learned admiration" so long accorded them by the Western nations. Rapid indeed has been their progress under influences which are bringing their wares into open competition with Western markets, and who shall say but that we proud Europeans may not yet be, perforce, to no small extent dependent upon them for edible produce?

The founding of this marine station is, biologically, a sign of the times. More than this, however. It is a mo ement upon which, in the long run, the intellectual as well as the commercial prosperity of a large section of the community must depend; for in the spread of that true science which seeks to unravel the knowledge of causes, there now lies the only sound basis for national prosperity. Prof. Mitsukuri's association with the undertaking is, in itself, a guarantee that these interests will be upheld. His earlier work was executed under the guidance of, and in fellowship with, American subjects whose names will be for ever memorable in the history of marine zoology: his association with them and with the illustrious Balfour, and his acknowledged indebtedness to Dohrn, are, in themselves, auguries of success. We note with much satisfaction that "arrangements will be made by which students in the biological course of the University will be required to pass at least one term in the station": workers will be thus assured, and we tender them our sincere congratulations and hearty good wishes for a prosperous development of their enterprise. It must not be forgotten that the Japanese waters have lately yielded us the interesting Chlamydoselache, and it would be a most interesting circumstance should the far-famed Hyalonema, to which Prof. Mitsukuri so frequently reverts in his article quoted, receive final consideration at the hands of his countrymen.

The following is a brief description of the station itself, extracted from the original article. "The building is of plain wood, and one story high, except in the middle part, which has a second floor. The main laboratory-room (A), which occupies the whole sea-front, is 48 feet long, 12 feet wide at the two ends, and 18 feet in the middle, and is able to accommodate about ten workers. A number of small aquaria for the use of investigators will be placed in this room. Of the rooms at the back of the main laboratory, one (B) has a cement floor and is for assorting and preserving specimens brought in from the sea. Another (E) is to be used as the library-room, and a third (C) as the store-room. The second floor over the central part of the building is able to give sleeping accommodation for a few persons. From a tank placed outside the building, fresh sea-water is carried into the main laboratory-room and the assorting-room, and is delivered out of many facets." G. B. H.

THE AURORA IN SPITZBERGEN.[1]

THE best observations hitherto made on the aurora borealis are those made at Bossekop, by Bravais, during the expedition of the French corvette *Le Recherche*, 1838–40. Bossekop is also situated in the maximum zone of the auroras, on the coast of Northern Norway. Considering that Spitzbergen lies a little *north* of the same zone, and nearly on the same meridian as Bossekop, it was resolved that the observations of auroras should be made with the greatest possible care at the Swedish International Polar Station at Spitzbergen in 1882–83. This work was confided to Mr. Carlheim-Gyllenskiöld, and the auroral observations are the most complete that have been made by any of the international expeditions during that year. The results are now printed, and form a large quarto volume of 409 pages, with a great number of tables, illustrations, and figures. The results confirm and enlarge those of Bravais, and of other observers of this brilliant phenomenon.

(1) The first question is the determination of the mean co-ordinates of the auroral arch. A mean of 371 measurements gave the azimuth of the culminating point or summit of the auroral arch in S. 24° 12′ E. As early as 1834, Argelander, in Åbo, Finland, found that the azimuth of the culminating point of the auroral arch differs about 10° from the magnetic meridian. At Bossekop the magnetic declination was N. 10° 8′ W., and the declination of the culminating point of the auroral arch N. 22° 4′ W., the anomaly being, of course, about 11° W. The magnetic declination at Cape Thordsen was found to be N. 12° 45′ W., and of course the auroral anomaly from the magnetic meridian was 11° 27′ W.

(2) Eighty-seven measures on the position of the corona borealis were made, and the position of the centre of the corona was found nearly in the magnetic zenith, and *not* in the same vertical as the highest point of the arch. The means are:—

Position of the centre of the corona	H = 79° 55′ ...	Az. = S. 7° 12′ E.
Position of the magnetic zenith	H = 80 35 ...	Az. = S. 12 4 E.
Position of the culminating point of the arch	H = — ...	Az. = S. 24 12 E.

This confirms the measurements made during the past century by Wilcke, Mairan, and others.

(3) The breadth of the auroral arches varies with their elevation above the horizon. The arches consist of rays running in the direction of the breadth of the arch, and converging towards the magnetic zenith. Thus they form a long fringe of rays parallel to the dipping-needle, suspended, like a curtain, from east to west, but with a small extent of breadth from north to south. If this curtain of rays moves from the horizon to the zenith, the breadth varies according to the laws of perspective. The formula gives the greatest breadth at a height of 45°. In the neighbourhood of the zenith the arches are very narrow, stretching as a luminous band across the heavens.

(4) Besides the arches and rays, the auroral light sometimes formed a true spherical zone parallel with the earth's surface, thus floating in space as a horizontal layer of light, often crossed by several arches. This form is seldom to be seen in lower latitudes. These auroral zones were apparently much broader in the zenith than at their extremities nearer to the horizon. When such an auroral zone was lying wholly over the heavens, with the excep-

[1] "Observations faites au Cap Thordsen, Spitzberg, par l'Expédition Suédoise." Tome II. (1) Aurores boréales. Par Carlheim-Gyllenskiöld.

tion of a low segment near the horizon, a dark segment was produced by contrast. Sometimes the luminous zone was broken, and then dark spots or irregular spaces were produced in the same way. These dark spaces were frequently seen tinted with a faint rosy light.

(5) The movement of the arches is ordinarily reported to be from north to south, at places situated to the south of the maximum zone, and, from the opposite direction, at places within the maximum zone. Thus, at different stations between the latitude of Rome and the latitude of Bossekop, 69·6 per cent. of the auroral arches have moved from the north; at Mossel Bay, Franz-Josef Land, and Discovery Bay, on the contrary, 62·5 per cent. have moved from the south. At Cape Thordsen it was of course expected that the most part of the auroral arches would move from the south. Yet this was not the case. On the contrary, 57·6 per cent. moved from the north. The movements were, of course, almost the same in both directions.

(6) The anomalous forms of arches were very frequent, and were made a matter of accurate investigation. Sometimes an auroral arch presents the form of a sinuous band, or resembles a brilliant curtain with deep folds. At other times the arches appeared as regular spirals. Seen from the outside of the earth, or from above, the spirals were almost all contorted in a direction contrary to the motion of the hands of a watch, and the undulations folded as an S. The motion was, in 80 per cent., from west to east. The folds of the auroral draperies had very different dimensions on different occasions. Sometimes a regular arch showed only a slight undulation; at other times, only a part of an immense auroral drapery was seen above the horizon, as a pseudo-arch.

(7) Often, waves of light are running along the arches, and then the rays or beams are apparently in vivid motion. This appearance of the aurora is known in England as "the merry dancers." In 103 cases the waves were running from west to east, and in 101 cases from east to west. The mean angular velocity per second was 38″·6. For a mean vertical height of the aurora of 100 kilometres above the earth's surface, or 222 kilometres from the observer's eye, this gives the immense velocity of about 2·5 kilometres per second. The light of the aurora was often suddenly changing as to the distribution and intensity of light, but the geometrical form of the whole phenomenon was only slowly varying. The rays were sometimes observed to have a slow proper motion from west to east, or *vice versâ*.

(8) As to the classification of the auroral forms, the author rejects that of Weyprecht. The different forms of the aurora in the classification of Weyprecht are, in fact, only different views or projections, as, for instance, the forms III. = beams or rays, and IV. = corona. The corona results, according to the rules of perspective, when a large number of separate beams parallel to each other and to the direction of the dipping-needle seem to converge to one point, viz. the magnetic zenith. A regular and fully-developed arch consists, as we have said before, of a long fringe of rays, and so on. The author considers only two different forms of auroral light, viz. zones, or horizontal layers of light; and arches, composed more or less of distinct rays parallel to the dipping-needle. The arches present themselves in four different conditions: (1) arch, or a regular band; (2) band, or drapery; (3) spiral; and (4) pseudo-arch.

(9) The light of the aurora is, according to the author, of two kinds: (1) the yellow light, entirely monochromatic, and showing in the spectroscope the well-known yellow line of Ångström; (2) the crimson or violet light, resolved in the spectroscope into several rays and bands, spread over all parts of the spectrum. In the following table we give (I.) the lines observed by the author, (II.) the lines observed by several authors before the year 1884, and (III.) the spectrum of lightning, according to the observations of Herschel, Vogel, Schuster, and the author. The unity for wave-length is, as usual, the 0·0000001 of the millimetre.

I.		II.		III.
6306 ± 7·3	...	6294 ± 6·4	...	6300
5776 ± 3·0	...	5776 ± 3·0	...	—
5664 ± 3·0	...	5664 ± 3·0	...	5685
5568 ± 1·6	...	5570 ± 0·9	...	—
5353 ± 3·0	...	5353 ± 3·3	...	5338
5264 ± 2·5	...	5280 ± 1·8	...	5260
5228 ± 2·7	...	5226 ± 3·2	...	—
5001 ± 4·2	...	5003 ± 2·7	...	5004
4837 ± 10·7	...	4862 ± 1·5	...	4860
4707 ± 5·1	...	4702 ± 2·9	...	—
4642 ± 3·3	...	4636 ± 2·4	...	4632
4236 ± 6·7	...	4286 ± 4·4	...	—

There were twelve other extremely faint auroral rays to be seen occasionally, but their position could not be exactly observed.

As to the further discussion of the different auroral spectra and their supposed connection with different auroral forms, we must refer to the original paper.

(10) No sound was ever heard from the auroral light. The feeble rustling noise sometimes heard was observed to come from the loose agile surface-layer of snow driven to and fro by the lightest wind over the underlying layers. Nor was a "smell of sulphur" observed.

(11) As to the height of the aurora, it may first be mentioned that the aurora was never seen to descend below the mountains or the lower clouds. Only two or three times it is possible that the light was seen below the upper clouds. Yet sometimes the auroral light was seen to be reflected from the surface of the snow. Direct measures of the parallax from the end of a short base (573 metres), by means of auroral theodolites of Mohn's construction, gave an average height of 55·1 kilometres; from observations of the corresponding amplitudes and heights of the arches, according to Bravais' method, 57·7 kilometres; and by several other observations and calculations, about 60 kilometres was found to be the probable mean height of the aurora.

(12) As to the annual and diurnal periods of the aurora, no annual variation in the frequency could be proved. The apparent daily period gave a maximum at 8h. 50m. Göttingen time, or 9h. 13m. local time, in the evening; and a minimum at exactly the same hour in the morning. This apparent period must be corrected for the influence of the quantity of clouds and for the influence of the twilight. If F represents the apparent frequency of the aurora, and Q the quantity of clouds in tenth parts of the whole sky, there was found $F = 1 - 0{\cdot}0730\,Q$, in taking for unity the apparent frequency when the heavens were totally clear.

Further, the apparent frequency when the sun was 10° 47′ below the horizon was the half of the true frequency, and the influence of the sun's light was sensible as far as to a depth of the sun of 17° 45′ below the horizon. Once only the aurora was seen when the sun was not more than 5° 25′ below the horizon.

Taking into account these sources of error, the true daily range has a maximum at 3h. 3m. p.m., and a minimum at 8h. 3m. a.m. local time.

Finally, there was also a well-marked daily range in the form of the aurora. The most brilliant phase of the phenomenon occurred at 4h. p.m.; the aurora then appeared as a complete regular arch. On the other hand, the minimum brilliancy took place at 9h. a.m.; the arches then were resolved into whirling fragments.

Upsala, April. H. HILDEBRANDSSON.

NOTES.

