THURSDAY, MAY 16, 1889.

BORNEO.

Borneo: Entdeckungsreisen und Untersuchungen; Gegenwärtiger Stand der Geologischen Kenntnisse; Verbreitung der Nutzbaren Mineralien. Von Dr. Theodor Posewitz. (Berlin: Friedlander, 1889.)

IN the work before us, Dr. Theodor Posewitz, of the Hungarian Geological Institute, gives the results of his three years' personal explorations in the Island of Borneo, with which he has incorporated the more important observations which are recorded in the literature of the subject. The larger portion of this literature being in Dutch, it is, as a whole, not very widely known; it is, accordingly, a matter of considerable importance to have it here summarized and critically examined by so competent an authority.

The three parts into which the volume is divided are: (1) Political and Historical; (2) Geological; and (3) Economic Mineralogy. Each of these parts is further subdivided into a number of clearly-defined sections, so that there is no difficulty experienced in at once mastering the range and contents of the work, which are further indicated by means of four excellent maps, showing respectively, (1) the routes of travellers, (2) the political divisions, (3) the geological structure, and (4) the distribution of useful minerals.

We are told, in Part I., that two-thirds of the island belong to the Dutch, but that the States on the north coast are more or less under British influence.

The history of exploration, as conducted by the Dutch, is treated separately from that which originated in connection with British colonial enterprise. During the last century, only one extensive journey was undertaken in Dutch Borneo, and scientific exploration was then altogether prohibited.

The genuine exploration of the country did not begin till 1820–30, when a Natural History Commission was established in Batavia, and its members undertook to investigate and describe various islands. Among others, Horner, G. Müller, Dr. Schwäner, and Von Gaffron devoted themselves to Borneo, and to the two last we owe our knowledge of South Borneo. Between the years 1850–60, systematic explorations for useful minerals were carried on by Dutch engineers in South-West Borneo, and these explorations have been recently resumed, after an interval of twenty years.

To Alexander Dalrymple, who travelled in 1769, we are indebted for our first knowledge of North Borneo; other early travellers were Burns, Hugh Low, and Spenser St. John, who visited Sarawak, Brunei, and the north-east coast, and ascended the Kina Balu Mountains. Among later travellers, Crocker and H. Everett merit special notice; as also do the courageous pioneers in the British North Borneo Company's territory—Dobrée, Peltzer, Wetti, Von Donop, Pryer, and F. Hatton.

With regard to the geological and physical structure, which are dealt with in Part II., we are told that there is no uninterrupted central mountain chain in Borneo, though such is represented on most maps. Isolated mountains occur at intervals, surmounting table-lands which extend in a north-east to south-west direction; but it is not yet decided whether a regular chain exists in any part of the interior. The Kina Balu Mountains, which have a maximum elevation of 13,698 feet, are, so far as is at present known, the highest in the island; they are situated in the territory of the British North Borneo Company.

The largest rivers—the Barito, Kapuas, Redjang, and Mahakkam—rise in the centre of the island.

The geological structure is remarkably free from complexity. The isolated mountains are of slate or schist penetrated by granite and diorite—conditions, it may be remarked, which are in many countries accompanied by the occurrence of mineral veins; this also seems to be the case in Borneo.

Succeeding these are rocks of Devonian age, in which auriferous veins occur. Till quite recently no formations had been recognized between them and the Tertiary deposits which have long been known, but Carboniferous strata (mountain limestone), which it is believed occur throughout a large area in Northern Borneo, have within the last few years been recognized, and Cretaceous rocks have been discovered in a single locality in West Borneo.

Tertiary formations belonging to several subdivisions are distributed over considerable areas; they form the plateaus through and above which the mountain chains rise. The older Tertiary strata were first studied by Verbeek and Pengaron in South Borneo. They are divisible into sandstone, marl, and limestone groups. The majority of the coral deposits occur in the sandstone, and the limestones consist mainly of wide-spreading coral reefs. These older Tertiary strata are often much disturbed and broken by intrusive masses of andesite. Oligocene strata are only known in East Borneo, where they include extensive deposits of coal.

The diluvium of our author is of considerable economic importance. It spreads over wide undulating tracts surrounding the Tertiary hills. It includes the principal sources of the gold and diamonds which, together with coal, constitute the most valuable mineral resources of the island. From the diluvium to the alluvium which is in process of formation at present, there is a gradual transition.

There are no evidences of any post-Tertiary volcanic energy in Borneo. The Kina Balu Mountains, at one time thought to be volcanic, are now known to consist of ancient eruptive masses. Earthquakes occur, but rarely, and so far as is known they originate in neighbouring islands.

In West Borneo a deposit which appears to be identical with one form of Indian laterite, is described as resulting from the weathering of the rocks. A similar laterite occurs near Singapore.

Taking a general survey of the probable geological history of Borneo, it appears that, up to the beginning of the Tertiary period, what now forms one united island consisted of an archipelago like that between Singapore and Banka. After the deposit of the Tertiary strata there followed a period when the island had the form of the Celebes. A tradition among the natives, that the sea formerly reached to the foot of the mountains, is referred

to as confirming the view that the present form of the island has only been acquired recently.

The useful minerals are described in Part III., and their distribution is indicated on the map already referred to. Of most of them Dr. Posewitz has previously published separate descriptive monographs.

The rich coal-fields are first described. The seams are exposed in many river cuttings in Sarawak and Brunei. Coal also occurs on the Island of Labuan and in Sabah. There are said to be rich and extensive deposits in East Borneo also, but they have not been worked.

Gold is of the next importance to coal as a mineral product. Mining in the older formations has hitherto not proved remunerative, the best field being from the diluvial deposits, which are worked almost exclusively by Chinese. The richest gold regions are in the south-east, near Tanah Laut and Kusan, on both sides of the auriferous Meatus Mountains; and in the north-east, in the Chinese districts of West Borneo and Sarawak. Recently, what promise to be rich gold deposits have been discovered in the Upper Segamah River in Sabah.

The production of gold was much more considerable formerly than it is at present. In West Borneo it amounts annually to 120,000–150,000 kilogrammes, and in Sarawak it amounted to 28,281 kilogrammes in 1886.

Diamonds are not, comparatively speaking, so abundant as gold, but they occur in the same deposits. They are searched for by Chinese. Since the introduction of the cheaper Cape diamonds, the production has fallen. In 1884, 2727 carats were exported from West Borneo, and 1200 carats from Sarawak in 1886.

Dr. Posewitz refers to the late Prof. Lewis's speculation as to the connection between diamonds and serpentine (*Peridotite*) (NATURE, vol. xxxvi. p. 571), but states that it is not yet known how far his conclusion is correct, that diamonds and platinum are only found in Borneo in streams which traverse areas containing serpentine. Indeed, it may be added that serpentine is of rare occurrence in the principal diamond regions of India, and in some of them none whatever has been observed.

The famous "diamond" of 367 carats, known as the "Matan," from the territorial title of the Rajah to whom it belongs, has been estimated to be worth £269,378 (Crawfurd). The Dutch made very large offers of money and warlike material for it early in the present century, but these were always refused. The stone, it now appears, was examined in 1868, and proved to be only a rock crystal with a specific gravity of 2·63, thus confirming doubts perviously expressed as to its being really a diamond.

Platinum is of very local occurrence in Tanah Laut only.

Antimony and quicksilver only occur, so far as is known, in sufficient quantities to be regularly mined in Sarawak.

Iron ores are widely distributed, but are of no present economic value. The introduction of cheap European iron has put an end to the native iron industry, as is the case, too, in many parts of India.

Dr. Posewitz states that the condition of mining industries generally in Borneo is at present very poor. In the south, private coal-mines existed, but were put an end to by an insurrection. The well-known Government mines at Pengaron ceased working after thirty-six years' existence, as they were no longer remunerative. A private company has now commenced to work valuable mines on the east coast. In Sarawak, mines have been worked by the Government since 1881, and in 1886 produced 44,167 tons. In Labuan, mines were also worked for some time, but are now closed. The principal source of supply at present is from Brunei (Muara coal). It is hoped that in the British North Borneo Company's territory extensive workings of gold and coal will be established.

It is impossible to give here an adequate idea of the careful details with which each topic discussed in this work is illustrated. At the same time there is a highly meritorious conciseness of treatment which, together with the soundness of the author's views and his careful quotation of his authorities, makes the work a text-book for which it is to be hoped that a competent translator into English and an enterprising publisher will be found. It is emphatically a work which was much wanted, as our knowledge of the geology of this important island has hitherto been most fragmentary and imperfect, and we trust, therefore, that, ere long, steps may be taken to make Dr. Posewitz's labours better known to English readers. V. B.

GRAPHICS.

Graphics; or, the Art of Calculation by drawing Lines, applied especially to Mechanical Engineering. With an Atlas of Diagrams. By Robert H. Smith, Professor of Engineering, Mason College, Birmingham. Part I. (London: Longmans, Green, and Co., 1889.)

MAXWELL was the first, according to the Introduction of the present treatise, to state the principles in a very complete and general manner by which stress-diagrams are drawn, in the *Phil. Mag.*, xxvii., 1864; and also in the Trans. Roy. Soc. Edinburgh, vol. xxvi.

But Maxwell himself is careful to point out that he derived the original idea from Mr. W. P. Taylor, or at least was unaware of his previous use of the method.

The method is of much greater antiquity, and can be traced through Moseley's "Mechanical Principles of Engineering and Architecture," 1843, to Hutton's "Course of Mathematics," 1811, and probably still further back.

It is, however, only of recent years that Maxwell's treatment has been followed up and developed by Cremona, Culmann, von Ott, and others; and now the method is considered indispensable in practice for the calculation of the stresses in bridges, roofs, and engineering and architectural structures generally.

Two great advantages of the graphic method recommend it to the practical man—the first, that the diagram is itself a check upon the correctness of its construction; and the second, that the numerical results of the diagram are read off on a scale only to the really practically significant number of figures, the very roughness and imperfection of the draughtsman's work showing the margin of variation to be allowed for.

As to the relative rapidity of the graphic method compared with ordinary numerical calculation by logarithms and arithmetical processes, the author points out that, while for a single isolated calculation the graphic method may easily be distanced, it is in the long-continued series of

operations of the same character required by the engineer, shipbuilder, or constructor in general, that the graphic method takes the lead once the calculator has got his mental operations thought out, and his instruments in good order; for which purpose Chapter I., on instruments, gives valuable hints and information.

Chapter II. explains succinctly the plan of the book in its applications to graph-arithmetic, Chapter III.; graph-algebra, Chapter IV.; grapho-trigonometry and mensuration, Chapter V., &c., and lastly, grapho-dynamics, experimental and mathematical tabulation.

It is in the later chapters that the full power of the graphic method is developed, but in the earlier chapters the student is exercised by well-chosen practical examples in the mental operations and manipulation required in the advanced processes. The student of ordinary mathematical processes will find here graphic solutions of geometrical loci, and the solution of quadratic, cubic, and other algebraical and trigonometrical equations, illustrated by carefully-drawn diagrams in the atlas of plates. But the author appears to underrate the value of the planimeter on p. 63, in its application to the evaluation of the irregular areas encountered in indicator diagrams, shipbuilding, and railway engineering.

In Chrystal's "Algebra," the importance of the graphic solution in integers of the loci represented by indeterminate equations of the first and second degree is pointed out; and in the present work the graphic solution of the general quadratic and cubic equations by means of a carefully-drawn curve, $y = \frac{x^2}{10}$, or $y = \frac{x^3}{100}$, and its intersections with a straight line, is also developed, and illustrated in the Atlas of Diagrams.

The logarithmic curve, $y = e^x$, or 10^x, would also be useful for the graphic solution of transcendental equations of the form—

$$Aa^x + Dx + F = 0,$$

required in the problem of the hydraulic buffer.

Again, in trigonometry, the solution of the equation—

$$a \cos \theta + b \sin \theta = c,$$

or the summations $\Sigma \cos (\alpha + n\beta)$ or $\Sigma' \sin (\alpha + n\beta)$ by a graphical method, or drawing Lissajous's figures graphically, would tend to impart freshness to a subject at present running in a narrow dry rut. Paper ruled into small squares of centimetres and millimetres, suitable for graphic methods, can be obtained in Germany, of Carl Schleicher and Schüll in Düren, for instance.

It is curious to notice that the fresh and original ideas and treatment of elementary mathemathical subjects due to Maxwell and Clifford are to be found embodied and adopted only in practical and technical treatises, such as the present work. Elementary mathematical treatises are in danger of becoming as dry and orthodox as a religious creed: examiners, on the one hand, are forbidden to set ideas out of the groove of a few antiquated text-books; and examinees, on the other hand, dare not allow themselves to learn new ideas and methods, for fear of finding themselves at a disadvantage with old-fashioned examiners.

Some reflections on p. 181 of the present work on the radiant-energy-carrying ether show, however, that the author allows himself occasionally to indulge in the purely abstract speculations dear to Sir W. Thomson and Mr. Macfarlane Gray.

Chapter IX., on the "Kinematics of Mechanisms," covers much the same ground as Kennedy's "Mechanics of Machinery," and follows Reauleaux's treatment in his "Kinematik." Chapter X., on "Static Structures, Frames, or Linkages," and Chapter XI., on "Flat Static Structures, containing Beam-Links," contain the applications of the graphic method to problems most commonly encountered by the practical designer.

The consideration of "Solid Static Structures" in Chapter XII. follows very usefully as a check upon the *in plano* treatment of the subject in the two preceding chapters. The failure of many very scientifically-designed bridges in America has shown that it is not sufficient to treat the beam in elevation only, as if it was a vertical plane structure; but that the torsional rigidity is of importance whenever the load is applied in the least degree eccentrically.

A glossary of special terms and symbols is inserted at the beginning, containing without redundancy the new terminology useful in this subject; and an index completes the work, in which we should like to have seen a complete list of books in English bearing on this and kindred subjects, such as Cotterill's "Applied Mechanics," Eagles's "Constructive Geometry," Clarke's "Graphic Statics," Wormell's "Plotting, or Graphic Arithmetic"; also McLay's articles on "Geometrical Drawing," now appearing in the *Practical Engineer*.

The author promises a second part dealing with "The Distribution of Stress and Strain," "The Strength, Stiffness, and Design of Beams and Struts," "Economy of Weight in Structures," "Stresses in Redundant Structures," "Statics and Dynamics of Machines," "Frictional Efficiency," "Governors and Fly-wheels," "Valve Gears," "Practical Thermodynamics of Furnaces, Boilers, and Engines," "Hydrostatics and Hydrokinetics of Ships and Hydraulic Machines"—all subjects of great practical and theoretical interest, to which we shall look forward with much pleasure.

A. G. GREENHILL.

THE CHEMICAL ANALYSIS OF IRON.

The Chemical Analysis of Iron. By Andrew Alexander Blair. (London: Whittaker and Co. Philadelphia: J. B. Lippincott, 1888.)

OF all the branches of quantitative analysis practised for the control of industrial processes, none is of greater importance than that which concerns iron. The precise relationship of chemical composition to mechanical properties is by no means fully ascertained; but a great deal of excellent work has been done in this direction, and we know in several cases the kind of variation in physical properties which is, *cæteris paribus*, to be expected to accompany a variation in the quantity of one constituent. We know, moreover, how extraordinarily great this physical change may be, compared with the change in composition. When we reflect that a quantity, which in most other technical analyses is within the error of experiment, may become the criterion by which an iron is appraised, we must recognize the necessity of accurate methods of analysis for this particular commodity.

The present work is stated to be a "complete account of all the best known methods for the analysis of iron, steel, pig-iron, iron-ore, limestone, slag, clay, sand, coal, coke, and furnace and producer gases," and we may say at once that the book realizes its title in a very admirable way.

The author brings high credentials to his task, having—as chief chemist to the United States Board, appointed to test iron, steel, and other metals in 1875, and as chief chemist to the United States Geological Survey and tenth census 1880—devoted many years to the subject. He records, he says, the results of his own experience, and there is a personal flavour about the work such as is too seldom found in modern hand-books. One feels in reading the descriptions of apparatus, processes, and precautions, that they are not merely what the author has collated, but what he has seen and done and learned. There are many novel arrangements of apparatus described, many improvements of detail in various analytical processes, and altogether the subject is handled in a thoroughly authoritative and practical manner.

The most striking thing, however, is the elaborateness and refinement insisted upon in the performance of the more important operations. There is no attempt to compromise unwisely between accuracy and rapidity—these two *desiderata* are treated separately. Thus there is a method described for determining silicon with elaborate precautions by volatilization in a current of chlorine, and another in which the amount of silicon in a pig-iron can be determined in twelve minutes from the time the ladle is put into the molten iron.

The book begins with a description of apparatus and manipulation required for sampling, and subsequent analytical operations. This portion of the work will no doubt be found useful—but we regard it as sufficient rather than exhaustive. We can scarcely say as much of the following 20 pages, devoted to reagents. There seems to be some uncertainty as to the chemical knowledge expected from the operator. The information about chlorine that it is a yellowish gas, about two and a half times heavier than air, sparingly soluble in water, and the somewhat obvious truth which completes this description, that "when required it must be made," will probably fall flat upon a person who a few lines further on is expected to know that chromic acid should not be dried by filter-paper. And again, if one is to be told the equations which represent the preparation of ammonium sulphide, why should not one be told *why* it "becomes yellow by age, or on exposure to air"? We think this portion needs revision; superfluous information should be removed, and the descriptions should be made more complete. We think also that it would be much to the benefit of the very large number of half-informed persons engaged in the routine analysis of iron, if the theory of the analytical process were described always at the beginning of a chapter instead of being interspersed (and then often imperfectly) with the details of operations. In these respects Mr. Blair's work might be improved, but in the main features there is no fault either of omission or commission. The book is beautifully printed, is supplied with full marginal notes and luxurious woodcuts, and is altogether a much more presentable volume than the British analyst is accustomed to have about him. We have no doubt it will be very cordially welcomed in the numerous iron and steel works laboratories of this country.

OUR BOOK SHELF.

Agricultural Canada: a Record of Progress. By W. Fream, B.Sc., LL.D., &c. (1889.)

LAST year, Dr. Fream, as Commissioner of the Canadian Government, visited Canada, for the purpose of reporting upon the position and prospects of agriculture in the Dominion, and his Report has now been published under the direction of the Government of Canada. The author, who was well fitted for the task by his previous knowledge of Canada, appears to have visited every province in the Dominion, from Nova Scotia on the Atlantic seaboard to British Columbia on the Pacific. Numerous details concerning the climate, and the geological, botanical, and other natural features of the northern half of the North American continent, are interwoven with the more prosaic facts bearing upon the agricultural development of an area as large as that of Europe. Some parts of the Dominion, little known even in Canada, are dealt with in special detail. The fine rolling prairie occupying North-Western Manitoba, and stretching away through Assiniboia to the banks of the North Saskatchewan River, is selected for favourable notice, but this region has at present to be explored on horseback or on a "buckboard." Far away to the west, in Alberta, there appears to be another fertile and beautiful region awaiting development, in the Rosebud country, which includes the Red Deer Valley. The attempt to unravel the complicated surface features between the Rocky Mountains and the Pacific deserves notice, and some reference is made to the little-known Kootenay district. The Commissioner extended his travels across an arm of the Pacific to Vancouver Island, the southern point of which is capable of considerable agricultural development. To the production of cattle, horses, grain, cheese, and fruit, the agricultural energies of the Dominion are chiefly directed, and the Report strongly urges the Government not to moderate one iota the stringency of the quarantine regulations, whereby alone Canadian cattle are kept free from contagious disease. The Report, as a whole, might advantageously take the place of nine-tenths of the school-books which profess to deal with Canada.

Longmans' School Arithmetic. By F. E. Marshall, M.A., and J. W. Welsford, M.A. (London: Longmans, 1889.)

THIS work owes much of its value to its being drawn up on the lines laid down by De Morgan. This is shown by the importance attached by the authors to computation in the early part of the work, and by the copious use of diagrams in the chapters devoted to vulgar fractions. A moving cause to such a casting of the book is the importance which has been attached to De Morgan's methods in the recently issued report of the Arithmetic Committee of the Association for the Improvement of Geometrical Teaching. With such an admirer of the Professor as the late President of the Association is, on the said Committee, we should expect such a result. Much space is devoted to oral exercises; this being so will account, in a measure, for the written explanations not being quite so full as we have seen them in other text-books. The treatment of recurring decimal fractions is thorough, the unitary method is employed in the solution of examples, and considerable care has been expended upon the commercial arithmetic. A large body of exercises is furnished in the text for solution, and very many specimens of examination papers as well as papers of miscellaneous exercises come at the end. There are a few small matters, in an appendix and elsewhere,

which call for more careful and precise statement, but on the whole the work is calculated to be useful, and we can recommend it for school use.

Glimpses of Feverland: or, A Cruise in West African Waters. By Archer P. Crouch, B.A. Oxon. (London: Sampson Low, 1889.)

IN this volume Mr. Crouch presents a record of the impressions made upon him by the land and people of certain portions of West Africa, which he visited in connection with the laying of a cable to put various places, principally French and Portuguese, in telegraphic communication with Europe. A large part of the book is devoted to an account of what he saw during his passage from Accra, on the Gold Coast, to the Portuguese island of St. Thomé. Afterwards we have a full description of St. Thomé and St. Paul de Loanda, and in several concluding chapters the author sums up the incidents of his voyage homewards. Mr. Crouch is so good an observer, and has so frank and lively a style, that his narrative, taken as a whole, is fresh and interesting, although his subject is often, apart from his treatment of it, dreary enough. He is particularly successful in those passages in which he seeks to give his readers glimpses of native customs and superstitions. It is worthy of note that he has formed a very unfavourable judgment as to the intellectual and moral qualities of the Negro race; but on this question, with regard to which he differs widely from Mr. Stanley, he perhaps speaks rather more positively than the extent of his experience warrants.

LETTERS TO THE EDITOR.

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

The Meteoritic Theory.

I HAVE during the past six months been led from the study of our own atmosphere to consider certain phenomena relating on the one hand to the solar *atmo-physics*, and on the other hand to the evolution of our own globe and its atmosphere. There has thus arisen in my mind a system of cosmogony which has led me, quite independent of Mr. Norman Lockyer's published course of reasoning, back to a meteoric theory that will, I hope, be acceptable to yourself and others. Awaiting the preparation of these views for publication, I have had occasion to look over the report on the total eclipse of the sun, July 1878 (Professional Papers of the Signal Service, No. 1, Washington, 1881). I quote from pp. 49 and 50 some paragraphs to show the connection between views then held and those at which I have recently arrived.

Washington, April 29. CLEVELAND ABBE.

"Under these circumstances, I could but regard the suggestion that occurred to me on July 29 as a slight but important extension and modification of the views previously held. . . . It amounted to saying that a large part of the phenomena of the outer corona is essentially non-solar, having to do with cold meteoric matter that is beyond the solar gaseous atmosphere and is shining by reflected light, . . . rushing on its way to plunge into the sun's atmosphere, where, within a few hours, it would be dissipated. . . . That these beams were due to wholly new meteor streams . . . now for the first time approaching the sun. . . . I am now inclined to extend this view to very many of the radiating dark and bright lines observed during eclipses, and would explain most of them as due to brightly illuminated groups and streams of meteors and to large meteors followed by trains. . . . Those meteors that enter the solar atmosphere and become incandescent will of course shine with a greatly increased splendour, and thus constitute a portion of the inner corona; these thus show us the limit of the gaseous atmosphere of the sun. . . . The extreme limit may be located at a distance of five minutes (of arc) above the sun's surface, and is very likely to be less than this. . . . Meteors glow as shooting-stars when they strike our atmosphere with a relative velocity of from twenty to forty miles per second, and at an altitude of about one hundred miles, where the density of the atmosphere may be about 3×10^{-9} times that which prevails at the surface. Now these same meteors will, when they have approached to within 130,000 miles of the sun's surface, have a momentum at least a hundred times greater than that with which they enter the outer limit of the earth's atmosphere; therefore we are allowed to assume the density of the outer limit of the supposed solar atmosphere to be but the hundredth part of that of the earth, or 3×10^{-11}; this gives us for the base of the solar atmosphere a density and a pressure quite within plausible bounds."

The Structure and Distribution of Coral Reefs.

THOSE who have read the additional appendix in the edition just published of Mr. Darwin's work on coral reefs will doubtless have observed that whilst the recent evidence there produced against the theory of subsidence lies chiefly in observations on living reefs in the Florida seas, in the Western Pacific, and in the Indian Ocean, the new testimony advanced on behalf of the theory is in the main indirect in bearing, and is based on assumptions that have yet to be proved.