THE general arrangements for the Bath meeting of the British Association have now been made. The first meeting will be held on Wednesday, September 5, at 8 p.m. precisely, when

Sir H. E. Roscoe will resign the chair, and Sir F. J. Bramwell, President-elect, will assume the Presidency, and deliver an address. On Thursday evening, September 6, at 8 p.m., there will be a *soirée;* on Friday evening, September 7, at 8.30 p.m., a discourse on "The Electrical Transmission of Power," by Prof. W. E. Ayrton; on Monday evening, September 10, at 8.30 p.m., a discourse on "The Foundation Stones of the Earth's Crust," by Prof. T. G. Bonney; on Tuesday evening, September 11, at 8 p.m., a *soirée*. On Wednesday evening, September 12, the concluding general meeting will be held at 2.30 p.m. Excursions to places of interest in the neighbourhood of Bath will be made on the afternoon of Saturday, September 8, and on Thursday, September 13.

THE fourth session of the International Geological Congress will be opened on Monday evening, September 17, and will last during the whole of the week. The meetings will be held in the rooms of the University of London, Burlington Gardens. The Honorary President of the Congress will be Prof. Huxley; the President, Prof. Prestwich; the Vice-Presidents, the Director-General of the Geological Survey, the President of the Geological Society, and Prof. McK. Hughes; Treasurer, Mr. F. W. Rudler; and General Secretaries, Mr. J. W. Hulke and Mr. W. Topley. Up to the present date 395 geologists have signified their intention of being present. Of these 210 are British, and 185 foreign. The number of countries represented is 22.

THE Linnean Society holds its centenary celebration to-day. The following is the programme of the proceedings:—At 2.30 p.m. the President will receive the visitors. At 3 p.m. the President will take the chair. After introductory remarks by the President, and the formal business of the anniversary meeting, the Treasurer will lay before the meeting an account of the financial condition of the Society during the last century; the Secretaries will lay before the meeting a history of the Linnean books, herbarium, and other collections; the President will deliver the annual address. The following Eulogia will be pronounced: On Linnæus, by Prof. Thöre Fries, the present occupant of the Chair of Botany at Upsala; on Robert Brown, by Sir Joseph Hooker; on Charles Darwin, by Prof. Flower; on George Bentham, by Mr. W. T. Thiselton Dyer. The Linnean Gold Medal, instituted by the Society on the occasion of its centenary, will be presented to Sir Joseph Hooker (botanist), and Sir Richard Owen (zoologist). (In subsequent years the presentation will be alternately to a botanist and zoologist.) At 6.30 p.m. the annual dinner will be held at the Hotel Victoria, Northumberland Avenue, the President in the chair. To-morrow (May 25th), at 8.30 p.m., the President and Officers will hold a reception of the members and visitors in the Rooms of the Society, when the Linnean collections and relics will be exhibited.

THE late Mr. Cooper Foster, of Grosvenor Street, for many years senior surgeon to Guy's Hospital, was famous among horticulturists as a collector and grower of Hymenophyllums, Trichomanes, and Todias, popularly known as Filmy Ferns. With very few exceptions, the whole of these plants are extremely difficult to cultivate. The conditions under which they grow naturally are not easily imitated. Mr. Foster, however, contrived to keep a very rich collection of species, many of them unknown in gardens except at Kew, where the collection of Filmy Ferns is perhaps unique; and even Kew did not possess several kinds which Mr. Foster possessed. When it is remembered that these extremely delicate plants were cultivated in one or two small greenhouses at the back of a house in Grosvenor Street, Mr. Foster's success appears still more remarkable. After his death the Filmy Ferns were removed to his son's residence at Binfield, Berks. Recently, however, Mrs. Foster offered the whole collection to Kew, and it has lately been transferred to these Gardens, special accommodation having been provided for it in the house (No. 3) where the bulk of the Kew collection is grown. Among the most noteworthy of the plants comprised in the Cooper Foster collection are *Trichomanes reniforme*, a magnificent specimen a yard across, bearing hundreds of fine healthy leaves; *T. parvulum*, which has a compact cushion-like mass of tiny palmate leaves; *T. alabamense*, *Hymenophyllum æruginosum*, *H. chiloense*, *H. cruentum*, *H. flexuosum*, *H. Fosterianum*, *H. pectinatum*, *H. pulcherrimum*, and some grand masses of *H. demissum*. This magnificent gift to the national gardens at Kew will no doubt receive the appreciation from the public which its intrinsic beauty, scientific interest, and actual pecuniary value deserve.

MRS. EMMA W. HAYDEN has given to the Academy of Natural Sciences of Philadelphia in trust the sum of $2500.00, to be known as the Hayden Memorial Geological Fund, in commemoration of her husband, the late Prof. Ferdinand V. Hayden. According to the terms of the trust, a bronze medal and the balance of the interest arising from the fund are to be awarded annually for the best publication, exploration, discovery, or research in the sciences of geology and palæontology, or in such particular branches thereof as may be designated. The award and all matters connected therewith are to be determined by a Committee, to be selected in an appropriate manner by the Academy. The recognition is not to be confined to American naturalists.

ACCORDING to the *Colonies and India*, the appointment of Superintendent of the Botanical Gardens, Singapore, has become vacant owing to the death of Mr. Cautley in Tasmania.

M. HERVÉ MANGON, Member of the Paris Academy of Sciences, and President of the French Meteorological Councils died on the 16th inst., at the age of sixty-seven. He was Minister of Agriculture in the Brisson Cabinet, and was a high authority on drainage and agricultural improvements.

THE Pilot Chart of the North Atlantic Ocean for May show, that, generally, fine weather prevailed over that ocean during April. Storms accompanied by electric phenomena occurred about once a week north of the 40th parallel. A cyclonic storm of great strength was generated on April 15 in about 35° N. and 60° W., moving across the Banks from the 16th to the 18th, in which the wind reached force 11. There was also a gale of considerable strength to the north-eastward of the Azores during the second week of April, and a "norther" was felt in the western part of the Gulf of Mexico on the 13th. Considerable fog was met with off the Grand Banks, and southwards. The amount of ice encountered was unusually small, and was confined for the most part to the south-east coast of Newfoundland. Although it has been delayed in its southward movement by the unusual prevalence of south-easterly winds, it is now liable to appear in quantity, and to constitute a source of danger for several months. Careful observations of the Gulf Stream and the equatorial current are now being made at certain points by the United States steamer *Blake*.

A SODIUM salt of zincic acid has at last been obtained in the crystalline state by Messrs. Comey and Loring Jackson, of Harvard University (*Berichte*, 1888, 1589). Every analyst is aware that zinc hydrate is soluble in potash or soda, and although it has been presumed that zincates of the alkalies or compounds of the alkaline oxides with zinc oxide are formed under these circumstances by replacement of the hydrogen of the hydrate by potassium or sodium, no such compounds have hitherto been isolated. Messrs. Comey and Jackson, however, find that when a concentrated solution of zinc or zinc oxide in soda is shaken with alcohol the mixture separates on standing into two layers a heavier aqueous and a lighter alcoholic layer. When the treatment of the heavier layer with alcohol is repeated once or twice, it eventually solidifies to a mass of white crystals which melt below 100° C. Moreover, on allowing the alcoholic washings to stand, long brilliant white needles, often more than a centimetre in length, are deposited. These latter crystals differ very markedly in melting-point from those obtained from the aqueous portion, as they remain unfused even at 300°. They were finally purified and subjected to analysis, the results of which point very clearly to the composition $2NaHZnO_2 + 7H_2O$, or $2Zn(OH)(ONa) + 7H_2O$. Hence this new salt may be regarded as hydrogen sodium zincate. It is soluble in water and alcohol holding soda in solution, but is decomposed both by pure water and alcohol. The crystals obtained from the aqueous solution above mentioned appear to differ from those just described only in containing more water of crystallization, the amount of which has not yet been fixed with certainty. The fact that zinc oxide behaves so negatively towards the more positive alkalies, playing as it evidently does the *rôle* of an acid, is now happily a proved one, and it is to be hoped that the American chemists will continue their researches until they have been as fortunate in preparing the normal salt of zincic acid.

AT the last meeting of the Asiatic Society of Japan, the Rev. J. Batchelor read a paper on "Some Specimens of Aino Folk-Lore." There were seven of these taken down as they were sung, chanted, or recited by the Aino bard or story-teller. After telling these stories, Mr. Batchelor observed that among the Ainos there are still prophets and prophetesses, but they limit their powers now to telling the cause of illness, prescribing medicine, using charms, and the like. A person when prophesying is supposed to sleep or otherwise lose consciousness, and to become, so to speak, the mouthpiece of the gods. The prophet is not even supposed to know what he himself utters, and often listeners cannot understand the meaning of the utterances. The burden of the prophecy sometimes comes out in jerks, but more often in a kind of sing-song monotone. Mr. Batchelor described one scene of Aino prophesying at which he was present. "Absolute silence reigned around, old men with gray beards sat with eyes full of tears, in rapt attention; the prophet himself was apparently quite carried away with his subject; he trembled, perspired profusely, and beat himself with his hands. At length he finished exhausted, and as he opened his eyes for a moment, they shone with a wild light." During the discussion which followed, it was stated that the author of the paper was engaged in the preparation of an Aino dictionary, for which seven or eight thousand words had already been collected. "Such a dictionary," said Prof. Chamberlain, "would in all likelihood be a kind of tomb in which the rapidly dying language would remain enshrined for ages. Even now it was striking to observe how all except the oldest men and women were really bi-lingual, speaking Japanese as easily as Aino."

MR. BRUCE FOOTE, Superintendent of the Geological Survey of India, lately contributed to the Asiatic Society of Bengal some most interesting "notes" on recent Neolithic and Palæolithic finds in Southern India. These notes have now been reprinted from the Society's Journal. One of the facts to which he calls attention is that "the old Stone-folk" of the Bellary-Anantapur country, where great numbers of Neolithic settlements have been found, selected granite-gneiss hills as the sites of their settlements. Four considerations may, he thinks, have influenced them in this choice:—(1) The more perfect isolation of the granite-gneiss hills, which mostly rise singly out of the plains, or, if in clusters, are yet individually detached, and therefore more suitable for defence than posts on continuous ridges, such as are generally formed by the schistose rocks. Some of the granite-gneiss hills are nearly perfectly castellated by the disposition of the rock-masses. (2) Rock-shelters of great efficiency and comfortable terraces are to be found in numbers on many of the granitoid hills, but hardly ever on the schistose hills. (3) The collection of rain water and its storage would, from the nature of the ground, be much easier on the average granitoid rock than on the average schistose hill. (4) The schistose hills are, in very many cases, generally, in fact, surrounded by a heavy and broad talus most detrimental to easy agricultural work. The granitoid hills, on the contrary, form, as a rule, no great talus, but rise up straight out of the great cotton-soil plains, so that the Neolithic field labourers could have been quite close to places of refuge in cases of attack from other tribes, and yet have been able to carry on their agricultural work.