Referring to the latter evidence in the order of mention, I come first to the 90-fathom reef off Socotra, a reef that is assumed to have been lowered by a movement of subsidence into its present position. So defective is our knowledge of the depths at which coral reefs may grow, and so incomplete is our acquaintance with the complex agencies that combine to produce a coral reef or to limit and prevent its growth, that the inference respecting the depth of the Socotra reef may be truly characterized as based on an unproved assumption. At present our acquaintance with the fauna of the submarine slopes of tropical islands in the Indian and Pacific Oceans, between the depths of 20 and 100 fathoms, is of the scantiest description; and we are not in a position to hazard even a guess on the subject, much less to assume that an island like Socotra has experienced a movement of subsidence because it possesses a reef "submerged in some places to a depth of over 90 fathoms." It is owing to our ignorance of the fauna in these depths that it has not been possible to identify the great numbers of minute molluscan shells, which occurred in the upraised post-Tertiary muds discovered by me in the Solomon Islands; and it is of the lack of such knowledge that Prof. K. Martin in his recent great work on the Tertiary formations of Java naturally complains. Surely, when the biologist is fain to acknowledge his want of acquaintance with the matter, and when as a consequence the palæontologist and the geologist have to bring their labours to a standstill from the lack of comparative material, it seems rather dangerous for the coral reef speculator to assume what has never been properly examined.

If, therefore, we have yet to determine the limit of depth of the growth of coral reefs, we are scarcely in a position to advance as evidence in behalf of subsidence the thickness of certain upraised beds of coral limestone in the West Indies and in the Sandwich Islands. Even if such evidence should be ascertained to be valid in itself, it must be remembered that Mr. Murray in his theory places no limit to the possible thickness of coral reefs, and that in the outward growth of a reef a considerable thickness may be produced. There was, in truth, no circumstance more impressed on my mind in the Cocos-Keeling Islands than the seaward extension of coral reefs.

Once more, however, I would impress on future investigators the extent of our ignorance of the depths in which coral reefs may form. In one of my papers (Proc. Roy. Soc. Edin., 1885-86, p. 887) I have pointed out that the estimates of observers in different regions vary between 5 and 40 fathoms. It is also singular how different observers may vary in the conclusions they draw from the same lines of soundings. The soundings off Keeling Atoll were made by Captain Fitzroy himself, and he places the limit of depth at 7 fathoms ("Voy. *Adventure* and *Beagle*," ii. 634); whilst his companion, Mr. Darwin, judging from the same soundings, concluded that it lay between 12 and 20 fathoms. In truth, as long since pointed out by Prof. Semper, the whole question of the depth of the reef-coral zone has never been methodically investigated. It never occurred to Mr. Darwin or Prof. Dana that coral reefs might grow in depths *beyond the belt of sand that apparently limited their growth*. Yet

such I found to be actually the case on the slopes of Keeling Atoll, where Captain Fitzroy's soundings were taken. Few, in fact, who have read the work of the young naturalist of the *Beagle*, can sufficiently realize how scanty were the data on which the fundamental inference of the theory of subsidence was based; and I may safely add that few must be the scientific questions that have been settled on a scantier basis of observation than that relating to the depths at which reef-corals grow.

With regard to the sections exhibiting the submarine profile of the reef of Masámarhu Island, I was first at a loss to understand why their character should be advanced as favouring the idea of a movement of subsidence, since, when they first appeared in NATURE (vol. xxxvi. p. 413), I regarded them as favouring Mr. Murray's views. However, it soon appeared that this opinion was based on our inextensive acquaintance with the habits of corals, especially with the limiting causes of their extension in depth. The "ditches" shown in these sections I look upon as indicating the formation of barrier-reefs at considerable depths, and as giving remarkable support to my views on the origin of these reefs. In the paper above quoted I have been led by the observations of Agassiz in the Florida seas, and by my own in the Solomon Islands, to the conclusion that the main determining condition of the depth in which reef-corals thrive is to be found in the injurious effect on coral growth of the sand and sediment produced by the breakers, and that the distribution of these materials is dependent on the angle of the seaward submarine slope and on other less important circumstances.

It follows from this that in those localities where the submarine slope is moderate, a barrier-reef will form beyond the belt of detritus derived from the shore-reef inside it. But when the slope is fairly steep, as in the case of Keeling Atoll, the reef *débris* will cover an area of much less horizontal extent, and, as at these islands, an off-lying line of coral shoals will spring up at a distance only of 150 or 200 yards from the inner reef. Should, however, the slope be precipitous, as at Masámarhu Island, the reef *débris* will extend to considerable depths; and beyond the area thus covered with sand and gravel, a line of reef will in the course of time grow upwards, giving rise to the so-called "ditches" of the sections.

Reefs of all classes, as I hold, have a two-fold mode of growth seawards. There is first the advancement of the outer edge of a reef on its own talus, as dwelt upon by Mr. Murray. In the second place, they grow seaward by a reclaiming process, whether they be fringing, barrier, or circular reefs. The distribution of the sand and *débris*, guided by the angle of the submarine slope, determines, as above shown, this second mode of growth, which may result, as at Keeling Atoll, in a line of adjacent coral banks that ultimately reclaim a new strip and add it to the width of the reef, or a more distant barrier reef may appear at the surface, the lagoon of which silts up and is choked with coral in the course of ages, or, as at Masámarhu Island, there may occur a deeply-submerged barrier-reef that can be discovered only by methodical soundings.

Let us take the instance of Keeling Atoll to illustrate the present condition of this controversy. In a series of papers on this celebrated atoll, that I am preparing for the Royal Scottish Geographical Society, I have shown that the direct evidence of subsidence adduced in its case by Mr. Darwin is, according to Mr. G. C. Ross, its present proprietor, founded in error. In truth, Mr. H. O. Forbes, during his visit in 1878, observed evidence leading in his opinion towards a movement of upheaval. In default, then, of direct evidence, we have to look for the indirect proofs to certain *a priori* considerations, based on a few soundings that appeared to demonstrate once and for all the limit of depth of the reef-coral zone, a subject concerning which we still have very incomplete data. Then we are transported across the Indian Ocean to the 90-fathom reef of Socotra, the origin of which, for the reason just stated, is hidden in mystery. Afterwards, appeal is made to the thickness of reef limestones in Cuba and in the Sandwich Islands, limestones which, it is alleged, could only have been formed during subsidence, notwithstanding that their exact nature has not yet been determined, and in spite of the circumstance that reefs can attain a considerable thickness, as Mr. Murray rightly holds, solely by their outward growth.

If a visitor from another planet, having thus far followed the discussion, were to inquire in an apologetic manner whether, instead of going to the other hemisphere for evidence we had methodically endeavoured to investigate the problem on the spot, by patiently studying the complex agencies at work on this atoll, by carefully inquiring into the changes of the past, and by interpreting through their aid the processes of the present, we should be obliged to answer: "Scarcely at all. A theory advanced on the very threshold of such an investigation explained so well our limited knowledge by a movement of subsidence, that it is only of late years that doubts have arisen and that a new theory has been advanced opening up the lines of research to which you refer." H. B. GUPPY.

"Bambangala."

I SHALL be glad if you will allow me to call the attention of those who visit the Congo Free State to the curious antelope called "*Bambangala*," which is spoken of by Captain Bateman in his "The First Ascent of the Kasai," lately published by Messrs. George Philip and Son. Captain Bateman describes it as being "in size as large as a mule; of a bright chestnut colour, striped with creamy white, much in the manner of a zebra, on the back and sides, and dappled on the neck and flanks."

From the form of the horns shown in the figure (which, by the kind permission of Messrs. George Philip and Son, is here reproduced from Captain Bateman's book), it would appear that this antelope must belong to the genus *Tragelaphus*, but probably to a new species.

I should be very glad to examine specimens of the head and horns of this antelope, in case any of your correspondents in the Congo should meet with it, or to have some further information on the subject from those who have visited that region.

P. L. SCLATER.

Zoological Society of London, 3 Hanover Square, London, W., May 7.

Inclusion of the Foot in the Abdominal Cavity of a Duckling.

A DUCKLING, four days old, sent from Eastry in Kent, hatched on April 25, 1889, presented the above curious abnormality. The right lower extremity was normal in every respect; the left appeared on superficial examination to be absent. An incision made through the skin over the left flank at once disclosed the left limb, the joints being flexed to their utmost extent, and the thigh adducted, so that it lay in contact with the abdominal muscles of the left side; at the tibio-tarsal joint the limb passed through the wall of the abdomen, a few millimetres above the symphysis pubis. A portion of the yolk-sac protruded at the aperture by which the foot penetrated the abdominal wall. Opening the abdomen showed the remainder of the yolk-sac, its connection with the ileum, and the left foot lying upon the surface of the intestines. This included foot was fully developed, having a complete web, and being covered with scales. An adhesion existed between the outer surface of the yolk-sac and the left leg in the region of its tibio-tarsal joint, and there were also adhesions of the sac to the skin of the abdomen,

covering the lower part of the tibial muscles. This adhesion of the yolk-sac to the leg had apparently taken place after the full development of the limb; and the yolk-sac, in the course of its withdrawal into the cavity of the abdomen, had apparently drawn the foot in with it. The withdrawal of the yolk-sac is generally held to be brought about by the absorption of its contents; if the above explanation of the existing condition be correct, a considerable force must be exerted by this act of absorption if it is capable of dragging the foot, from its normal position, into the cavity of the abdomen.

E. WAYMOUTH REID.

St. Mary's Hospital, W., May 6.

Atmospheric Electricity.

I SEND you the following account of a curious, and, I believe, rare electrical phenomenon witnessed last week by a friend of mine and myself.

We had, in the course of a long mountain ramble, reached the summit of Elidyr Fawr (3033 feet), a mountain lying to the north-east of Llanberis, and about four miles north of Snowdon. Being a short distance in front of my friend, I sat down and rested with my back to the cairn, sheltering myself from a cold south wind which was blowing with considerable velocity. In about two minutes I heard a curious buzzing sound commence, apparently proceeding from the top of the post set up not long ago by the Ordnance surveyors. I had heard the same noise about three years ago while descending the *arête* of the Weisshorn, and on that occasion, as on this, there was a south wind blowing, accompanied by snow—on the Weisshorn in large flakes, on Elidyr Fawr in fine powdery flakes. On the Weisshorn, for above an hour every rock seemed to emit the peculiar buzzing noise, and our ice-axes did the same. We were in too great a hurry, however, to pay much attention to the phenomenon. A day or two after, I related my experience to a gentleman, Mr. Powell—who, I trust, will forgive me for mentioning his name—and learned from him that he had had a similar experience on the Unter-Gabelhorn, near Zermatt. The day was on that occasion, if I remember right, clear, when the noise was heard, followed in a short time by a flash, and a shout from two of the party that they were struck. No harm was done by the shock, but the sensation was described as being like that which would be felt if every hair of the head were caught hold of and violently twisted. Having heard the sound before, I readily recognized it on Elidyr Fawr, and resolved if possible to study the phenomenon more closely. I first climbed on to the cairn, and found that the sound proceeded from the whole surface of the wood for about two feet from the top of the post. I then raised my stick, which had an iron point, and found that the sound began to proceed from it directly a height of about six feet from the ground was reached. I then put my hand on the part emitting the sound, but could feel nothing. On putting my stick down, and keeping my hand up, the sound proceeded from my hand—from more or less of it according as I raised it higher or lower—and I imagined that on the back of my hand the sensation of being very slightly pricked in many places was perceptible. My friend was much impressed by the peculiarity and intensity of the sound, and agreed with me that it would not be wise to stay long. As we proceeded along the ridge, after a slight drop, we rose again, and while standing on some rocks, the noise began in our caps, accompanied by such an agitation of the hair that it quite seemed as if we had literally a "bee in the bonnet." There was no sound of thunder, and in the course of about half an hour the snow-storm passed away, not however before we had descended far below the enchanted summit.

C. A. C. BOWLKER.

Halo of the Moon and Formation of Peculiarly Shaped Clouds at Oxford.

I NOTICED the following very beautiful phenomenon on the night following May 8, and it seems to me worth recording. At 9.45 p.m. the moon was surrounded by a very large halo, the sky being quite clear in the immediate vicinity of the same, with the exception of a small accumulation of clouds at the lower part of the halo (to the left of the spectator).

At 10.45 the halo had completely disappeared, and a large cloud was obscuring it and the moon. The margin of the cloud was split up into tongue-like protuberances. At 11.20 the halo had again appeared, but it was not so bright; the moon was hidden from the spectator by some clouds.

At 11.30 the clouds had disappeared, and the moon was shining out brightly, but the halo was only very slightly visible, and that only at its highest point. Just before it began to disappear gradually, some of the clouds with the peculiar tongue-like protuberances already mentioned were formed, but they disappeared again after a few minutes. As was to be expected, we had rain on the following day, and some already during the same night.

I need only just mention that the halo is supposed to be produced by the refraction of light by crystals of ice. Brewster proved this by viewing the sun through some plate-glass on which he had allowed some alum to crystallize out in a thin sheet, when he saw a number of rings closely resembling halos.

OTTO V. DARBISHIRE.

Balliol College, Oxford.

Spherical Eggs.

THE problem of packing the greatest number of equal spheres into a given space, to which Prof. Aldis has drawn attention in your columns, is the simplest case of a more general problem which I have employed in my theory of crystallization (Cam. Phil. Trans., vol. xiv. part 3)—that is, the packing of the greatest number of equal and similar ellipsoids into a given space. The solution is that the ellipsoids should be arranged in a manner similar to that described for spheres by Profs. Aldis and Greenhill, so that every ellipsoid be touched by twelve others, and, further, that all the ellipsoids be similarly situated. The curious result comes out that so long as the ellipsoids are all similarly situated the orientation of the axes makes no difference in the number of them per unit volume. They may be turned about, provided they are all similarly turned, without affecting the ratio between the space filled by them and the unfilled space between them.

In the case of spheres, if tangent planes be drawn through all the points where the spheres touch one another, they will cut up space into regular rhombic dodecahedrons, every sphere being circumscribed by such a dodecahedron. Now, of plane-faced figures which can be described about a sphere and which will exactly fill space, the smallest in volume is the rhombic dodecahedron; hence the spheres arranged in the way described occupy the minimum volume. In like manner if tangent planes be drawn through all the points where the ellipsoids touch one another, they will divide space into dodecahedrons with quadrilateral faces, which will be unsymmetrical, but will be all similar and equal. If the ellipsoids be all turned in a similar manner the dodecahedrons will alter in form but not in volume. These dodecahedrons are the smallest which can be described about the ellipsoids consistently with the condition that they shall exactly fill space. The condition of similarity in the situation of the ellipsoids involves the consequence that, if we consider one ellipsoid and the twelve others which touch it, four planes can be drawn each passing through the centres of seven ellipsoids. The points of contact of the ellipsoids will lie in those planes, and the tangent planes through these points will be parallel to the diameters conjugate to those planes. Other geometrical properties follow which do not concern the present problem.

Cambridge, May 10. G. D. LIVEING.

Columnar Structure in Ice.

THERE are several notices in existence on the subject of the columnar structure of ice, to which attention has been called by Mr. La Touche (NATURE, May 9, p. 35). For instance, a letter by myself in the first volume of NATURE (p. 481), which contains references to sundry cases of the occurrence of the structure in Britain and in other parts of Europe, and offers a suggestion as to the cause. The structure may often be seen, if looked for, and is be t exhibited when a very gradual thaw follows a hard frost.

T. G. BONNEY.

SCARLET FEVER AND COW DISEASE.

FEW questions have within recent years more engrossed the attention of the veterinary and medical professions of this country, and have been the subject of greater or more acute controversy, than the relation of

human scarlet fever to cow disease. As is well known, the Medical Department of the Local Government Board, through the Reports of Mr. Power, Dr. Cameron, and Dr. Klein (1886), have brought forward a formidable array of facts, by which it was established that, in an epidemic of scarlet fever prevailing towards the end of 1885 in the north of London, the contagium was distributed through a milk supply derived from particular milch cows at a dairy farm at Hendon, which cows were affected with a specific eruptive and visceral disease—the Hendon disease. It was further shown (Report of the Medical Officer of the Local Government Board, 1887) that this cow disease is to be considered as cow scarlatina, and that both human and cow scarlatina are associated with and caused by a microbe, the *Streptococcus scarlatinæ*.

The veterinary profession, headed by the Agricultural Department of the Privy Council, have been foremost in the opposition to these statements. In the Report "On Eruptive Diseases of the Teats and Udders of Cows," issued towards the end of 1888 by Prof. Brown, the chief of the Agricultural Department, a superabundance of opinions were forthcoming, and, as often happens under the circumstances, fact has appeared for a while in danger of being smothered in the confusion engendered. But, happily, facts are stubborn things, and not easily stifled. However much trampled on, facts are ever prone to re-assert themselves and to multiply, and one result of the cow controversy has been that the recently issued Report of the Medical Officer of the Local Government Board gives promise of a new and abundant crop of them. The first subject bearing on this controversy and dealt with in the recent volume is the significance of the *Streptococcus scarlatinæ*. Many and various have been the assertions as to this microbe being an unessential concomitant of the disease. The experiments now made by Dr. Klein (Appendix B, No. 1, Section A.), with artificial cultures of the *Streptococcus scarlatinæ* on recently-calved milch cows, show that an eruptive and visceral disease is produced in these cows which closely resembles the Hendon disease, and consequently lend firm support to the view previously enunciated by the Medical Department that the *Streptococcus scarlatinæ* is the real microbe of scarlet fever.

Amongst a further array of facts therein marshalled, some that are historical obtain, in view of the cow controversy, fresh interest and importance. It is pointed out (Section B.) that, before the time of Jenner, "cow-pox" was the familiar name given to every sort of sore on cows' teats; that, with recognition by Jenner of a form of sore denominated by him *variolæ vaccinæ*, one particular cow-pox obtained the distinctive name of "true," while all others became designated as "spurious"; and that, except for Ceely's notable endeavours to obtain better knowledge, "spurious cow-pox," blister-pock, and the like vague terms continued to be used indifferently for all sores on the teats and udders that were not "true cow-pox." So the matter stood for eighty years, until at the Hendon farm a second definite member of this group was recognized by Mr. Power, when the old division into true and spurious cow-pox became manifestly insufficient. It was now seen that the name "spurious cow-pox" had in all probability been used to cover a variety of sores having essential differences in nature, just as, until the time of Jenner, the name "cow-pock" had covered along with various other things the disease which we know as vaccinia. But it is one thing to have learnt the essential nature of those sores of the cow that are concerned with vaccinia or scarlatina in the human subject, and quite another thing to affirm the distinguishing characters by which these may be recognized from other sores that once on a time laid claim to being equally with them "cow-pox" or "spurious cow-pox." It is very obvious, too, that our new discontent with the name "spurious cow-pox" does not at once give us knowledge of those sores which remain on the list, while it is equally clear that there are many kinds of such sores.

In these circumstances there was nothing to be done but to begin over again the study of cow-poxes with a view to learning of each one its complete natural history. And this has been the procedure of the Medical Department, with the result that a considerable instalment of positive knowledge respecting certain cow eruptions is afforded in the Report already referred to. When it is said that there was no alternative procedure to that adopted by the Medical Department, no more is meant than that from the scientific stand-point no alternative was possible. Other ways there were, of course, of dealing with the subject, as, for instance, in its "practical" or trade aspects, or from the sentimental point of view. That adopted by the Veterinary Department of the Privy Council is not easy of definition, but it may be described as a method of composite character by which uncertain science and excess of sentiment are oddly interjumbled.

It has consisted in flat denial of the possibility of cow scarlatina, along with reversion in the matter of cow-poxes to the attitude of the cow-man of pre-Jennerian days. Thus Prof. Brown, in the earlier pages of his Report in denial of cow scarlatina, speaks indifferently of "eruptive disease among cows," "udder disease among cows," "outbreaks of udder disease common as usual," "a very common eruptive affection which is usually called cow-pox by dairymen," and the like. And throughout his Report Prof. Brown studiously avoids giving a name to any udder disease or diseases with which he is dealing. Only once does his reader, when referred to Plate 4, at the end of Prof. Brown's volume, obtain hope of some definite nomenclature; but he turns to the plate in question only to be confronted with such terms as "blister-pock" and "blue-pock"—terms of the pre-Jennerian prototype. Having thus smoothed the way for discovery of a cow-pox (or "Hendon disease") not associated with scarlatina among consumers of the milk of the affected animals, Prof. Brown would seem to exercise almost superfluous caution in his phrasing of the following passage at p. vii. of his Report:—"Leaving for the present the subject of the original Hendon cow disease in 1885–86, it is necessary to refer to outbreaks of the same *or similar*[1] cow disease which occurred at Hendon and elsewhere in 1887–88." Be this as it may, he had of course no difficulty whatever in finding instances of one or another cow malady, which it pleased him to call "Hendon disease," not associated with scarlatina among persons consuming the implicated milk. This sufficed for Prof. Brown, and for a while, perhaps, he was altogether content.

But Prof. Brown's confidence in his own opinion, fortified as it had been by his failure in the early stage of his investigation to find any udder affection associated with illness of scarlatinal sort among consumers of the milk of the affected cows, was destined later on to receive somewhat rude shocks. Prof. McFadyean, a coadjutor of Prof. Brown's, having made discovery at Edinburgh of an udder malady associated with sore throat among persons consuming the milk of the cows affected by it, Prof. Brown, on personal examination of the Edinburgh cows, was constrained to admit for this disease clinical characters distinguishing it from any that he himself had been investigating, and pathological features very similar to those of the original Hendon disease.

Of this Edinburgh disease (the pathology and ætiology of which are described by Dr. Klein in Appendix B., No. 2) Prof. McFadyean notes that it "differed in every important respect from true cow-pox," and that (like the Hendon disease) "it did not cause sores on the hands of the milkers." Here, then, on the evidence of the Veterinary Department, was a cow malady that was not cow-pox,

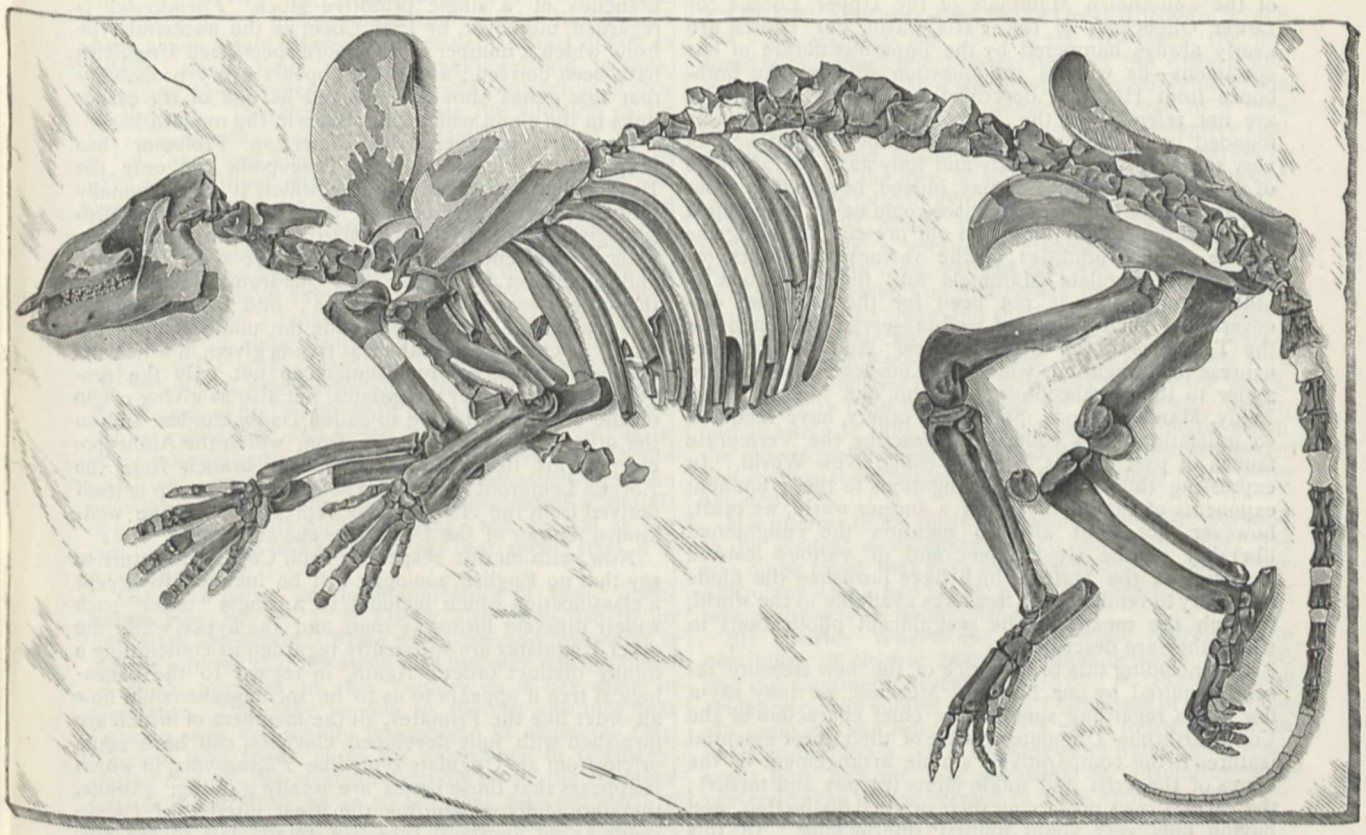
[1] The italics are ours.

that was not the "Hendon disease" of Prof. Brown, but which was associated with throat illness among consumers of the milk of the affected cows—just such a cow malady, in fact, as the Medical Department stated could have, and had, existed without recognition by veterinary surgeons.