AT the last meeting of the Archæological Society of Sweden, Herr N. F. Sander read a paper on the wholly or partly undeciphered runic inscriptions in Sweden, which he divided into three classes: (1) those composed of ordinary runic letters, but in which the runic "staf" or sign I, when signifying *i* or *e* had purposely been left out, in one inscription even twenty-five times; (2) the conventional runic signs, which were really runic cipher; and (3) the so-called Sudermania "qvist" (sprig or faggot) runes, as well as the "ice" runes. Here the secret lay in the circumstance that the three "sets" of letters had been purposely misplaced, so that in the inscriptions the third set (*h, b, l, m, r*) came first; first set (*f, u, t, h, o, r, k*) second; and second set (*u, i, a, s*) third. Referring to seven of the first-named order of inscriptions which had recently been deciphered, Herr Sander stated that five of them, all situated in the province of Upland, had the same contents, and contained some curious objurgations. In four of them appeared the word *Pim* or *Piment* (*i.e.* a strong drink composed of wine, honey, and spice), which, as well as *Klaret*, was mentioned in the *Saga* of Rollo the Ganger and the Normans. All these inscriptions were referred to the close of the pagan age. One of them read as follows: "Reksessr, only Thynne's son (son of), assigned (to himself)—*i.e.* wedded—asa-Askra; (she) is daughter of Thynne-Signil and the giant." At the mouth of the River Åby, close to which this stone was found, is a little island called Thynne or Tönnö.

IN an interesting article in a recent number of the *Naturwissenschaftliche Wochenschrift*, Prof. Nehring discusses the question as to the origin of the dog. He expresses his belief that it is descended from various still-surviving species of wolves and jackals. The taming of jackals, he says, presents no particular difficulty, and many attempts to domesticate wolves have been successfully made in recent times. Herr Rongé has so completely tamed a young wolf that it follows him exactly as a dog might do.

THE United States Consul at Auckland, in a recent report, says that rabbits have so eaten out the ranges in New Zealand, that the capacity for maintaining sheep has greatly lessened, and the flocks have fallen off in numbers. At the Stock Conference of 1886 it was stated that rabbits reduced by a third the feeding capacity of land, and that the weight of fleeces had decreased by 1 lb. to 1½ lb. each. The number of lambs decreased from 30 to 40 per cent., while the death rate increased from 3 to 13 per cent. Since 1882, when the Rabbit Act became law, Government has expended £7000 on Crown lands alone, and it is estimated that during the last eight years private persons have spent £2,400,000 in extirpating rabbits. The methods generally in favour are fencing, poisoned grain (generally phosphorized oats), and ferrets, weasels, and stoats.

THE Canadian Minister of Agriculture in his report for the past year refers to various measures taken by the Government for the advance of scientific agriculture in the Dominion. Five experimental farms in various parts of the country were provided by the Legislature, a botanist and entomologist were appointed, and a large number of experiments to ascertain the roots and cereals most suited for the circumstances of Canada—especially its short summer—were carried out under scientific supervision.

A RICH gold-field has been discovered between the two rivers, Lava and Papanahoni, in Surinam. It is an open question whether this district of 20,000-25,000 square kilometres belongs to France or Holland. M. Condreau, the French traveller, who has been closely investigating the district, considers that it will be as productive as the gold-fields of Australia and California.

THE University of Christiania has despatched a zoologist, Herr J. Jversen, to Sumatra, for the purpose of collecting natural history objects for that institution.

A SUM of £550 has been granted by the Danish Government towards the expenses of publishing the zoological and botanical results of Lieut. Hovgaard's Arctic expedition in the *Dijmphna* in 1880-81. The work will soon be issued.

IN addition to a sum already granted, the Norwegian Government has given £300 towards the publication of Prof. Friis's ethnographical chart of the provinces of Tromsö and Finmarken.

THE number of visitors to the Natural History Museum, recorded by aid of Benton's "O" register up to 6 o'clock on Whit Monday, was 4567, and the Museum was open for two hours longer. This number compares with 6010 and 6589 admissions on the Whit Mondays of the two preceding years. During the week ending Saturday last, 149,583 persons visited the Museum in the present year, being an increase of 8000 on last year.

THE honorary degree of LL.D. has been conferred by the McGill University, Montreal, upon Prof. W. Fream, B.Sc. Lond., of the College of Agriculture, Downton, Salisbury, in recognition of his contributions to agricultural science and of his services to Canadian agriculture.

MUCH interest has been excited by the successful transplantation of nerve from a rabbit to man. The operation was performed by Dr. Gersung, of Vienna, and the patient was Dr. von Fleischl, Professor of Physiology in the University of that city. Sixteen years ago Dr. von Fleischl accidentally wounded himself while conducting a *post-mortem* examination, and the consequent severe inflammatinn of his right arm and hand led ultimately to the loss of the terminal joint of his thumb. The end of the stump having become painful, amputation somewhat further back was performed. This was followed by the formation of "neuromata." In the hope of obtaining relief he underwent several fruitless operations. Ultimately, Dr. Gersung suggested that the nerves might be repaired, and the missing portions replaced, by means of fresh nerve taken from a rabbit. The *Times* of Tuesday gives the following account of the operation:—"Just as there is nothing special in any individual human nerve, and as any one of them would be capable of discharging the duty of any other, so, it may be assumed, there is no difference between the endowments of the nerves of man and those of the lower animals, which fulfil identical functions in an identical manner. It was, therefore, inherently probable that the nerve of an animal, if a piece could be obtained of the proper size and length, and if transplantation and union could be successfully effected, would suffice to make good any loss of nerve in man; and, in the present instance, which is, we believe, the first of the kind on record, not only have the transplantation and union been successful, but the new piece of nerve seems to have overcome the tendency of the old to undergo degeneration of structure at its divided extremity. A portion, six centimetres in length, of the great nerve of a rabbit's thigh was selected, and was so removed from the freshly killed animal as to include the natural bifurcation of the main trunk into two branches. The divided stem was secured by stitches to the stump of the nerve in Prof. von Fleischl's arm, and the ends of the branches were secured in like manner to the nerve terminations which remained in his fingers, and which were rendered useless by their separation from the trunk to which they belonged. The whole operation, as a matter of course, was conducted with strict adherence to those principles of antiseptic surgery without which failure would have been more than likely; but, by the observance of which, union, almost anywhere or of any thing, can with a near approach to certainty be secured. The wound healed kindly, the transplanted nerve soon became at home in its new position; and already, after the lapse of a little more than two months, it is reported that sensation is returning to the fingers. At the same time there has been no return of pain, and no fresh indication of the development of neuromata, so that hope of an absolutely successful issue may now with some confidence be entertained."

THE additions to the Zoological Society's Gardens during the past week include three Cape Crowned Cranes (*Balearica chrysopelargus*) from Zanzibar, presented by Colonel E. Smith; two Peregrine Falcons (*Falco peregrinus*) from India, presented by Mr. J. Davidson; a Gannet (*Sula bassana*), British, presented by the Baroness de Taintegnies; a Three-toed Chalcis (*Chalcides tridactylus*) from France, presented by Mr. J. C. Warburg; an Indian Python (*Python molurus*) from India, received in exchange; an Elliot's Pheasant (*Phasianus ellioti* ♀) from China, purchased; an American Bison (*Bison americanus*), a Great Kangaroo (*Macropus giganteus* ♂), seven Suricates (*Suricata tetradactyla*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET 1888 *a* (SAWERTHAL).—Several computers having shown that the Cape observation of this object made on February 18 cannot be harmonized with those made since perihelion by means of parabolic elements, Prof. Lewis Boss has computed elliptic elements for it, based on the above-mentioned Cape observation, and observations obtained at Albany on March 17 and April 18. His first effort was to find a parabolic orbit from the last two observations, and another, also made at Albany, on March 30; but the resulting parabola not only entirely failed to satisfy the Cape observation, but also left residuals too large to be admitted, for other observations at his disposal which had been made since perihelion. The ellipse, on the contrary, which he obtained from the places of February 18, March 17, and April 18 satisfied these other observations very fairly, the largest differences being given by the observation of March 30, viz. (C – O)—

$$\Delta\alpha = -8''\cdot5. \qquad \Delta\delta = -7''\cdot2.$$

The residuals point to a somewhat larger eccentricity than that given below, but are probably due in great part to comparatively small errors in the first and last observations used.

The elements are as follow:—

T = 1888 March 16·9987 G.M.T.

$$\left.\begin{aligned}\omega &= 359^\circ\ 54'\ 58''\cdot4\\ \Omega &= 245\ \ 22\ \ 46\cdot6\\ i &= 42\ \ 15\ \ 23\cdot1\end{aligned}\right\}\ 1888\cdot0$$

$$\begin{aligned}\log e &= 9\cdot997790\\ \log q &= 9\cdot844329\\ \text{Period} &= 1615 \text{ years.}\end{aligned}$$

Prof. Boss suspects, however, that the true period will be found decidedly greater than 2000 years.

$$\begin{aligned}x &= r\,[9\cdot898389]\sin(v + 328^\circ\ 9'\ 7''\cdot6).\\ y &= r\,[9\cdot999694]\sin(v + 236\ \ 29\ \ 13\cdot9).\\ z &= r\,[9\cdot787085]\sin(v + 323\ \ 42\ \ 17\cdot9).\end{aligned}$$

In the same number of *Gould's Astronomical Journal* in which the above elements appear, the Rev. G. M. Searle gives an independent elliptic orbit very closely resembling that computed by Prof. Boss. The first two places used are the same as those Prof. Boss employed; the third is one obtained on April 16 at Harvard College. Prof. Boss gives the following ephemeris for Greenwich midnight:—

1888.	R.A. h. m. s.	Decl. ° ′ ″	Log *r*.	Log Δ.
May 26	0 17 19·4	38 1 45 N.	0·17274	0·26595
28	0 20 45·6	38 43 8	0·18109	0·27036
30	0 24 5·5	39 23 19	0·18928	0·27459
June 1	0 27 19·0	40 2 24	0·19730	0·27864
3	0 30 26·1	40 40 25	0·20516	0·28252
5	0 33 26·6	41 17 26	0·21287	0·28623
7	0 36 20·5	41 53 30	0·22042	0·28978
9	0 39 7·6	42 28 39	0·22783	0·29317
11	0 41 47·8	43 2 56	0·23509	0·29639
13	0 44 21·1	43 36 23	0·24222	0·29947
15	0 46 47·5	44 9 1 N.	0·24921	0·30240

The light ratio on June 15 is $\frac{1}{20}$ of that at discovery.

NEW MINOR PLANET.—A new minor planet, No. 278, was discovered by Herr Palisa at Vienna on May 16.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *MAY* 27—*JUNE* 2.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on May 27

Sun rises, 3h. 54m.; souths, 11h. 56m. 57·8s.; sets, 19h. 59m.: right asc. on meridian, 4h. 18·8m.; decl. 21° 25′ N. Sidereal Time at Sunset, 12h. 22m.

Moon (at Last Quarter June 1, 13h.) rises, 21h. 10m.*; souths, 1h. 27m.; sets, 5h. 41m.: right asc. on meridian, 17h. 47·6m.; decl. 20° 31′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m.	° ′
Mercury..	4 42 ...	13 14 ...	21 46 ...	5 35·8 ...	25 29 N.
Venus.....	3 26 ...	11 6 ...	18 46 ...	3 28·2 ...	17 56 N.
Mars	14 42 ...	20 22 ...	2 2* ..	12 45·1 ...	4 31 S.
Jupiter....	19 12 ...	23 31 ...	3 50*...	15 55·3 ...	19 22 S.
Saturn....	8 2 ...	15 57 ...	23 52 ...	8 19·3 ...	20 14 N.
Uranus ...	14 47 ...	20 27 ...	2 7*...	12 50·2 ...	4 39 S.
Neptune..	3 47 ...	11 31 ...	19 15 ...	3 52·8 ...	18 35 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich).

May.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
27 ...	31 Sagittarii ...	6 ...	22 17†...	23 23 ...	49 240
30 ...	20 Capricorni ...	6 ...	2 45 ...	3 38 ...	40 322

† In horizon at Greenwich.

Variable Stars.

Star	R.A. h. m.	Decl. ° ′		h. m.
U Cephei	0 52·4 ...	81 16 N. ...	May 27,	0 57 *m*
			June 1,	0 36 *m*
U Cancri	8 29·4 ...	19 17 N. ...	May 28,	*M*
S Leonis	11 5·1 ...	6 4 N. ...	,, 27,	*M*
R Corvi	12 13·8 ...	18 38 S. ...	June 2,	*M*
R Boötis	14 32·3 ...	27 13 N. ...	May 29,	*M*
U Coronæ	15 13·6 ...	32 3 N. ...	June 1,	0 37 *m*
S Libræ	15 15·0 ...	19 59 S. ...	,, 2,	*m*
R Scorpii	16 11·0 ...	22 40 S. ...	May 30,	*M*
U Ophiuchi	17 10·9 ...	1 20 N. ...	,, 28,	2 8 *m*
		and at intervals of		20 8
W Sagittarii ...	17 57·9 ...	29 35 S. ...	May 27,	21 0 *M*
Z Sagittarii	18 14·8 ...	18 55 S. ...	,, 27,	1 0 *M*
			,, 31,	0 0 *m*
β Lyræ...	18 46·0 ...	33 14 N. ...	,, 30,	21 0 *M*
R Lyræ	18 51·9 ...	43 48 N. ...	June 2,	*M*
S Vulpeculæ ...	19 43·8 ...	27 1 N. ...	May 29,	*m*
S Sagittæ	19 50·9 ...	16 20 N. ...	,, 28,	3 0 *M*
T Vulpeculæ ...	20 46·7 ...	27 50 N. ...	,, 31,	23 0 *M*
			June 2,	1 0 *m*
δ Cephei	22 25·0 ...	57 51 N. ...	,, 1,	1 0 *M*
S Pegasi	23 14·9 ...	8 18 N. ...	May 29,	*M*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near χ Boötis	227° ...	30° N. ...	June 2.
,, 54 Draconis ...	290 ...	60 N. ...	Slow, short. May 30.
From Vulpecula	303 ...	24 N. ...	Swift.
Near ι Pegasi	332 ...	27 N. ...	Swift. Very long paths. Streaks.

GEOGRAPHICAL NOTES.

REFERRING to the ethnology of the Himalayan hill region o Sikkim, where a small British force is at present in occupation, the *Madras Mail* says that the population may, broadly speaking, be divided into three nationalities: the Lepchas, who are the aborigines; the Nepalese immigrants, now forming nearly half the entire population; and the Bhuteas, or Bhutanese, who very closely resemble the Tibetans, and are pure Tartars. It is remarkable that the last-named are like the Chinese in the make of their hats, clothes, and boots, and in their pig-tails, but their language is somewhat like Turkish in its sound. It is supposed that this people originally came from Tibet, though they apparently derive their name from Bhutan, which lies to the east of Sikkim. They are tall, strong, and hardy, though they are accused of being lazy. They have their Buddhist temples, and erect long poles round their houses, with paper streamers on which are printed prayers in Chinese-looking characters. One may often meet them on the roads twirling their praying-machines, which are cylinders of brass or copper, with a printed roll of prayer inside, and small weights attached to it to make it revolve when once it is set going. It is thought that amongst them, like the Tibetans, polyandry prevails. The women are large and coarse-featured; they wear thick woollen clothes of bright colours, and numerous massive gold and silver ornaments. Some of them smear themselves with a browni-h ointment which makes their faces appear as if a coating of French polish had been put on. With regard to the aborigines of Sikkim, they are a Mongolian race, short and stout. In appearance they resemble closely the Nepalese, though, far different from the latter, who are brave soldiers, they are the most arrant cowards. They live by cultivating small tracts of the forests, which they clear by setting fire to the trees and brushwood, and move to a fresh spot each year. As may be supposed, their agriculture is of the most primitive description, and in their language they have no word for a plough. They worship the forces of Nature under the form of demons; the Bhuteas also, though professed Buddhists, propitiate evil demons, the same sort of imaginary beings as the Nats of the Burmese. The Lepchas are monogamous. The race is gradually dying out. The Limboos are a race of half-breeds between the Nepalese and the Lepchas, but resembling the former more than the latter. There are several similar mongrel races to be found in Sikkim, for the Nepalese immigrate in vast numbers, being driven out of their own country by press of over-population. Few ever return to their own country, and great numbers of them work as coolies on the tea estates. Their religion is a mixture of Buddhism and Brahminism, and they boast of their caste distinctions. Many of them carry curved weapons in their belts, while the Bhuteas and Lepchas use straight-bladed weapons. The Bhutea sword is like that of the old Roman legionary, but the hilt has no guard, after the Mongolian fashion. Amongst the jungles of Perai there are some curious aboriginal tribes, who do not appear to suffer from the malaria which attacks everybody else who sets foot in their territory; but it is said that if they leave their jungles they are immediately attacked themselves by fever, the malarial poison with which they have become inoculated thus finding an exit when they quit their own locality. All the natives of the plain call these races indiscriminately "Pahariyas," or "hill-men," who, though they differ from each other, differ still more from the inhabitants of the plain in their language and mode of life. They are all mountaineers and Mongolians, and have all great physical strength. A story is told of a Bhutea woman who once carried a grand piano up the Ghaut from Punkabari to Darjeeling in three days, and arrived on the third day quite fresh and unexhausted at her destination with her burden on her back.

A RECENT number of the *China Review* (vol. xvi. No. 3) contains a long paper by Mr. Taylor, whose publications on

Formosa and its people have frequently been noticed in these columns, entitled "A Ramble through Southern Formosa." It really describes a long journey along the almost wholly unknown east coast, and has much information respecting the various tribes, their relations to each other and to the Chinese Government—the Tipuns, Paiwans, Diaramocks, Amias, and others. Mr. Taylor refuses to discuss gravely the theory of a cataclysm put forward to account for the aborigines in Formosa. "One might just as well introduce the mythical convulsion which lost Atlanta to Europe, and detached Great Britain from the neighbouring continent, to account for the painted savages Cæsar found in England." The Tipuns are probably descended from emigrants from some northern islands, probably Japan; the Paiwans as a rule inhabit the mountains of the interior, and are head-hunters, a cruel, predatory, and passionate race, probably of Malay origin, and the very earliest settlers in Southern Formosa. The Pepohoans probably came from Loochoo; they have no language of their own, speaking only Chinese, while all the other tribes have their own tongue. The Diaramocks are the most dreaded tribe of the south part of the island; they are reputed cannibals, but Mr. Taylor doubts whether they are not accused without cause. The paper concludes with some vigorous engravings of representatives of the different tribes, including a Diaramock, a Tipun chief, an Amia, a Paiwan, a Tipun warrior, a Nicka, and Tipun weapons.

THE *Bollettino* of the Italian Geographical Society for April publishes the results of some preliminary studies, by Prof. Giulio Beloch, of the Roman University, on the vital statistics of Italy during the last three centuries. According to these studies, the total population of the peninsula has increased from a little over 11,000,000 in 1550 to 13,000,000 in 1700, 16,500,000 in 1775, over 18,000,000 in 1880, and nearly 30,000,000 in 1887. The growth of the population for some of the larger States is given as under:—

States.	Year.	Pop. in millions.	Year.	Pop. in millions.	Year.	Pop. in millions.
Naples ...	1511	2·7	1700	3·0	1770	4·09
Sicily	1570	1·07	1714	1·12	1770	1·48
States of the Church ...	1560	1·6	1701	1·98	1769	2·17
Tuscany ...	1562	0·8	1738	0·89	1766	0·94
Venetia ...	1548	1·6	1700	1·8	1766	2·24
Milanese ...	1542	1·0	1724	1·1	1773	1·1
Piedmont ...	1569	1·05	1723	1·55	1773	2·3
Sardinia ...	1575	0·15	1728	0·3	1775	0·42

A GEOLOGICAL Expedition, under the leadership of MM. Ivanoff and Konshin—the two well-known investigators of the geology of Turkistan—is to be sent out this summer for the exploration of the littoral region of Russian Mantchuria. The orography of this region is hardly yet known, and the Expedition will certainly throw some light on the structure of the chains of mountains which are still hypothetically represented on our maps.

THE IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute took place last week at the theatre of the Institution of Civil Engineers, under the presidency of Mr. Daniel Adamson. On the motion of the President, His Royal Highness the Prince of Wales was unanimously elected an honorary member. Sir Henry Bessemer presented the Bessemer medal to the President, and referred in the course of his remarks to the circumstance that whereas in Sheffield, the stronghold of steel-making, he could find no one to investigate his process when he first brought it out, fortunately for him—and he might add, fortunately for the world—their President, Mr. Daniel Adamson, did so, and having satisfied himself as to its applicability determined to employ it. The President, whose investigations with regard to steel are well known, thanked Sir Henry Bessemer and the Council of the Institution for the award, and referred to his early connection with Bessemer steel, which metal he had continued to use ever since.

The President then delivered the annual address, which was mainly statistical in character. The Iron and Steel Institute had been nineteen years in existence, during which period 2116 members had been elected, including seventy-two elected at the present meeting. He drew attention to the falling off which had taken place in the production of manufactured iron in this country since 1884, and the large increase in the production of steel during the same period. Thus in 1884 about one and a quarter million tons of Bessemer steel ingots were produced, and in 1887 about two million tons, being an increase of about 60 per cent.; in 1884 nearly half a million of tons of Siemens open-hearth steel ingots were cast, and nearly a million tons last year, the actual increase during the period being over 106 per cent., besides which plant is at present in course of erection estimated to produce another quarter of a million tons annually. During the same period there has been an enormous increase in the application of steel to ship-building purposes. Thus from a table supplied to the President by Mr. William Parker, Chief Engineer to Lloyd's Registry of British and Foreign Shipping, it is found that whereas in 1878, under 3000 tons of steel were employed in the manufacture of steamers and sailing-vessels built under Lloyd's survey, and over 300,000 tons of iron, last year over 210,000 tons of steel were employed and about 52,000 tons of iron. The proportional increase in the use of steel in the last three years has been about cent. per cent., and the falling off in the use of iron during the same period 350 per cent. Before leaving the subject of steel, the President referred to the papers read at the Institution of Civil Engineers on "Manganese in its Application to Metallurgy," and on "Some Novel Properties of Iron and Manganese," wherein it was shown that whereas 2·5 to 7·5 per cent. of manganese in steel makes it as brittle as glass, breaking under a much less transverse load than cast iron, 12 to 14 per cent. of manganese in the metal secures high carrying power with great elongation. Thus a bar of the composition—carbon 0·85 per cent., silicon 0·23 per cent., sulphur 0·08 per cent., phosphorus 0·09 per cent., and manganese 13·5 per cent., carried a load of 57·02 tons to the square inch, and took a permanent set at 29½ tons, with an elongation of 39·8 per cent. This metal is toughened by heating it to a high temperature, and plunging it into water at a temperature of 72° F. It is difficult to machine, which would militate against its practical application for many purposes, unless cooling in water whilst developing strength and toughness should also have a softening tendency. The President concluded his address by drawing attention to the influence of the alloys they contain on the various applications of pig metal, as outside of high-class hæmatites that are used for the manufacture of Bessemer and open-hearth steel, selections may be made giving the highest results without using some of the higher-priced irons that are now considered necessary for given purposes.

Mr. Carbutt, President of the Institution of Mechanical Engineers, in proposing a vote of thanks to the President for his address, drew attention to the interesting circumstance noted by Mr. Parker that 100 tons can now be carried one mile by steamships at the rate of thirteen miles an hour, at a total cost, including fuel, insurance, &c., of seven-eighths of a penny.