SKELETON OF PHENACODUS.

ALL readers of the *American Naturalist* must be familiar with a striking woodcut of the entire skeleton of a peculiar fossil Ungulate, which occurs throughout a long series of numbers among the advertisements, and bears the following somewhat startling subscription, viz. "The five-toed horse—the ancestor of lemurs and man." This figure we are enabled, through the courtesy of Prof. Cope, to reproduce in the accompanying woodcut. The name given by its describer, Prof. E. D. Cope, of Philadelphia, to the animal of which the skeleton is so marvellously preserved, is *Phenacodus primævus;* the genus forming one of the best-known representatives of that very curious extinct group of generalized Ungulates for which the Professor has proposed the name Condylarthra.

Till quite recently those zoologists who have not enjoyed the good fortune of visiting the United States have been acquainted with this remarkable and unique fossil only by description and figures; the largest figure being the fine plate in Prof. Cope's magnificent quarto work on the "Tertiary Vertebrata of the West," published a few years ago by the United States Government among the Reports of the Geological Survey of the States. Some months ago, however, the Keeper of the Geological Department



The Skeleton of *Phenacodus primævus;* from the Wasatch Eccene of Wyoming. One-seventh natural size. (After Cope.)

of the British (Natural History) Museum entered into negotiations with Prof. Cope, to whom this priceless specimen belongs, with a view to obtaining a plaster model for exhibition in the palæontological galleries of the Museum. Fortunately these negotiations have been attended with success, and all students of Mammalian osteology ought certainly to pay a visit to the Museum in order to see this beautiful cast, which is now mounted in its place, and is, we will venture to say, of far more value to the student than many of the real but fragmentary fossil specimens for which large prices have been paid. We may indeed congratulate the popular Keeper of the Geological Department in not hesitating to pay what we believe was a somewhat heavy price for the acquisition of this cast.

No figures could, indeed, possibly give an adequate idea of the marvellous state of preservation of the original specimen; and we must confess that personally we totally failed to acquire a conception of the real size of the specimen till we were brought face to face with the cast.

The original slab was obtained some years ago by Mr. J. L. Wortman from the Wasatch Eocene of the Big-Horn basin in Northern Wyoming, and was subsequently transferred to the collection of Prof. Cope, of which it is one of the chief gems. The Wasatch beds, it may be observed, are low down in the Eocene, and when we consider that so many of even the Upper Eocene Mammals of Europe are known only by isolated and often imperfect skulls, teeth, or limb-bones, we are struck with the marvellous preservation of the American form. The dimensions of the slab are about 49 by 28 inches; and Prof. Cope describes the animal as intermediate in point of size between a sheep and a tapir. The animal lies on its right side, with the tail bent suddenly down behind the

posterior limbs, and the shoulder-blades thrown up from their proper position some distance above the line of the vertebral column. The skull is almost entire, and although the scapulæ are imperfect, and the right pectoral limb has sustained some losses, all the bones of the skeleton are in their original juxtaposition, so that we may note the arrangement of the bones of the carpus or tarsus almost as well as in the skeleton of a recent type. It strikes us, indeed, that it would have been quite easy to have extracted the skull and many of the bones of the limbs from the matrix, and made entire casts from them, which could have been placed in cavities in the cast from the original slab.

The chief importance of this and other American specimens of fossil Mammals belonging to totally extinct types is their completeness, whereby we are enabled at once to gain a very fair idea of the affinities of the animals to which they belonged. In Europe, with the exception of the well-known Mammals of the Upper Eocene (or Lower Oligocene) of the Paris basin, our efforts are nearly always hampered by the imperfect nature of our specimens—as witness the question whether the limb-bones from Hordwell described by Kowalewsky are or are not referable to the *Dichodon* of Owen, which was founded upon the evidence of the skull—so that we can very rarely speak confidently and fully as to the affinities of any particular form. It may, indeed, be stated, without any fear of contradiction, that we could never have hoped to have attained anything like our present knowledge as to the mutual affinities of the various sub-orders (or orders) of Ungulate Mammals and their relations to other groups, had it not been for the fortunate discoveries of such a host of well-preserved specimens in the Tertiaries of the United States. And we may here express the obligations which all European students are under to those palæontologists who, like Messrs. Cope, Leidy, Marsh, Osborn, Scott, and others, have laboured so indefatigably to collect and describe the Vertebrate faunas of past epochs in the so-called New World. In expressing thus briefly our obligations to these eminent exponents of the life-history of a former world, we must, however, not omit also to mention the enlightened liberality of the Government and of various learned Societies in the States, which have furnished the funds necessary to render these treasures available to the world, through the means of the magnificent publications in which they are described.

In concluding this brief notice of the new treasure recently aquired by our National Museum, we may say a few words regarding some of the chief characters of the Condylarthrous Ungulates. One of their most essential features is the comparatively simple arrangement of the bones of the wrist and ankle joints (carpus and tarsus); the various rows preserving their original distinction, and having only very slight mutual interlocking. In this respect, this group agrees with the existing Hyracoidea so closely that Prof. Cope has considered himself justified in brigading the two groups together under the common title of Taxeopoda. Usually the dentition comprises the full number of teeth found in those higher, or placental, Mammals in which the teeth are differentiated into groups; and very generally the cheek-teeth have their crowns formed on what is known as the bunodont type. That is to say, their crowns are low, and carry three or more low and blunt tubercles, as exemplified in the pig and in man. Further, the eye or canine teeth are well developed, and recall those of the Carnivora. Again, the humerus, or bone of the upper arm, has a foramen at its lower extremity, which is totally unknown in all other Ungulates, and likewise recalls the Carnivora and some of the lower orders. The digits are nearly always five in number, and their terminal joints are so pointed as frequently to render it difficult to say whether their coverings should be termed nails or hoofs. The femur, or leg-bone, has a third trochanter, like that of existing Perissodactylate Ungulates; and the ankle-bone, or astragalus, has its lower articular surface uniformly convex, instead of flattened or facetted as in all modern Ungulates. The astragalus and the wrist joint are, indeed, very similar to the same parts in the generalized Carnivora of the Eocene. The tail was larger and heavier than in any existing Ungulate, and was thus more like that of many Carnivora, such as the wolf. In walking, it appears that the three middle toes of each foot touched the ground, whilst the first and fifth toes stuck out on the sides and behind, after the fashion obtaining with the second and fifth toes of the pigs.

The curious approximation made in the osteology of this remarkable type of Mammal to the generalized Carnivora of the Eocene, to which Prof. Cope has applied the name of Creodonta, is so marked that Dr. Max Schlosser, of Munich, considers that we are now justified in regarding the Ungulates and the Carnivores as divergent branches of a single primitive stock. *Phenacodus* is regarded, moreover, by Prof. Cope, as the ancestral type from which a number of the more specialized Ungulates have been derived; and there appears every probability that this genus should be placed as one of the earlier links in the chain which culminates in the modern horse.

Recently, however, the American Professor has proposed to include in the Taxeopoda not only the Hyracoidea and Condylarthra (which it was originally formed to receive), but also the Primates of English zoologists, which it is proposed to divide into the Daubentoidea, represented by the existing aye-aye (*Chiromys*) and the extinct *Mixodectes*; the Quadrumana, embracing the other lemurs and monkeys; and the Anthropomorpha, which is taken to include the man-like apes and man. A complex genealogical tree is given, in which the *Phenacodontidæ* are represented as not only the progenitors of the other Ungulates, but also as giving origin on the one hand to the so-called Daubentoidea, and on the other to the Quadrumana, from which the Anthropomorpha are derived as a secondary branch from the Eocene Lemuroid *Anaptomorphidæ*, which group is itself derived from the *Adapidæ*, as represented by the well-known *Adapis* of the Upper Eocene of Europe.

Now, with all due respect to Prof. Cope, we venture to say that no English zoologist will be inclined to accept a classification which includes in a single "order" such widely different forms as man and the hyrax, while the other Ungulates are apparently regarded as constituting a totally distinct order. Again, in regard to the genealogical tree it appears to us to be incomprehensible how an order like the Primates, all the members of which are furnished with fully-developed clavicles, can have taken origin from an Ungulate type like *Phenacodus*, in which it appears that those bones are totally wanting. While, therefore, fully recognizing the great interest of *Phenacodus* as an ancestral type, we totally fail to see how it can also be regarded as the "ancestor of lemurs and of man." R. L.

THE IRON AND STEEL INSTITUTE.

THE twentieth session of the Iron and Steel Institute was opened on Wednesday, May 8, when the President, Sir James Kitson, gave his inaugural address, which was of a technical character, and was devoted mainly to the consideration of the best Yorkshire iron as an industrial product; but the subject of iron alloys, to which we shall refer again, the extending application of iron and steel for railways and ships, and other matters of interest, such as technical education and the revival of trade, were also referred to.

The first paper read was one on the alloys of nickel and steel, by Mr. James Riley. This led to a very lengthy and interesting discussion, from which it appeared, as has

often occurred in similar instances, that another metallurgist had been working in the same direction for a considerable time. The results obtained by Mr. F. J. Hall, of Messrs. Jessop's, of Sheffield, and Mr. Riley are very similar in character, but whilst the former appears to have made what may be called industrial experiments, those of the latter have been mainly confined to the laboratory. Nickel can be made to form an alloy with steel, in quantities varying from a hardly appreciable amount up to as much as 50 per cent.; the alloy does not require an excessively high temperature to melt it, special attention is not necessary in its production, the resulting metal is definite in character, and is easily worked both under the hammer and in the rolls. A very remarkable increase in the tensile strength and elasticity of steel is produced by alloying it with nickel. Among many tests given by Mr. Riley, the following specially referred to by him may be cited:—"In No. 6, the carbon present (0·22) is low enough to enable us to make comparison with ordinary mild steel, which would give (when annealed) results about as follows: elastic limit, 16 tons, breaking strain, 30 tons, extension 23 per cent. on 8 inches, and contraction of area 48 per cent. Therefore, in this case the addition of 4·7 per cent. of nickel has raised the elastic limit from 16 up to 28 tons, and the breaking strain from 30 up to 40·6 tons, without impairing the elongation, or contraction of area to any noticeable extent." In his remarks Mr. Hall referred to his applications of nickel steel to gun barrels, propeller blades, and other purposes during recent years, and concluded by observing that in an experiment he had made about twelve months ago, he had obtained with nickel steel a tensile strength of 97 tons per square inch, with an elongation of 7 per cent. Another important point with regard to nickel steel referred to by Mr. Riley is its non-corrosibility when the alloy contains 25 per cent. of nickel, for, with low proportions of nickel, ordinary mild steel and nickel steel appear to corrode in about the same proportion. In the discussion Mr. White (the Chief Constructor of the Navy) drew attention to the question of cost, as affecting the application of materials in practice, and with nickel at £224 a ton, or £56 as the cost of the nickel in a ton of 25 per cent. nickel steel, it is a consideration.

The next paper, on the manufacture of basic open-hearth steel, by Mr. J. H. Darby, also gave rise to an important discussion. From the paper and discussion it may be inferred that the basic steel industry has not made so much progress in this country as it has done in Germany. This may be due to the circumstance that German ores are mainly phosphoric in character (Mr. Thielen, who spoke as to his experience in Germany, stating that of the steel now produced in the Siemens furnace in Germany 70 or 80 per cent. was produced in the Siemens basic furnace), or to the "Batho type" of furnace used in this country being inapplicable to steel-making, an opinion expressed as well by the author of the paper as by speakers who followed him. Mr. Windsor Richards could not understand why they had gone away from the rectangular furnace of Sir William Siemens, and was pleased to say that since he had returned to it his difficulties had come to an end; whilst Mr. John Head, Mr. Frederick Siemens's representative, spoke of a new form of regenerative gas furnace, recently built and tried, which consumed about 50 per cent. less coal than the original regenerative gas furnace, and promised a paper on the subject for the autumn Paris meeting of the Institute.

A statistical paper on the progress made in the German iron industry since 1880 was read by Mr. R. Schroedter.

One on the influence of copper on the tensile strength of steel was read by Messrs. E. J. Ball and A. Wingham, in which the authors state that from a general consideration of the results of their experiments it would seem that within certain limits copper does not prejudicially affect the mechanical properties of steel. In this they agree with a theory brought by Prof. Roberts-Austen before the Royal Society last year to the effect that small quantities of a metallic impurity exert a deleterious effect on a large mass of another metal only if the atomic volume of the impurity is greater than that of the metal in which it is hidden. Mr. Bauerman, in discussion, expressed the opinion that it was not the copper, but the sulphur which generally came with the copper, that was injurious to iron.

The papers on universal rolling-mills for the rolling of girders and cruciform sections, by Mr. H. Slack, and on the Thomasset testing-machine, by M. Gautier, were mainly of mechanical interest. M. A. Pourcel read a paper on the application of thermal chemistry to metallurgical reactions.

ROBERT STIRLING NEWALL, F.R.S.

OBSERVANT travellers by the Great Northern Scotch express may see, as it nears Newcastle, the low dome of an astronomical observatory on the eastern side of the line. It is a spot which will be memorable in the history of astronomy, and it marks the home of a man who combined the practical sagacity and inventive skill which have made England the first industrial nation in the world, with the love of science which must be added to these if it is to hold its place.

Mr. Newall, whose death we chronicled a fortnight ago, was a successful manufacturer. When he was still a young man, a friend who was studying mining in Saxony informed him that cables made of iron wires were largely used there, but that the process of making them was "unmechanical," and suggested that he should invent a machine for the purpose. This he did, and wire ropes of his construction are now used all over the world. From time to time he improved on the original design, and so lately as 1885 he devised a new machine by which the rope is made at one operation, the double process of first making the strands and then combining them being avoided.

His interest in his business was not, however, confined to the gradual development of his earlier patents. He was quick to see that wire rope might help in solving the difficulties which had to be overcome before submarine telegraphy was an accomplished fact.

Sir Charles Wheatstone had clearly conceived the possibility of electric communication between England and the Continent as early as 1837. In 1840 he gave evidence on the subject before a Committee of the House of Commons, and references were made to his suggestion in the public Press. His drawings and notes show, however, how difficult the problems of insulating and preserving the cables seemed to these early pioneers.

The insulation was attained by the use of gutta-percha—of which Mr. Newall received a portion of the first sample transmitted to this country—but the cumbrous devices at first suggested for protecting the outer covering of the cable were forgotten when Mr. Newall proposed that the "gutta-percha lines containing insulated wire should be surrounded with a strong wire rope" (pamphlet by Mr. R. McCalmont, dated September 19, 1850).

The first cable, laid between Dover and Cape Grisnez, in which this plan was not employed, broke after one day. The first successful cable, which was laid on September 25, 1851, by Mr. Crampton, was manufactured by Mr. Newall, and protected by wire.

The submergence of cables in seas deeper than the English Channel presented greater difficulties, and the Newall drum-brake, which was introduced in 1853, and afterwards for a time abandoned, has since been again employed, so that, as Mr. F. C. Webb stated at the Institute of Telegraph Engineers in 1876, "we have come back to the old drum-brake of Newall."

Mr. Newall took an active part in superintending the actual laying of many cables, and on these occasions he showed the qualities of a leader of men—cool in an emergency, confident in his own resources, and undismayed in disaster. "Gentlemen, it's over now; ye may go to bed," was his only remark when a cable broke involving a loss of many thousands of pounds.

During the Crimean War he laid a wire insulated in gutta-percha without sheathing of any kind from Varna to the Crimea. It was run out over the stern through hand leathers held by the cable men in turn. He formed one of the boat's crew that left to seek help for the passengers of the P. and O. steamship *Alma*, wrecked in 1859 in the Red Sea.

But, during this busy life, Mr. Newall never allowed his love of pure science to be crushed by the weight of the practical affairs in which he was engaged. The success of submarine telegraphy was due to no one individual only, but to Mr. Newall belongs the credit of inaugurating a new era in the construction of refracting telescopes. He had long wished to possess a refractor of large dimensions, and in the Exhibition of 1862 he discovered two large disks of crown and flint glass, manufactured by Mr. Chance, of Birmingham. He at once saw that his opportunity was come, secured the glass, and placed it in the hands of Mr. Cooke, of York.

As the result of his boldness in risking a very large sum on an experiment the success of which was most uncertain, Mr. Newall carried, at one bound, the diameter of the largest object-glass from 15 to 25 inches. His observatory was a spot to which the most distinguished astronomers journeyed, and to which Profs. Newcomb, Holden, and Alvan Clark came as a deputation from the other side of the Atlantic.

Mr. Newall's original idea was to mount the telescope in the Mauritius, and spend as much time as possible there himself. This plan has never been carried out, and the great Newall refractor has never yet had a fair chance under the adverse skies of Newcastle. Almost his last act was to offer it as a gift to the University of Cambridge, and it is to be hoped that it may there add to the high scientific reputation that University has won.

To have established a new industry, to have taken an active part in securing a triumph of applied science which will modify the history of the world, and to have led the way in the development of the refracting telescope, is a record of achievement to which few attain, but which does bare justice to the life-work of Robert Stirling Newall.

NOTES.

THE Report of the Royal Commission appointed to consider the expediency of establishing a Teaching University for London, has been laid on the table of the House of Commons, and the Blue-book may be expected in the course of the next week. The Commissioners are agreed—first, that the petition of the Royal Colleges of Physicians and Surgeons to be authorized to grant degrees in medicine should not be entertained; secondly, that it is desirable that London should have a Teaching University. On the third point—whether a charter shall be granted to the associated Colleges of King's and University, constituting these Colleges the Teaching University of London—the Commission are divided. The three Commissioners connected with the teaching profession (Sir William Thomson, Prof. Stokes, and Mr. Welldon), are in favour of it; the three lawyers (Lord Selborne, Sir James Hannen, and Dr. Ball), are opposed to it. The Report ends with a request that this question be referred back to the Commission for their further consideration, in order that they may determine whether it is not possible to devise a scheme of common action between the two Colleges and the existing University of London.

PROF. STOKES will deliver the Rede Lecture on Wednesday, June 12, at 2 p.m., in the Senate House, Cambridge, the subject being, "Some Effects of the Action of Light on Ponderable Matter."

THE Museums and Lecture Rooms Syndicate, Cambridge, have been authorized to have quantities taken out and tenders invited for the proposed Anatomical and Physiological Buildings, in three distinct blocks.

MRS. DE LA RUE has presented to the Royal Institution the philosophical apparatus of the late Dr. Warren de la Rue. A fine portrait of Sir Humphry Davy has been presented to the same Institution by Mr. James Young, grandson of the late Dr. James Young, F.R.S., of Kelly, the former owner of the portrait.

THE Swedish Government has decided to send a man-of-war to New York to bring home the body of Captain Ericsson, who expressed a strong desire to be buried at Långbanshyttan, in Vermeland, the place of his birth. In his will no directions are given as to the disposal of his valuable collection of models, but Swedish journals state that the executors will present them to the Smithsonian Institution.

THE last mail from Bombay brings news of the formal opening, by Lord Reay, of the Jubilee Technical Institute in that city. The *Times of India*, commenting on this event, says it forms a notable landmark in the educational history of Bombay. That the Institute meets a public want is shown by the circumstance that it already numbers two hundred and forty students, while nearly half as many are awaiting nomination. The origin of the Institute is this. When Lord Ripon was about to leave India, a movement was set on foot to signalize his Viceroyalty by a memorial of some kind, and subscriptions were collected for the purpose. Soon after Lord Reay's arrival in Bombay there arose suggestions for the formation of a technical school. The Government in January 1887 promised a grant of 25,000 rupees annually, and recommended to the Municipal Corporation of Bombay that 80,000 rupees which they proposed to devote to commemorating the Jubilee of the Queen's reign should be devoted to the founding of a technical institute. The other funds were amalgamated with this, and a Board of management was formed; but still the funds were found insufficient, until at last the munificence of Sir Dinshaw Petit came to the rescue. He presented the Board with a noble building, and work began at once, and the formal official opening took place recently, although, in fact, the Institute has been open for several months. The immediate and signal success of the Institute Lord Reay attributes in no small measure to the fact that in starting the movement its originators did not allow themselves to yield to the demand for a programme.

THE Upsala University and the Swedish Geographical Society have sent Dr. Carl Forsstrand to study the marine fauna of the West Indian Islands during the present summer.

THE Indian papers report the death from cholera, at Rangoon, of Dr. Robert Romanes, Professor of Science in the Rangoon College, and Chemical Examiner to the Burmah Government.

IN the horticultural part of the Paris Exhibition there are some splendid beds of Darwin tulips in full bloom. The flowers are magnificent, and a *sergent de ville* keeps watch over them—an unusual proceeding in France, where flowers are never in ordinary circumstances stolen from public gardens. Unfortunately the presence of an unusual number of foreigners makes this precaution necessary. In the same part there is a very curious exhibit of Japanese horticulture. It consists of a

number of specimens of dwarfed trees—trees which are usually tall, but in the present case hardly attain the height of 2 or 3 feet. This exhibit excites much interest among gardeners.

ZOOLOGISTS will be interested in the exhibit of the Principality of Monaco at the Paris Exhibition, as all the implements used by the Prince in his dredging experiments are to be shown, with numerous specimens of deep-sea fauna. The exhibit of the results of the *Talisman* researches will unfortunately be scanty.

LAST week, Mr. Ralph Moore, Inspector of Mines for the Eastern District of Scotland, on his retirement from that post, which he has held for twenty-seven years, received a farewell present from a number of gentlemen connected with the Scottish coal and iron trades. In thanking the donors, Mr. Moore gave some interesting details of the improvement in mining appliances since he first was a colliery manager, forty-eight years ago. At that date, he said, there were cages at two or three collieries in the county of Edinburgh, but there was none in Lanarkshire. The coals were all drawn in corbes. A few years after, there was not a single colliery without them. Pug engines were first introduced about 1845. Ventilating furnaces were of the most primitive description. Fans were unknown. The first fan in Scotland was put up in 1868; now there were hundreds, and scarcely anyone thought of doing without a fan. The amount of ventilation in a colliery was from 8000 or 10,000 down to as low as 1000 cubic feet per minute, and now there were some collieries in the district with 250,000 cubic feet per minute. Last year he made the calculation that eight tons of air were sent into the mines for every ton of coals extracted. Wire ropes were not in use at the time of which he spoke; now there was nothing else. Underground mechanical haulage was practically unknown; now it was universal. Many large collieries had only one shaft, now all had two. A coal-owner putting out 100,000 tons a year was a large coal-owner. There were coal-owners now putting out over 600,000 annually. As a consequence of all these improvements, the output of minerals in the district, which in 1856 was 4,500,000 tons, was now 17,000,000 tons, and the death-rate, which in 1853 was one for every 250 persons employed, is now about one in 800.

IN connection with the Congress of German Anthropological Societies, which is to meet this year at Vienna, a large exhibition of prehistoric objects is being formed. All the smaller public collections and the most important private ones of Austria will be represented.

SIR W. BRANDFORD GRIFFITH, Governor of the Gold Coast, has reported to Lord Knutsford the occurrence of a smart shock of earthquake at Accra on April 5, at 12.2 noon. The seismic wave seemed to run from south to north, and was felt at Aburi, twenty-six miles to the northward of Accra. Sir W. B. Griffith had not heard of any serious damage being caused in the colony, nor, so far as he could hear, was the earthquake felt at sea or at Addah. Christiansborg Castle, the Government House at Accra, was once laid in ruins by an earthquake.