The papers read and discussed at this meeting ranged over a large variety of subjects. Mr. T. Turner's paper on "Silicon and Sulphur in Cast Iron," read at a previous meeting, was discussed. The conclusions at which the author arrives are that in the blast furnace three chief agencies are at work tending to eliminate sulphur, of which in Cleveland practice not more than one-twentieth passes into the iron: (1) a high temperature tends to prevent the absorption of sulphur by iron; (2) a slag rich in lime readily combines with sulphur; and (3) the amount of sulphur actually retained by the metal is influenced by the proportion of silicon and probably certain other elements present in the iron—the more silicon the less sulphur. This paper was discussed by Messrs. Snelin, Gautier, Riley, Bauerman, and Sir Lowthian Bell; but the author, in his reply on the discussion, considered that nothing had been brought forward to disprove what he maintained, viz. that if they put silicon and sulphur together in iron, they would not combine there, the sulphur would pass off and the silicon remain.

Mr. Gautier read a paper on the melting in cupola furnaces of wrought iron or steel scrap mixed with ferro-silicon, the conclusion at which he arrived being that ordinary wrought-iron scrap so heated may yield results as good as those obtained from castings made with ordinary steel scrap. This conclusion was contested, however, by various speakers in discussion.

A paper read at the last meeting of the Institute by Mr. A. Wilson, on "The Use of Water Gas for Metallurgical

Purposes," was discussed. The author had found water gas and producer gas practically equal both as regarded cost of production and heating values.

Mr. H. Eccles drew attention, in a paper on "An Imperfection in Mild Steel Plates considered chemically," to want of care in sampling steel before casting, whereby defects in the ingots were rolled out into the plates; and it appeared in the discussion, as well as in a paper by Major Cubillo, on "The Manufacture and Treatment of Ordnance at Trubia," that the ingot was much improved when the steel was made and heated in a radiation furnace. Another paper by Major Cubillo, on "Steel Castings for the Manufacture of Guns," gave rise to a highly technical discussion; as did also papers on "The Behaviour of Arsenic in Ore and Metal during Smelting and Purification Processes," by Messrs. Pattinson and Stead, and on "The Effect of Arsenic on Mild Steel," by Messrs. Harbord and Tucker.

The last paper read was on "A New Instrument for the Measurement of Colour, more especially as applied to the Estimation of Carbon in Steel," by Mr. H. Le Neve Foster. In the instrument are two fields of view under similar monocular conditions, freed from any errors which may arise from the introduction of unequal side lights, and also the different power of distinguishing colour that often exists in the eye of the observer; in conjunction with the instrument is a standard set of coloured glasses, each set being the same colour, but regularly graded for depth of tint. The instrument consists of a tube, divided by a central partition terminating at the eye-piece in a knife-edge, which, being inside the range of vision, is not seen when the instrument is in use. At the other end of the instrument are two apertures of equal size, and alterable in size or shape by means of diaphragms. The two apertures are divided by the thick end of the central partition, which, together with the sides, is recessed so as to hide the edges of the standard glasses, as well as the sides of the gauged glass vessels, which are used to contain the liquid that requires to be matched or compared. The only light coming to the eye must pass in equal quantity through the gauged glass vessel and the standard glasses respectively.

The instrument has been used by dyers, brewers, and sugar, and various other manufacturers. It forms a ready means of measuring the depth of colour in water, and is also applicable for Nessler's ammonia test as used in water analysis. For the estimation of carbon, the author finds the best results are obtained by dissolving 0·5 gramme of steel in 10 c.c. nitric acid, sp. 1·20, and boiling for twenty minutes, and then diluting to 50 c.c. and placing the liquid in a 1-inch cell. For mild steel this gives an easy colour to match, the results obtained agreeing well with those found by the Eggerty method.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for April, 1888 (vol. xxviii. part 4) contains:—A monograph on the species and distribution of the genus Peripatus, Guilding (plates 34 to 40), by Adam Sedgwick, F.R.S., gives an account of all the known species of the genus, with a bibliography of most of the literature relating to them. Many of the figures are coloured from nature.—Notes on the anatomy of *Peripatus capensis* and *P. novæ-zealandiæ*, by Lilian Sheldon, Bathurst Student, Newnham College, Cambridge. Gives details about the crural glands, the segmental organs, the accessory glands of the male, and the vas deferens.—On the construction and purpose of the so-called labyrinthine apparatus of the labyrinthine fishes (plate 41), by Dr. Nicholas Zograff.—Studies on the comparative anatomy of sponges; (1) on the genera Ridleia, n. gen., and Quasillina, Norman (plate 42), by Arthur Dendy —Kleinenberg on the development of Lopadorhynchus, by G. C. Bourne. This paper gives a *résumé* of Prof. Kleinenberg's very detailed account of the development of the Polychæte Annelid Lopadorhynchus, which extends over 225 pages of the *Zeitschrift für Wissenschaftliche Zoologie.*

American Journal of Science, May.—The absolute wave-length of light, Part 2, by Louis Bell. In continuation of his previous communication the author here gives the angular measurements, and the details of the measurement and calibration of the gratings, together with the final results. He also inquires into the probable sources of error in some recent determinations of wave-length. His own final determination of the mean value of the absolute wave-length for the line D_1 is 5896·18 in air at 760 mm. pressure and 20° C. temperature, or *in vacuo* 5897·90, which he considers not likely to be in error by an amount as great as one part in two hundred thousand.—Three formations of the Middle Atlantic slope (continued), by W. J. McGee. In this paper the author deals with the Columbian formation alone, describing in detail the general characters of its fluvial and interfluvial phases. By the *fluvial* phase he understands the thicker and more conspicuous formations commonly occurring along the great rivers at and for some miles below the fall line, while the *interfluvial* comprises the thinner deposits forming the surface over the remainder of the coastal plain. These interfluvial deposits are shown to corroborate and extend the testimony of the deltas, all the phenomena conjointly recording a brief period of submergence of the entire coastal plain in the Middle Atlantic slope reaching 100 feet in the south and over 400 in the north, with coæval cold, long anterior to the terminal moraine period.—On some peculiarly-spotted rocks from Pigeon Point, Minnesota, by W. S. Bailey. The character and origin are discussed of some curious circular spots occurring here and there on the quartzites of Pigeon Point, a district projecting about 3½ miles into Lake Superior, and consisting mainly of a great dyke of coarse olivine gabbro or diabase.—The Taconic system of Emmons, and the use of the name Taconic in geological nomenclature (continued), by Chas. D. Walcott. In this paper the author deals with the subject of nomenclature, discussing the use of the names Taconic and Cambrian, and concluding with a classification of the North American Cambrian rocks.—Prof. R. D. Salisbury has some remarks on the terminal moraines of North Germany, and Carl Barus communicates a short note on the viscosity of gases at high temperature, and on the pyrometric use of the principle of viscosity.

Bulletin de l'Académie Royale de Belgique, March.—Remarks on some stone implements found in Spain by MM. H. and L. Siret, by A. F. Renard. Amongst the rich archæological finds recently made by MM. Siret in the Carthagena and Almeria districts are some polished stone hatchets of small size and beautiful workmanship. With a view to determining the material of which these implements were made, the author has subjected them to a careful analysis, and finds that this material is fibrolite, which occurs in many parts of Spain. In appearance it somewhat resembles jade, but its chemical composition and general properties show that it is quite distinct from that substance.—Determination of the variations in the specific heat of fluids near the critical point, by P. de Heen. It is suggested as a working hypothesis, that fluids are formed of molecular groups which may be called liquidogenic molecules. These groups and their constituent elements, presenting the aspect of little vortices, would appear simply to be the molecules as regarded in the gaseous state (gasogenic molecules). The transition from the liquid to the gaseous state at the critical temperature might then be thus interpreted. It may be admitted that at a given temperature the *gasogenic molecules* cease to move in closed curves, and describe the rectilinear trajectories of M. Clausius. The author's researches, as here described, tend mainly to confirm this view.

Rendiconti del Reale Istituto, Lombardo, April.—On the importance of the phagociti in the morphology of the Metazoi, by Prof. Leopoldo Magi. The author's researches generally tend to confirm the conclusions of Metschnikoff regarding the physiological functions of the phagociti. He considers that "phagocitism"—that is, the intracellular digestive process—is a function which attests in the morphology of the Metazoi, or pluricellular organisms, their genetic descent from the Protozoi. Thus physiology, as well as embryology and palæontology, confirms the now commonly accepted views regarding biological volution in animal organisms.

Rivista Scientifico-Industriale, April 30.—On some recent discoveries in electro-optics, by Prof. Ercole Fossati. In connection with the recent researches of Hertz and Hallewachs on the influence of light on electrified conductors, attention is directed to the analogous experiments made by Morichini at the beginning of the present century. Reference is made more particularly to this physicist's observations on the magnetization of steel by the effect of light alone, independently altogether of any action caused by heat or terrestrial magnetism.—Researches on magnetic thermogenesis, by Prof. Giuseppe Martinotti. The experiments described in this and previous papers lead to the general conclusion that heat is developed when soft iron, or any other magnetic body, is successively magnetized; and that the heat is increased by reversing or even simply interrupting the current, which is in accordance with the modern theories on thermodynamics and molecular polarization. But all these experiments are merely preliminary studies in a field of vast and increasing importance, the cultivation of which may ultimately lead to the greatest discovery of modern times, the determination and application of the laws by which the material universe is governed even in phenomena of a psychic order.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 8.—"Contributions to the Anatomy of the Central Nervous System of Vertebrate Animals: Anatomy of the Brain of *Ceratodus forsteri*." By Alfred Sanders, M.R.C.S., F.L.S.

The brain of Ceratodus has the following general arrangement: the membrane which represents the pia mater is of great thickness and toughness; there are two regions where a tela choroidea is developed; one where it covers in the fourth ventricle, and the other where it penetrates through the third ventricle and separates the lateral ventricles from each other.

The thalamencephalon and the mesencephalon are narrow, and the medulla oblongata is wide. The ventricles are all of large size, and the walls of the lateral ventricles are not completed by nervous tissue. All the cranial nerves are to be seen except the abducens and the hypoglossal. There is a large communicating branch between the trifacial and the vagus. The glossopharyngeal has no separate root, but is a branch of the vagus; the ganglion of the vagus is not the termination of the main trunk, but is an off-shoot from the ramus lateralis; the ganglion gives off the branchial nerves and the ramus intestinalis, the ramus lateralis passing on without entering it.

The minute structure of the dorsal part of the cerebrum presents four layers: externally a layer of finely granular neuroglia, with slight indications of radial striation; next a layer of larger-sized cells; then another layer of neuroglia, with fibrillæ having a tendency to a longitudinal direction; and internally a layer of rounded cells closely crowded together. The ventral part of the cerebrum has only two layers, the external of neuroglia, and the internal of rounded cells.

The olfactory lobes resemble the cerebrum in structure, there is an internal layer of cells continuous with those of the cerebrum, and an external layer of glomeruli olfactori, which seem as if they were the external layer of the cerebrum condensed; and between the two, a layer of longitudinal fibres, on which fusiform cells are developed.

The optic lobes also consist of four layers: externally there is a layer of longitudinal fibrils derived from the optic tract; then a layer of smoothly granular neuroglia; then a layer of transverse fibrillæ which collect into a commissure in the central line at the dorsal surface. This layer also contains fusiform and rounded cells sparsely scattered through it; and internally there is a layer of cells mostly rounded. At the central line on the dorsal surface there is a ganglion of large cells resembling those of the optic lobe of the Plagiostomata.