EARTHQUAKES still continue in the neighbourhood of Vyernyi in Turkestan. On February 19, at 3 p.m., an earth-tremor was felt after a fortnight of absolute rest. The shock was quite isolated, and lasted but a few seconds. Another slight shock was felt during the night, at 2 a.m. On February 25, at 11 a.m., a noise like that of a discharge of a battery of guns was heard, and the soil was set in motion for about three seconds. Many houses cracked, but there was no loss of life.

La Nature of April 27 contains a representation, by photo-lithography, of an interesting synoptic table of weather prediction, by MM. Plumandon and Colomès, whereby anyone may find mechanically the probable weather, by observing the direction of the wind, as based upon fourteen years' observations at the Puy-de-Dôme Observatory. The table from which the representation is reduced, is printed in six colours, and is divided into eight sectors corresponding to the principal directions of the wind, and comprising 216 weather conditions. A movable indicator, with three arms, works upon a pivot; one arm being moved to represent the wind direction as shown by the clouds or a good wind-vane, the others then point to the region of lowest barometer, and to the probable weather, indicated by one of the cases referred to. These conditions are contained in a few words, and differ for each season of the year, and for different states of the barometer, *e.g.* high, low, &c. The principle involved is merely an application of the rule known as Buys Ballot's law: "Stand with your back to the wind, and the barometer will be lower on your left hand than on your right," combined with the experience gained in weather prediction during the last thirty years. A card somewhat similar in principle was published some years ago by the late F. Pastorelli. Persons unable to consult daily weather charts may find the diagram very useful.

IN a private letter recently received from Dr. Macgregor, the Governor of British Guinea, an interesting account of his trip in the *Hygeia* through the Louisiade Archipelago and the adjacent groups of islands is given. He found them, he says, all thickly inhabited, the natives being in thousands, and in many cases very wild—so wild, in fact, that he thinks it probable they had never seen a white man before. On some of the islands he found hot mud-springs, some of them being strongly impregnated with sulphur. Gold was found on many of the islands, but in no instance was it in payable quantities.

ACCORDING to *Allen's Indian Mail*, the Madras Museum now possesses the skeleton of the largest elephant ever killed in India. This elephant was the source of great terror to the inhabitants of South Arcot, by whom it was killed and buried. The Museum authorities despatched a taxidermist to the spot to exhume the bones and transfer them to Madras. The skeleton is exactly 10 feet 6 inches in height, being 8 inches higher than the highest hitherto measured in the flesh by Mr. Sanderson.

MR. LESTER WARD has recently claimed an American origin for the entire genus Platanus, of which the plane and the sycamore are the best-known species. It occurs abundantly, however, in these isles, in the Lower Eocenes of Mull, Reading, and the Middle Eocene of Lough Neagh, the former being probably at least as old as the beds in which it makes its earliest appearance in America. It probably came into existence in the Old World in late Cretaceous times.

DR. MARION describes, in the *Annales des Sciences Géologiques*, a new conifer, having the foliage of Araucaria with the cones of Dammara, and therefore an essentially Australasian type, which only became extinct in France in the Miocene. The material is so perfect and ample that very little more would remain to be learnt about it, were it still living. The same, or a nearly allied, species abounded in the Isle of Wight in the Oligocene. In outward form the tree must have resembled Cryptomeria.

THE May number of the *Kew Bulletin* opens with an interesting account (with plate) of the Persian dye plant *Zalil*, prepared by Sir Joseph Hooker for the April number of the *Botanical Magazine*. This is followed by an account of Tasmanian woods, some curious details as to lily flowers and bulbs used as food, a paper on Pu-êrh tea, an account (with plate) of the short-podded yam-beam, and a list of the staffs of the Royal

Gardens, Kew, and of botanical departments and establishments at home, in India, and in the Colonies, in correspondence with Kew.

In his Report for 1888, just issued, the librarian of the Mitchell Library, Glasgow, notes, for the third year in succession, a decrease in the number of volumes issued to readers. This is believed to be mainly due to the fact that the rooms are not nearly large enough to provide accommodation for those who wish to use the library. Even now, notwithstanding the decrease of attendance, the rooms are often inconveniently crowded. It seems strange that in a wealthy and intelligent city like Glasgow there should be the slightest difficulty about the provision of a proper building for so good a collection of books—a collection which, according to the librarian, "is becoming year by year richer in all departments of literature, better fitted to supply the wants of every student and every reader."

The Burton-on-Trent Natural History and Archæological Society have begun to issue "Transactions"; and if we may judge from the first volume, which we have just received, succeeding volumes are likely to contain a good deal of interesting work. The most important paper in the present volume is a Report, by Mr. John Heron, on certain explorations carried on at Staplehill in 1881, under the auspices of the Society. In the course of these explorations the remains of upwards of thirty-six human bodies were found, accompanied in some cases by personal ornaments, small iron knives, or weapons of a kind which showed that the ground had been a burial-place of the English in pagan times. The various "finds" are clearly described by Mr. Heron, whose paper is admirably illustrated by a frontispiece and ten plates.

The third chapter of the revised edition of Dr. Elias Loomis's "Contributions to Meteorology" has been issued. In this chapter the author deals with the mean annual rainfall for different countries of the globe; describes the conditions favourable, and the conditions unfavourable, to rainfall; examines individual cases of rainfall in the United States, in Europe, and over the Atlantic Ocean; and defines the areas of low pressure without rain. Many valuable plates accompany the text.

The May number of *Himmel und Erde* (Berlin) opens with an interesting description of the Lick Observatory, and an account of its foundation by the Director, Prof. Holden. The article is illustrated by a view of the giant refractor and the interior of the Observatory, the presence of three of the observers serving to give an idea of the immense size of the instrument. Dr. Mohn continues his account of the Norwegian North Sea Expedition, and Dr. Wagner concludes his article on the Krakatão eruption. Other articles and astronomical data for the month are also given.

The new number of the *Folk-lore Journal* (vol. vii. part 2) contains an interesting paper, by Mr. John Abercromby, on the beliefs and religious ceremonies of the Mordvins, a people of Finnish descent inhabiting parts of Central Russia, who were pagans up to the beginning of the present century. The paper gives their conception of the Deity, a list of the various objects of worship, their account of the creation and the fall of man, and descriptions of their feasts and sacrifices. The paper is one of considerable length. Mr. Edward Clodd follows up his recent paper on "The Philosophy of Punchkin" by a similar one called "The Philosophy of Rumpelstiltskin," the latter being a generic title derived from the character in Grimm's well-known *Märchen*. An interesting bibliography of variants of the tale is appended. Students of folk-lore anxious to aid the Society by practical work will be glad to have their attention attracted to the appeal of the Council for volunteers to tabulate certain works which are mentioned, the method of tabulation being shown at the end.

Messrs. Smith, Elder, and Co. have issued a new edition of "Wild Life in a Southern County," one of the finest of the late Mr. Richard Jefferies's writings.

At a recent meeting of the Linnean Society of New York City, Dr. G. B. Grinnell read an instructive paper upon the Rocky Mountain goat (*Mazama montana*). The limits of the range of this animal have never been fully defined by any one writer. It is a mammal belonging to the Arctic fauna, and only found among the high and rugged mountains of the Rockies and Coast Range, where the snow lies all the year. The centre of its abundance seems to be in Western Montana, Idaho and Washington Territories, and British Columbia, and it has been found from about latitude 44° to about latitude 65°; its southernmost records being on the highest peaks of the Sierra Nevada, near Mount Whitney. This goat is in no immediate danger of extermination, as it inhabits the most inaccessible localities, and has few natural enemies.

Uric acid has been synthesized by Drs. Behrend and Roosen, of Leipzig, in a manner which completely settles the question of its constitution. A few months ago a synthesis of this important natural compound was effected by Horbaczewski, by fusing together glycocine, $CH_2.NH_2.COOH$, and urea, $CO(NH_2)_2$. High temperature reactions, however, are never satisfactory as indicating the constitution of organic compounds, inasmuch as there is always a possibility of inter-molecular change. Hence a new mode of synthesis at lower temperatures has been devised by the Leipzig chemists, and carried out in an admirable manner, every stage being most critically investigated so as to be absolutely certain of the constitution of the intermediate compounds. The process consists of seven stages:—(1) The substances started with are aceto-acetic ether, $CH_3.CO.CH_2.COOC_2H_5$, and urea, $CO(NH_2)_2$. These two compounds combine together with elimination of water, forming an ether of crotonic acid in which one of the hydrogen atoms is replaced by the radical of urea,

$$NH_2.CO.NH-C(CH_3)=CH-COOC_2H_5$$

(2) This substance on saponification with caustic potash yields the potassium salt of the corresponding acid. The free acid itself readily splits off water, forming the anhydride,

$$CO(NH-C(CH_3)=CH-NH)CO$$

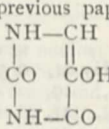
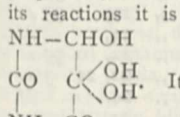
, methyl uracil, as it is termed. (3) On treatment with fuming nitric acid, the CH_3 of methyl uracil becomes oxidized to the acid radical, COOH, a nitro-group, NO_2, being simultaneously introduced,

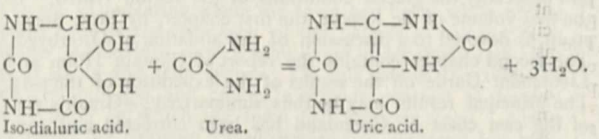
$$CO(NH-C(COOH)=C(NO_2)-NH)CO$$

. (4) On boiling this nitro-acid with water, a molecule of carbonic anhydride is eliminated, leaving a substance termed nitro-uracil,

$$CO(NH-CH=C(NO_2)-NH)CO$$

. (5) On reduction with zinc and hydrochloric acid, nitro-uracil yields iso-barbituric acid—a compound which has been shown

in a previous paper of Dr. Behrend's to possess the constitution  (6) By oxidation of iso-barbituric acid with bromine water another acid is obtained, which is found to be isomeric with dialuric acid, but differs entirely from that acid in properties; it is therefore termed iso-dialuric acid. From its reactions it is shown to correspond to the constitution  It crystallizes in long rhombic prisms containing a molecule of water of crystallization, which it loses at 100° C. The yield is very good, 80 per cent. or more of the theoretical. (7) It now only remains to mix this iso-dialuric acid with one equivalent of urea and six equivalents of sulphuric acid, the latter to take up three molecules of water which are eliminated in the reaction between the two former substances. The reaction is complete in the cold in twenty-four hours, or in five minutes if the mixture is gently warmed upon a water-bath. On cooling and adding water, uric acid is precipitated in small crystals, which, on purification, exactly resemble those of natural uric acid. The equation is very readily understood, there being a simple combination of iso-dialuric acid and urea with formation of uric acid and elimination of three molecules of water—



Iso-dialuric acid. Urea. Uric acid.

Hence the formula of Medicus and Fischer for uric acid may now be considered as finally proved.

THE additions to the Zoological Society's Gardens during the past week include a Purple-faced Monkey (*Semnopithecus leucoprymnus*) from Ceylon, presented by Mr. J. H. Taylor; a Vervet Monkey (*Cercopithecus lalandii* ♂) from South Africa, presented by Dr. W. K. Sibley; an Otter (*Lutra vulgaris*) from Cornwall, presented by Mr. Basset; a Long-eared Owl (*Asio otus*), British, presented by the Hon. Eric Thesiger; a Herring Gull (*Larus argentatus*), British, presented by Mrs. Gainsford; a Yellow-billed Amazon (*Chrysotis panamensis*) from Panama, presented by Lord William Cecil; two Common Kestrels (*Tinnunculus alaudarius*), captured at sea, presented by Captain Janes; two Common Rheas (*Rhea americana*, juv.) from Uruguay, presented by Mr. J. D. Kennedy; a Black Swan (*Cygnus atratus* ♂) from Australia, presented by Mrs. Siemens; a Long-eared Owl (*Asio otus*), British, presented by the Rev. F. Hopkins; two Natterjack Toads (*Bufo calamita*), British, presented by Master H. Millward; two Natterjack Toads (*Bufo calamita*), British, presented by Master A. Smith; a Bonte-bok (*Alcelaphus pygargus* ♂) from South Africa, deposited; a Squacco Heron (*Ardea ralloides*) from South Europe, three Japanese Teal (*Querquedula formosa* ♂ ♀ ♀), from North-East Asia, an Amherst Pheasant (*Thaumalea amherstiæ* ♂), from Szechuen, China, purchased; two Moor Harriers (*Circus maurus*) from South Africa, received in exchange.

OUR ASTRONOMICAL COLUMN.