The cerebellum is a mere bridge over the fourth ventricle. Its structure presents the usual number of layers: internally the fibrous layer, which ultimately forms the crura cerebelli ad medullam; then the granular layer, the cells of which are of large size compared to those of the same layer in Teleostei and Plagiostomata; then a layer of Purkinje cells, of which the form and the number of processes are not uniform; externally is the molecular layer, which consists of a coarsely granular network derived from the processes of the Purkinje cells, also a network of finer fibrils and many rounded cells.

In the spinal cord there are three columns of longitudinal fibres on each side in the white substance: viz. the ventral columns between the two ventral roots of the spinal nerves; the lateral columns between the dorsal and ventral roots; and the dorsal columns between the two dorsal roots. Fibres of large size are scattered throughout the two former columns, but collected principally in the ventral. The dorsal consists entirely of minute fibres.

The principal feature in the white substance is a fibre of gigantic size, which is situated on the summit of the ventral columns, one on each side; it consists of a common medullary sheath; inclosing (where the fibre is largest) about 40 to 50 axis-cylinders; these have the character of the axis-cylinders of the ordinary fibres of the white substance, but have no separate medullary sheaths; this fibre is traceable throughout the spinal cord; commencing opposite the posterior end of the abdomen, it extends to a short distance behind the exit of the facial nerve; it varies in size, and becomes of the greatest diameter near the posterior end of the medulla oblongata; its axes escape through the medullary sheath, and join the longitudinal fibres of the ventral columns. Near its anterior termination all the axes have escaped except one; at this point it bears a great resemblance to Mauthner's fibre in the Teleostei. This remaining fibre decussates with that of the other side a short distance behind the exit of the facial nerve, and enters the root of that nerve on the opposite side.

In the gray substance of the spinal cord, there are two series of ganglia, one in the ventral horn, which consists of multipolar cells often of very large size. They send processes into the ventral and lateral columns, which often become the smaller-sized longitudinal fibres. The cells of the other series of ganglia are of smaller size, and are situated in the substantia gelatinosa centralis; they are smooth in outline, and give off one or two processes; they probably have to do with the dorsal roots of the spinal nerves. Cells also of this kind occur at other places, as in the fibræ rectæ, and in the field of the ventral columns.

The transverse commissures are: one in the spinal cord, which passes through the substantia gelatinosa centralis over the central canal; another on the ventral side of the anterior part of the medulla oblongata, which corresponds to the commissura ansulata of the Teleostei, and is connected with the commissure in the dorsal part of the optic lobes; then there is the posterior commissure at the posterior part of the third ventricle; and a commissure at the posterior end of the cerebrum which is the anterior commissure.

There is no chiasma of the optic nerves visible externally; what there is of it, is situated in the substance of the thalamencephalon. The anterior root of the fifth nerve arises from a ganglion occupying a broad swelling at the lateral part of the gray matter of the floor of the fourth ventricle. The posterior root arises from the summit of the restiform bodies.

The facial passes backward in a small tubercle at the junction of the floor of the fourth ventricle with the restiform bodies.

The acusticus arises from a bundle of fibres which are situated on the summit of the ventral column, and appear to be a continuation forward of part of the multi-axial fibre which has not decussated.

The five roots of the vagus pass backward, and enter in succession the same tubercle as, and to the outside of, the facial nerve; the three posterior roots are double, so that the vagus is equivalent to eight nerves, and consists entirely of dorsal roots.

Two nerves are given from the ventral side of the medulla oblongata, each of which has two roots; they do not join the vagus, and pass back some distance within the vertebral canal, and emerge on a level with the exit of the dorsal roots of the spinal nerves.

The second and third spinal nerves supply the pectoral fin, and follow the course usually pursued by the hypoglossal when that nerve is present in Teleostei.

The fibres of the ventral roots of the spinal nerves enter in a direction upward and forward toward the inner edge of the multi-axial fibre, between it and the central canal, and then passing over the dorsal edge of the same are either lost in the gray substance of the ventral horn, join a process of one of the multipolar cells, or become one of the longitudinal fibres of the ventral columns of the cord.

The brain of Ceratodus presents an embryonic condition in three points: viz. first, in the extreme size of the ventricles and the tenuity of the substance of their walls; second, in the alternating origins of the dorsal and ventral roots; third, in the origin of the dorsal roots close to the central line.

Compared to Protopterus, it differs in the shape and imperfection of the cerebral lobes, and in the fact of its having a well-developed rhinencephalon; but it agrees in the narrowness of the mesencephalon, and breadth of the medulla oblongata, and in the rudimentary character of the cerebellum.

Ceratodus agrees also with the Ganoids in the comparative narrowness of the mesencephalon, and in the proportions of the cerebellum.

With the Plagiostomata it agrees in the structure of the optic lobes, both orders presenting a ganglion of large cells in the dorsal part.

With the Teleostei it agrees in the multi-axial fibre, which anterior to its termination resembles the Mauthner's fibre, also in the position and fact of its decussation.

With the Petromyzon it agrees in the structure of the tela choroidea which covers the fourth ventricle.

April 19.—"On the Heating Effects of Electric Currents, No. III." By W. H. Preece, F.R.S.

I have taken a great deal of pains to verify the dimensions of the currents as detailed in my paper read on December 22, 1887, required to fuse different wires of such thicknesses that the law

$$C = ad^{3/2}$$

is strictly followed; and I submit the following as the final values of the constant "*a*" for the different metals:—

	Inches.	Centimetres.	Millimetres.
Copper	10244 ...	2530 ...	80·0
Aluminium	7585 ...	1873 ...	59·2
Platinum	5172 ...	1277 ...	40·4
German silver	5230 ...	1292 ...	40·8
Platinoid	4750 ...	1173 ...	37·1
Iron	3148 ...	777·4 ...	24·6
Tin	1642 ...	405·5 ...	12·8
Alloy (lead and tin 2 to 1)	1318 ...	325·5 ...	10·3
Lead	1379 ..	340·6 ...	10·8

With these constants I have calculated the two following tables, which I hope will be found of some use and value:—

Table showing the Current in Amperes required to Fuse Wires of Various Sizes and Materials.

$$C = ad^{3/2}.$$

No. S.W.G.	Diameter. Inches.	$d^{3/2}$.	Copper. $a = 10244$.	Aluminium. $a = 7585$.	Platinum. $a = 5172$.	Ger. Silver. $a = 5230$.	Platinoid. $a = 4750$.	Iron. $a = 3148$.	Tin. $a = 1642$.	Tin-Lead Alloy. $a = 1318$.	Lead. $a = 1379$.
14	0·080	0·022627	231·8	171·6	117·0	118·3	107·5	71·22	37·15	29·82	31·20
16	0·064	0·016191	165·8	122·8	83·73	84·68	76·90	50·96	26·58	21·34	22·32
18	0·048	0·010516	107·7	79·75	54·37	54·99	49·95	33·10	17·27	13·86	14·50
20	0·036	0·006831	69·97	51·81	35·33	35·72	32·44	21·50	11·22	9·002	9·419
22	0·028	0·004685	48·00	35·53	24·23	24·50	22·25	14·75	7·692	6·175	6·461
24	0·022	0·003263	33·43	24·75	16·88	17·06	15·50	10·27	5·357	4·300	4·499
26	0·018	0·002415	24·74	18·32	12·49	12·63	11·47	7·602	3·965	3·183	3·330
28	0·0148	0·001801	18·44	13·65	9·311	9·416	8·552	5·667	2·956	2·373	2·483
30	0·0124	0·001381	14·15	10·47	7·142	7·222	6·559	4·347	2·267	1·820	1·904
32	0·0108	0·001122	11·50	8·512	5·805	5·870	5·330	3·533	1·843	1·479	1·548

Table giving the Diameters of Wires of Various Materials which will be Fused by a Current of Given Strength.

$$d = \left(\frac{C}{a}\right)^{2/3}.$$

Currents in amperes.	Diameter in inches.								
	Copper. $a = 10244$.	Aluminium. $a = 7585$.	Platinum. $a = 5172$.	German Silver. $a = 5230$.	Platinoid. $a = 4750$.	Iron. $a = 3148$.	Tin. $a = 1642$.	Tin-Lead alloy. $a = 1318$.	Lead. $a = 1379$.
1	0·0021	0·0026	0·0033	0·0033	0·0035	0·0047	0·0072	0·0083	0·0081
2	0·0034	0·0041	0·0053	0·0053	0·0056	0·0074	0·0113	0·0132	0·0128
3	0·0044	0·0054	0·0070	0·0069	0·0074	0·0097	0·0149	0·0173	0·0168
4	0·0053	0·0065	0·0084	0·0084	0·0089	0·0117	0·0181	0·0210	0·0203
5	0·0062	0·0076	0·0098	0·0097	0·0104	0·0136	0·0210	0·0243	0·0236
10	0·0098	0·0120	0·0155	0·0154	0·0164	0·0216	0·0334	0·0386	0·0375
15	0·0129	0·0158	0·0203	0·0202	0·0215	0·0283	0·0437	0·0506	0·0491
20	0·0156	0·0191	0·0246	0·0245	0·0261	0·0343	0·0529	0·0613	0·0595
25	0·0181	0·0222	0·0286	0·0284	0·0303	0·0398	0·0614	0·0711	0·0690
30	0·0205	0·0250	0·0323	0·0320	0·0342	0·0450	0·0694	0·0803	0·0779
35	0·0227	0·0277	0·0358	0·0356	0·0379	0·0498	0·0769	0·0890	0·0864
40	0·0248	0·0303	0·0391	0·0388	0·0414	0·0545	0·0840	0·0973	0·0944
45	0·0268	0·0328	0·0423	0·0420	0·0448	0·0589	0·0909	0·1052	0·1021
50	0·0288	0·0352	0·0454	0·0450	0·0480	0·0632	0·0975	0·1129	0·1095
60	0·0325	0·0397	0·0513	0·0509	0·0542	0·0714	0·1101	0·1275	0·1237
70	0·0360	0·0440	0·0568	0·0564	0·0601	0·0791	0·1220	0·1413	0·1371
80	0·0394	0·0481	0·0621	0·0616	0·0657	0·0864	0·1334	0·1544	0·1499
90	0·0426	0·0520	0·0672	0·0667	0·0711	0·0935	0·1443	0·1671	0·1621
100	0·0457	0·0558	0·0720	0·0715	0·0762	0·1003	0·1548	0·1792	0·1739
120	0·0516	0·0630	0·0814	0·0808	0·0861	0·1133	0·1748	0·2024	0·1964
140	0·0572	0·0698	0·0902	0·0895	0·0954	0·1255	0·1937	0·2243	0·2176
160	0·0625	0·0763	0·0986	0·0978	0·1043	0·1372	0·2118	0·2452	0·2379
180	0·0676	0·0826	0·1066	0·1058	0·1128	0·1484	0·2291	0·2652	0·2573
200	0·0725	0·0886	0·1144	0·1135	0·1210	0·1592	0·2457	0·2845	0·2760
225	0·0784	0·0958	0·1237	0·1228	0·1309	0·1722	0·2658	0·3077	0·2986
250	0·0841	0·1028	0·1327	0·1317	0·1404	0·1848	0·2851	0·3301	0·3203
275	0·0897	0·1095	0·1414	0·1404	0·1497	0·1969	0·3038	0·3518	0·3413
300	0·0950	0·1161	0·1498	0·1487	0·1586	0·2086	0·3220	0·3728	0·3617

May 17.—"On the Structure of the Electric Organ of *Raia circularis*." By J. C. Ewart, M.D., Regius Professor of Natural History, University of Edinburgh. Communicated by Prof. J. Burdon Sanderson, F.R.S.

This paper gives an account of the structure of the cup-shaped bodies, which, as mentioned in a previous paper read on April 26, 1888, make up the electric organs of certain members of the skate family. The structure of these electric cups has been already studied in three species of skate, viz. *Raia fullonia*, *R. radiata*, and *R. circularis*. The present paper only deals with the electric organ of *R. circularis*. It shows that the cups in this species are large, well-defined bodies, each resembling somewhat the cup of the familiar "cup and ball." The cup proper, like the disks of *R. batis*, consists of three distinct layers, (1) the lining, which is almost identical with the electric plate of *R. batis*; (2) a thick median striated layer; and (3) an outer or cortical layer. The lining or electric plate is inseparably connected with the terminal branches of the numerous nerve-fibres, which, entering by the wide mouth in front, all but fill the entire cavity of the cup, and ramify over its inner surface, the intervening spaces being occupied by gelatinous tissue. This electric layer, which is richly nucleated, presents nearly as large a surface for the terminations of the electric nerves as the electric plate which covers the disk in *R. batis* and *R. clavata*. The striated layer, as in *R. batis*, consists of numerous lamellæ, which have an extremely contorted appearance, but it differs from the corresponding layer in *R. batis*, in retaining a few corpuscles. The cortical layer very decidedly differs in appearance from the alveolar layer in *R. batis*. It is of considerable thickness, contains large nuclei, and sometimes has short blunt processes projecting from its outer surface. These short processes apparently correspond to the long complex projections which in *R. batis* give rise to an irregular network, and they seem to indicate that the cortical layer of *R. circularis* essentially agrees with the alveolar layer of *R. batis*, differing chiefly in the amount of complexity. Surrounding the cortex there is a thin layer of gelatinous tissue in which capillaries ramify. This tissue evidently represents the thick gelatinous cushion which lies behind the disk in *R. batis*, and fills up the alveoli.

The stem of the cup is usually, if not always, longer than the diameter of the cup. It consists of a core of altered muscular substance, which is surrounded by a thick layer of nucleated protoplasm continuous with the cortical layer of the cup, and apparently also identical with it.

The cups are arranged in oblique rows to form a long, slightly-flattened spindle, which occupies the posterior two-thirds of the tail, being in a skate measuring 27 inches from tip to tip, slightly over 8 inches in length, and nearly a quarter of an inch in width at the widest central portion, but only about 2 lines in thickness.

The posterior three-fifths of the organ lies immediately beneath the skin, and has in contact with its outer surface the nerve of the lateral line. The anterior two-fifths is surrounded by fibres of the outer caudal muscles. It is pointed out that while the organ in *R. circularis* is larger than in *R. radiata*, it is relatively very much smaller than the organ of *R. batis*.

Linnean Society, April 19.—Mr. Carruthers, F.R.S., President, in the chair.—Prof. Martin Duncan exhibited a specimen of *Heterocentrotus mamillatus*, showing the apertures of three of the genital ducts to be in the median interradial sutures, the corresponding basal plates being imperforate. A discussion followed, in which Mr. W. Percy Sladen and Dr. C. Stewart took part.—Mr. George Murray exhibited some specimens of *Spongocladia*, with explanatory coloured diagrams, and made some interesting remarks on the presence of sponge-spicules on Algæ at present unaccounted for.—Mr. D. Morris, of Kew, exhibited, and made remarks upon, the bird-catching sedge, *Uncinia jamaicensis*.—Mr. John R. Jackson, of Kew, exhibited some table mats from Canada made of the highly scented grass *Hierochloa borealis*, and a sample of the so-called pine wool prepared from the leaves of the American long-leaved or turpentine-yielding pine, *Pinus australis*, with a mat made from the wool, an industry which has recently been started on a large scale at Wilmington, North Carolina.—Mr. J. E. Harting exhibited a living specimen of Natterer's bat, which had been captured the previous day at Christchurch, Hants, together with a water-colour drawing from life of Daubenton's bat recently taken at the same place.—The first paper of the evening was by the Rev. George Post (communicated by Mr. Thiselton Dyer), and contained descriptions of new plants from Palestine. In the absence of the author, the salient points in the paper were admirably demonstrated by Mr. J. G. Baker, F.R.S., who exhibited specimens of the plants alluded to.—A paper was then read by the Botanical Secretary, Mr. B. Daydon Jackson, on behalf of Prof. Fream, on the flora of water meadows. An interesting discussion followed, and the meeting adjourned.

May 3.—Dr. John Anderson, F.R.S., Vice-President, in the chair.—The Chairman announced a resolution of the Council to found a gold medal, to be called the "Linnean Medal," to be awarded at the forthcoming anniversary meeting to a botanist and zoologist, and in future years to a botanist and zoologist alternately, commencing with a botanist.—Dr. Francis Day exhibited some specimens of Loch-leven and sea trout raised at Howietoun to illustrate his observation that the markings usually relied upon to distinguish the species are not constant, and therefore, taken alone, of no value for the purpose of identification. He also exhibited specimens of trout from Otago, New Zealand, descendants of some which had been introduced there, presenting some curious modifications of structure. A discussion followed, in which some interesting remarks were made by Prof. Howes and Mr. Willis Bund.—On behalf of Mr. Miller Christy, the Botanical Secretary (Mr. B. Daydon Jackson) exhibited some specimens of the Bardfield oxlip (*Primula elatior*, Jacquin), gathered near Dunmow, and occurring only in this part of England (cf. Trans. Essex Field Club, iii. p. 148).—Mr. A. D. Michael read a paper on the life-histories of the Acari *Glyciphagus domesticus* and *G. spinipes*. After describing in detail observations and dissections extending over three years, the author concludes that there is a hypopial stage in the life-history of *Glyciphagus*, but far less developed than in *Tyroglyphus*, and not an active stage in the species observed; that it does not occur to all individuals of a species, and it has not been ascertained whether it occurs in all species; that the stage is not the result of desiccation or unfavourable conditions; and that it occupies the period between the penultimate ecdysis and that immediately previous. Dr. C. Stewart criticized Mr. Michael's researches in favourable terms.—A communication was then made by Mr. C. B. Clarke on root-pressure. He contested the view of A. Sachs (and his followers) that root-pressure is sufficient to sustain the weight of a column of water of the height of 100 (or even 30) feet, and to force out drops at particular points of the leaves. He maintained that it was a mathematical error to apply the equation $p = g\rho z$ to the case of water in plants, and that in a collection of cells and longitudinal tubes of varying size (all very small) the only mechanical ideas that could be applied were those of capillary attraction and motion. In the discussion which followed, Prof. Marshall Ward thought root-pressure necessary to explain the admitted results of manometer experiments. Mr. A. W. Bennett, on the other hand, regarded the assumption of a high fluid tension in the cells of roots to drive moisture to the summits as nothing more than an expression of our ignorance as to what the water does move.—A paper on the ovicells of some Lichenoporæ was read by the Zoological Secretary (Mr. W. Percy Sladen in the absence of the author, Mr. A. W. Waters.

Physical Society, April 28.—Prof. Reinold, F.R.S., President, in the chair.—The following communications were read:—On electromotive force by contact, by Mr. C. V. Burton. The object of the paper is to discuss the seats of the electromotive forces developed by the contact of conductors. By considering the distribution of electricity on the surfaces of the conductors, and from the fact that the potentials throughout their masses are constant, except about a thin layer near the junction, the author deduces that "*the molecular action which gives rise to a contact E.M.F. between two conductors is confined to the immediate neighbourhood of the junction.*" If E be the contact E.M.F., and M the quantity of electricity which passes across the junction when two metals originally at the same potential are placed in contact, it is shown that the work done is EM, half of which is spent in producing heat and half in raising the potential energy of the system. Since the conductors are supposed to be kept at constant temperature, and the action which gives rise to the E.M.F. is confined to the immediate neighbourhood of the junction, the molecular energy must be absorbed at the junction. By supposing the surface of contact very small, and the capacity of the system large, it is shown that *heat* and *chemical action* are the only kinds of energy which fulfil the required conditions of supplying an indefinite amount of energy. Hence, for substances chemically inactive, "*the true contact E.M.F. is equal to their coefficient of the Peltier effect* *expressed in absolute measure*"; and for substances chemically active, but devoid of Peltier effect, "*the E.M.F. is equal to the energy of combination of one electro-chemical equivalent.*" Since metal-metal contacts can only be the seats of Peltier E.M.F.'s it is inferred that the apparent contact E.M.F. (measured inductively) must be due chiefly to air-metal contacts. A list of analogous properties of Peltier and chemical E.M.F.'s is given in parallel columns. The results of some experiments on the contact E.M.F. of glass and ebonite with mercury are tabulated, but they are very irregular, and the author concludes that there is no true and definite contact E.M.F. between conductors and non-conductors. Profs. Ayrton, Schuster, Thompson, and Perry discussed the points raised, and it was considered that direct experiment on contact E.M.F. in a very perfect vacuum could alone decide the questions.—On a theory concerning the sudden loss of magnetic properties of iron and nickel, by Mr. H. Tomlinson. Experiments by himself and other observers have shown that the temperatures at which iron and nickel lose their magnetic properties depend on the specimens used, and the magnetizing forces employed; but the temperature at which they *begin to lose* these properties are definite—for nickel about 300° C., and iron about 680° C. The author's own experiments on "Recalescence of iron" show two critical temperatures; and Pinchon has shown by calorimetric measurements that between 660° and 720° C., and between 1000° and 1050° C., heat becomes latent. All these facts seem to indicate a molecular rearrangement about these temperatures. In his proposed theory, he assumes that the molecules of iron (say) contain magnetic atoms capable of motions of translation and of rotation. These tend to form closed magnetic circuits, but at ordinary temperatures are unable to do so on account of the close proximity of their centres. On raising the temperature, their centres are further separated till at about 680° C. their polar extremities rush together, forming complete circuits and exhibiting no external magnetic properties. On cooling down, the centres approach until the gravitation attraction overcomes the magnetic attraction of their poles, when the magnetic properties reappear. Prof. Ayrton asked whether the author had made experiments on the reappearance of magnetic properties when raised to a white heat, and Prof. Thompson inquired whether cobalt had been tested. Both questions were answered negatively.—Note on the graphic treatment of the Lamont-Frolich formula for induced magnetism, by Prof. S. P. Thompson. The formula referred to is $N = \bar{N} \frac{Si}{Si + b}$; where $\bar{N}$ = total induction when saturated, N = induction due to Si ampere turns, and b = value of Si which makes $N = \frac{1}{2}\bar{N}$. Simple geometrical constructions are given for plotting the curve when $\bar{N}$ and b are known, and for finding $\bar{N}$ and b when two pairs of values of N and Si have been determined. The use of the formula is shown to be justified in practice, for, as pointed out to the author by Prof. Perry, the curves connecting permeability, μ, and induction, B, are straight lines from B = 7000 to B = 16,000, between which dynamos are usually worked. A method of predetermining $\bar{N}$ and b is given for magnetic circuits of known form and materials, thus removing the objection often urged against the above formula, viz. that it involves two constants which had to be determined after the magnet was made.

Mathematical Society, May 10.—Sir J. Cockle, F.R.S., President, in the chair.—Mr. E. B. Elliott communicated a fourth paper on cyclicants or ternary reciprocants and allied functions.—Mr. Cook Wilson gave a sketch of some theorems on parallel straight lines, together with some attempts to prove Euclid's twelfth axiom. Messrs. Elliott, Buchheim, and Prof. Henrici, F.R.S., took part in a lengthened discussion of the paper.—The following were taken as read:—On the flexure and the vibrations of a curved bar, by Prof. H. Lamb, F.R.S.—On the figures formed by the intercepts of a system of straight lines in a plane and on analogous relations in space of three dimensions, by S. Roberts, F.R.S.—On Lamé's differential equation; and stability of orbits, by Prof. Greenhill.

Entomological Society, May 2.—Dr. D. Sharp, President, in the chair.—Dr. P. B. Mason exhibited an hermaphrodite specimen of *Saturnia carpini*, from Lincoln, and another specimen of the same species with five wings, bred at Tenby.—Herr Jacoby exhibited female specimens of *Chrysomela japana*, collected by Mr. J. H. Leech in Japan, and called attention to a sexual structure in the middle of the abdominal segment.—Mr. Adkin exhibited a variety of *Eubolia bipunctaria*, taken at Box Hill.—Mr. W. F. Kirby exhibited, for Dr. Livett, a curious discoloured female specimen of *Ornithoptera minos*, Cramer.—Mr. H. Goss exhibited, for Mr. W. Denison-Roebuck, a number of specimens of an exotic species of bee obtained by the Rev. W. Fowler, of Liversedge, from split logwood. The cells or pouches were very irregular and rough, and altogether unlike those of any known British species.—Dr. J. W. Ellis read a paper entitled "Remarks on the British Specimens of *Aphodius melanostictus*, Schmidt," and he exhibited a number of specimens and drawings of this species and of *Aphodius inquinatus*, F. A discussion ensued, in which Dr. P. B. Mason, Dr. Sharp, Mr. Champion, and Dr. Ellis took part.—Mr. E. Meyrick communicated a paper on the Pyralidina of the Hawaiian Islands, the material for which paper consisted principally of the collection of Lepidoptera Heterocera formed by the Rev. T. Blackburn during six years' residence in the Hawaiian Islands. Mr. Meyrick pointed out that the exceptional position of these islands renders an accurate knowledge of their fauna a subject of great interest. He stated that, of the fifty-six known species of Hawaiian Pyralidina, nine had probably been introduced through the agency of man in recent times; but he believed the remaining forty-seven to be wholly endemic: of these latter the author referred twenty-six species to the *Botydidæ*, twelve to the *Scopariadæ*, four to the *Pterophoridæ*, three to the *Crambidæ*, and two to the *Phycitidæ*. Dr. Sharp, Mr. McLachlan, Dr. Mason, and Mr. E. B. Poulton took part in the discussion which ensued.

PARIS.

Academy of Sciences, May 14.—M. Janssen, President, in the chair.—On diamagnetism, by M. Mascart. In connection with M. Blondlot's recent communication describing an experiment on the apparent diamagnetism of a solution of the perchloride of iron in a more concentrated solution of the same substance, it is pointed out that in 1845 Faraday showed that the action of the magnetic forces on a body depends on the medium in which it is plunged, as it results from the difference of their coefficients of magnetic induction. If the intensity of magnetization remains proportional to the magnetizing force, which is the case with all diamagnetic and slightly magnetic bodies, the theory then shows that the magnetizm on the surface of the body in question changes its sign when the outer medium has a high coefficient.—Remarks accompanying the presentation of a map of Massaya in Abyssinia, by M. d'Abbadie. Attention was drawn to some cartographic improvements introduced into this map by the author with the view of rendering the nomenclature more distinct, and more in accordance with the local pronunciation of geographical names. In all cases such foreign descriptive terms as *Ras*, *Jebel*, &c., give place to their equivalents *Cape*, *Mount*, &c.—Fluorescence of cupriferous lime, by M. Lecoq de Boisbaudran. After calcination in the air, carbonate of lime containing a little oxide of copper yields a substances which gives in vacuum an extremely bright green fluorescence. No spectral rays have been observed. When calcination takes place in hydrogen, instead of the green fluorescence, a more or less pink or reddish light is obtained, at times somewhat intense, but always greatly inferior to the green fluorescence.—Observations of the new planet 277, discovered on May 3, at the Observatory of Nice, by M. Charlois. The observations extend over the period from May 3 to May 9, when the planet appeared to be of the thirteenth magnitude.—Observations of the same planet are recorded for the period May 5-12, taken by M. Trépied, at the Observatory of Algiers.—Observations of the channels in Mars, by M. Perrotin. Some important modifications are described, that have taken place in these appearances since they were first observed by the author in 1886. The triangular continent, somewhat larger than France (the Lybia of Schiaparelli's map), which at that time stretched along both sides of the equator, and which was bounded south and west by a sea, north and east by channels, has disappeared. The place where it stood, as indicated by the reddish-white tint of land, now shows the black, or rather deep blue colour of the seas of Mars. The Lake Mœris, situated on one of the channels, has also vanished, and a new channel, about 20° long and 1° or 1°·5 broad, is now visible, running parallel with the equator to the north of the vanished continent. This channel forms a direct continuation of a previously existing double channel, which it now connects with the sea. Another change is the unexpected appearance about the north pole of another passage, which seems to connect two neighbouring seas through the polar ice.—Action of hydrochloric acid on the solubility of stannous chloride; hydrochlorate of stannous chloride, by M.

Engel. It is generally assumed that the solubility of stannous chloride in water increases in the presence of hydrochloric acid. But the experiments here described show that this is the case only when the quantity of acid added to the saturated solution of the chloride attains a certain value. The hydrochlorate of stannous chloride, here also described, has for formula, $SnCl_2 + HCl_2 + 3H_2O$. It crystallizes and melts at about $-27°$.—On the existence of a pyrophosphorous acid, by M. L. Amat. The existence here demonstrated of this body is a brilliant verification of the theory of Wurtz regarding the constitution of the phosphorous and hypophosphorous acids.—Essay on the equivalents of the simple bodies, by M. Delauney. Taking as unity the equivalent of hydrogen, the equivalents of the simple bodies may be obtained by the expression, $\frac{N}{3}\sqrt{5^2 - n^2}$, where N and n are integers, the values of n being obviously restricted to 0, 1, 2, 3, or 4. According to these several values of n the elementary bodies are disposed in so many family groups, from which chlorine alone is excluded, while its neighbour, bromine, appears to belong to as many as three of the groups. This classification seems natural, the first family supplying the true metals—copper, gold, lead—below which, in the descending scale, the fifth family corresponds to the alkaline metals and metalloids. From all this is deduced a curious molecular theory based on the assumption of a primitive molecule formed of six atoms. Around one of these the other five describe circles with radii 1, 2, 3, 4, 5, all moving in the same plane, and the central atom revolving round its own axis perpendicular to the plane. The atoms at the distances 1, 2, 3, 4 revolve in the same direction as the central, the outer in the contrary direction, the molecule thus constituting a sort of astronomic system, infinitely small, but analogous to the stellar groups. All these considerations go to confirm in principle, if not in fact, the views of those chemists who hold that all the simple bodies are ultimately reducible to one—that is, hydrogen. —Researches on the synthesis of the albuminoid and proteic substances, by M. P. Schutzenberger. Having completed his analytical studies of albumen, fibrine, caseine, gelatine, and other proteic substances, the author has now begun the study of their synthesis. In this paper the first results are given, showing that the leuceine obtained by the synthetic process is identical with that yielded by decomposition.

BERLIN.

Physiological Society, April 27.—Prof. du Bois-Reymond, President, in the chair.—Dr. Blaschko spoke on the development of horny tissue. Between the rete Malpighii and the corneous layer (stratum corneum) of the epidermis two layers are found—the stratum granulosum and the stratum lucidum—in which the cells of the rete, produced karyokinetically, must undergo their conversion into the epidermal cells of the stratum corneum. The speaker confined himself first to a consideration of the granules of the stratum granulosum, about which most widely different views have been advanced by various writers. They have been regarded as consisting of fat, cholesterin, amyloid substance, proteid, keratin, and hyalin; and further as fluid, semi-fluid, or solid. Dr. Blaschko has satisfied himself that the granules are not fluid, but that they contain more water than the cells of the epidermis. He has further proved by employing all the chemical reactions which are characteristic of such different substances as fat, cholesterin, proteid, &c., that the granules cannot be regarded as composed of any of the above. The curious colour they assume when stained with hæmatoxylin, and their behaviour with chemical reagents, shows that their proper place is one intermediate between albumen and keratin; the speaker hence proposed to give the name of prokeratin to the material of which the granules are composed.—Dr. Klaatsch had made a series of preparations from the skin of monkeys, by which he shows that it is possible, by using various colouring-matters, to give different colours to the stratum lucidum and stratum corneum in one and the same specimen, thus making it easy to distinguish these layers each from the other and from the stratum granulosum. He shows further that in the skin of monkeys, as in that of man, alternating elevations and depressions are met with; the former, or gland-hillocks, cover the glands of the skin, while the latter, or folds, are joined by tense bundles of connective-tissue passing through the rete, and thus forming an attachment for the skin. Finally, and in the third place, the preparations showed that the nuclei of the cells in the rete are still here and there recognizable in the stratum corneum as spaces which are probably formed by a disappearance of the nuclear substance, the nuclear membrane being persistent.—Dr. R. Schneider has carried on a series of researches, extending over nearly every class of animals, on the absorption of iron and on its occurrence as oxide in the organs and tissues of the animals. Up to the present time all the animals examined, whether living in water, mud, or underground, have contained oxide of iron; which was detected, using all due precautions, by employing ferrocyanide of potassium and dilute hydrochloric acid. The speaker gave an account of the behaviour of single animals taken from the Protozoa, Cœlenterates, Worms, Arthropods, Gasteropods, Fishes, and Amphibia. Among Vertebrates, oxide of iron was found in the cells of the alimentary canal, in the liver and spleen, occasionally in the kidneys and teeth, and in Proteus it occurred throughout the whole skeleton. Among the Invertebrates oxide of iron was found to occur in the cells of the liver and intestine, in the respiratory organs, the shells and chitinous envelopes. The oxide occurred chiefly in the protoplasm of the cells, but also frequently in the nuclei. It is impossible here to enlarge further upon the interesting details of which Dr. Schneider supplied an extended series.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Theoretische Geologie: Dr. E. Reyer (E. Schweizerbachsche).—Practical Lessons in the Use of English: M. F. Hyde (Heath, Boston).—The Origin of Floral Structures: Rev. G. Henslow (Kegan Paul).—The Baths and Wells of Europe, 3rd edition, revised: J. Macpherson (Stanford).—Jahrbuch der Naturwissenschaften, 1887–88: Max Wildermann (Herder, Freiburg).—A Manual of General Pathology: J. F. Payne (Smith, Elder).—Practical Zoology, 2nd edition: Marshall and Hurst (Smith, Elder).—Tropical Africa: H. Drummond (Hodder and Stoughton).—A Manual of Practical Assaying, 6th edition: J. Mitchell; edited by W. Crookes (Longmans).—Hand-book for the Stars, 4th edition: H. W. Jeans; revised by W. R. Martin (Longmans).—Descriptions of New Indian Lepidopterous Insects from the Collection of the late Mr. W. S. Atkinson; Part 3, Heterocera (continued): F. Moore (Calcutta).—Memoirs of the Geological Survey of India, Palæontologia Indica, ser. xiii., Salt Range Fossils, vol. i. Part 7: W. Waagen (Trübner).—Beiträge zur Kenntniss der Nagelfluh der Schweiz: Dr. J. J. Früh (Williams and Norgate).—Plotting, or Graphic Mathematics: Dr. R. Wormell (Waterlow).—Hylomorphism of Thought—Being Part 1 Theory of Thought: Rev. T. Q. Fleming (Williams and Norgate).—Transactions of the Society of Naturalists of Cracow University, 1887.—Mémoires de la Société de Physique et d'Histoire Naturelle de Genève, tome xxix. seconde partie (Genève).—Brain, April (Macmillan).

CONTENTS.