THE RESIDUALS OF MERCURY.—In a recent discussion of the perturbations of Mercury (*Astronomical Journal*, No. 191, April 15, 1889), Mr. O. T. Sherman has arrived at some important and highly suggestive results relating to the residuals. His method of determining these appeared in No. 173 of the *Astronomical Journal*, and this process has been employed in obtaining the data given in the article referred to. The values arrived at show a remarkable relation to the heliocentric latitude of the planet, the maximum effect being nearer the solar equator, and the effect decreasing as the latitude increases. Since the lower latitudes correspond to maximum and the higher ones to minimum solar activity, the apparent connection of the disturbances of the planet with solar phenomena should also bear some relation to the sun-spot period, and Mr. Sherman gives figures to show that this is the case. The chief disturbances occur in the years when the sun-spots are increasing in frequency, and it is pointed out that this result is in strict accordance with the retardations of Encke's Comet during perihelion passage.

It is further stated that "the forces deflecting the planet are sunward when the planet is in that part of space towards which the sun is travelling, and away from the sun when the planet follows in his path." This, taken in conjunction with the disturbances of Encke's Comet, seems to Mr. Sherman "to indicate a considerable amount of matter coming to the sun from space. If so, its place of meeting with the matter coming from the sun should abound in collisions, and display local spectra showing bright lines. Our knowledge of the zodiacal light is fully in accord with such a supposition."

If the more detailed investigations of the residuals, which it is intended to make when more observations have been collected, confirm the results already obtained, we may look for a considerable advance of our knowledge, especially of the nature of the solar surroundings. Already the residuals clearly admit of explanation by supposing that the sun, with its meteoritic surroundings, in the form of the corona and the zodiacal light, is moving with considerable velocity through a meteoritic plenum. In that case the planet would encounter most meteorites when on the advancing side of the sun, and it would obviously be more retarded there than elsewhere.

The apparent relation to the sun-spot period is of great interest in connection with the meteoritic theory of the formation of sun-spots. According to this theory, there should be most meteorites in the solar surroundings at maximum spot period, and greater disturbances of the planet at that period would therefore be expected. The collisions between the two sets of meteorites would further produce the spectroscopic phenomena associated with the zodiacal light—namely, the appearance of a line near wave-length 558, which has been ascribed to manganese. It seems probable that the variability of this spectrum which has been suspected by Mr. Sherman (letter to Mr. Lockyer, quoted in Roy. Soc. Proc., vol. xlv. p. 248) may also subsequently be shown to be connected with the sun-spot period.

RIGHT ASCENSIONS OF NORTH CIRCUMPOLAR STARS.—Prof. T. H. Safford, Field Memorial Professor of Astronomy at Williams College, Mass., has just published a very useful piece of work in the shape of a Catalogue of North Polar Stars. This Catalogue, which is a first instalment of a more extensive one, the observations for which are now in progress, has been constructed by Prof. Safford in order to strengthen what he felt to be the weak point of all the standard Catalogues, viz. the right ascensions of Polar stars. It was also a consideration with him that it would be easier to take account of instrumental corrections if a more extended list of Polars were generally used than has been the custom. These stars are also of importance in the study of proper motions, since their early observations are accurate.

The observations for this Catalogue were made at the Field Memorial Observatory, and not at the Hopkins Observatory of Williams College, and the meridian circle with which they were made was a fine one of 4½ inches (French) aperture, by Repsold. The observations were made at first by eye and ear, but a fillet chronograph was used in 1887 and 1888. Prof. Safford's intention throughout was to make his Catalogue a differential one; the stars he has relied upon for his instrumental corrections, being those of Publication 14 of the Astronomische Gesellschaft, which lie within 10° of the Pole. Besides the catalogue itself, which contains 261 stars, of which just 200 are within 10° of the Pole, a very important part of the work is the discussion of the right ascensions, with a view to clearing up certain points as to mode of observation, as well as to find the weights and systematic corrections necessary for combining this series with others. The result of this discussion is to show that it tends to greater accuracy to base a catalogue of Polar R.A.'s on standard places in all hours of right ascension rather than on double transits alone; that the eye-and-ear method should be used as the stan-

dard only near the Pole; and that a thorough comparison of it with the chronographic method through a wide range of magnitude and declination is desirable; that modern meridian instruments are subject to irregular small changes of position which are not direct functions of temperature; and that, therefore, it is well not to trust the instrumental zero points for more than two hours without re-determining the most essential.

Prof. Safford is at work on a paper, now well advanced, on the proper motions of the stars within 10° of the Pole, and he hopes shortly to complete the comparison of the chronographic and eye-and-ear methods which the present discussion had shown him to be needed.

Two Remarkable Solar Eruptions.—Father Jules Fényi, of the Kalocsa Observatory, records, in a note to the Paris Academy of Sciences, his observation of two remarkable solar eruptions which he observed on September 5 and September 6, 1888. Both eruptions would have been remarkable had they occurred at a time of maximum activity; but, coming as they did nearly at dead minimum, they stand out as most unusual. The first prominence was seen to rise from a height of 25″, as seen at 6h. 6m. (Kalocsa M.T.), to 151″·4 at 6h. 19m., its speed of movement attaining at one time 171 kilometres per second. A number of brilliant metallic lines were seen, some so bright that, with a wide slit, they showed as a small prominence, reaching 19″ in height on 1474 K and 15″ on the D lines. The second eruption was seen eighteen hours later, on September 6, at 11h. 45m., and was even more violent. In 6½ minutes it mounted from 37″ to 158″, with a speed at one time of 296·8 kilometres per second. It was of dazzling brilliance whilst it lasted, but passed away in about 14 minutes. The two eruptions were nearly but not quite in the same heliographic latitude. The first was on the east limb in S. lat. 18°; the other was distant some 4½°, and, as the base of each was about 3° in length, they could not have overlapped, and if connected in origin, must have sprung from a deep-seated source.

Comet 1889 *b* (Barnard, March 31).—This object is now too near the sun for observation, but accepting the elements of its orbit as hitherto determined, it will not travel far from its present position for some time to come. Dr. Krueger gives its position for Berlin midnight (*Astr. Nach.*, No. 2893) for the end of May and beginning of July as under, but with reserve from the uncertainty of the elements:—

1889.	R.A. h. m. s.	Decl. ° ′	Log Δ.	Brightness.
May 28	5 6 52	14 13·1 N.	0·5099	0·71
July 3	5 9 8	12 19 0 N.	0·4944	0·76

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 MAY 19–25.

(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 19

Sun rises, 4h. 4m.; souths, 11h. 56m. 15·8s.; daily increase of southing, 2·8s.; sets, 19h. 48m.: right asc. on meridian, 3h. 45·6m.; decl. 19° 52′ N. Sidereal Time at Sunset, 11h. 39m.

Moon (at Last Quarter on May 21, 22h.) rises, 23h. 50m.*; souths, 3h. 50m.: sets, 7h. 53m.: right asc. on meridian, 19h. 37·9m.; decl. 22° 25′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m.	° ′
Mercury..	4 57	13 29	22 1	5 18·2	25 27 N.
Venus ...	3 0	10 12	17 24	2 1·5	13 8 N.
Mars ...	4 25	12 30	20 35	4 19·2	21 53 N.
Jupiter ...	22 48*	2 44	6 40	18 32·1	23 0 S.
Saturn ...	9 42	17 19	0 56*	9 9·3	17 35 N.
Uranus ...	15 48	21 18	2 48*	13 9·0	6 38 S.
Neptune..	4 24	12 11	19 58	4 0·4	18 59 N.

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

May.	h.	
20	12	Venus stationary.
23	3	Neptune in conjunction with the Sun.
24	19	Mercury at greatest elongation from the Sun, 23° east.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·5	81 17 N.	May 21,	0 50	*m*
R Persei	3 23·0	35 18 N.	,, 19,		*M*
U Monocerotis ...	7 25·5	9 33 S.	,, 21,		*M*
S Leonis	11 5·1	6 4 N.	,, 22,		*M*
S Boötis	14 19·2	54 19 N.	,, 21,		*M*
R Boötis	14 32·3	27 13 N.	,, 23,		*m*
δ Libræ	14 55·1	8 5 S.	,, 20,	22 59	*m*
U Coronæ	15 13·7	32 3 N.	,, 19,	1 35	*m*
R Draconis	16 32·4	66 59 N.	,, 24,		*M*
U Ophiuchi... ...	17 10·9	1 20 N.	,, 22,	0 55	*m*
			,, 22,	21 3	*m*
T Herculis	18 4·9	31 0 N.	,, 24,		*M*
R Lyræ	18 52·0	43 48 N.	,, 21,		*m*
U Aquilæ	19 23·4	7 16 S.	,, 25,	2 0	*M*
η Aquilæ	19 46·8	0 43 N.	,, 21,	0 0	*m*
T Vulpeculæ ...	20 46·8	27 50 N.	,, 21,	22 0	*M*
T Cephei	21 8·1	68 2 N.	,, 19,		*M*
δ Cephei	22 25·1	57 51 N.	,, 25,	0 0	*M*

M signifies maximum; *m* minimum.

GEOGRAPHICAL NOTES.

In the new number of *Petermann's Mitteilungen*, Dr. Rink describes the recent Danish researches in Greenland, especially those carried out in East Greenland under the leadership of Captain Holm. The aim of the expedition was mainly antiquarian and ethnological; at the same time the report of its work contains valuable observations on the geology, geography, and especially the glacial conditions of the region visited. In the first volume of the Report, the first chapter, by Prof. Steenstrup, is devoted to a discussion of the situation of Osterbygd. The second chapter contains the report of Captain Holm and Lieutenant Garde on the results of the expedition of 1883–85. The principal results may be thus summarized:—Graah's map of the east coast of Greenland has been corrected and completed; a map has been prepared of a part not previously surveyed, and now named Christian IX. Land; and, after sketches and information from the natives, the outline of the coast has been continued from 66° to 68½° N. lat. It was found that the country called after Christian IX. was inhabited by a branch of the Eskimo which, before the arrival of the expedition, had not been in contact with Europeans. Detailed observations have been made on their mode of life, their customs, language, legends, &c., and a large collection made of articles of ethnological interest. During the various journeys of the expedition, and especially in their winter quarters, systematic researches were made in the physical geography of the country. Geological and botanical observations were made and specimens collected along the east coast. It was found that the east coast of Greenland is not so inaccessible as has hitherto been supposed. The expedition explored the east coast as far to the north as it was at all likely Osterbygd could have been located, without discovering the least trace of buildings which were not of Eskimo origin, and without finding anything in the physiognomy, the customs, mode of life, or legends of the natives that could furnish the slightest ground for inferring former relations with Europeans. From this it is concluded that Osterbygd could not have been situated on the east coast of Greenland. The third chapter deals with the geography of Danish East Greenland, *i.e.* as far as 66° N. This part of the east coast is divided into five natural zones—(1) the most southerly part as far as Anarket; (2) from Anarket to Ikermiut; (3) from Ikermiut to Igdlolnarsuk; (4) from Igdlolnarsuk to Inigsalik; (5) the section which extends to the east of the last-named place. Zones 1, 3, and 5 have strong resemblances with each other, as also zones 2 and 4. The three first-mentioned zones are cut by deep fjords, crowned with lofty serrated mountains, never covered by the continental ice. Some places are characterized by a vegetation comparatively rich. Beneath the mountains there are, in general, numerous glaciers, which often descend to the fjords, and towards the interior is found a mountainous region filled with large local glaciers. Zones 2 and 4 have a different aspect. The country is very barren, and the continental ice descends almost directly to the sea, or to the edge of the fjords, only a few mountains or rounded groups of mountains emerging from the ice. Another characteristic of the east coast is the parallelism of

most of the fjords in an E. ¼ S. direction, as compared with the south-west direction of the fjords on the west coast.

THE new number of the *Mitteilungen* also contains a map of the flora of Schleswig-Holstein, with accompanying text by Dr. Ernest Krause, and an account of a journey to the sources of the Tigris by Prof. Wimsch.

THE paper read at Monday's meeting of the Royal Geographical Society was by Mr. J. R. Werner, on his journeys up the Ngala and Aruwimi tributaries of the Congo. The Ngala enters the Congo a little south of 2° N. lat., coming from a generally north-east direction. A little above its junction with the Congo is a channel through which the waters of the latter flow into the Ngala. For a considerable distance the banks of the river are low, swampy, and forest-clad. Gradually hills appear, and latterly bluffs, between which the channel narrows considerably. In May of last year, Mr. Werner accompanied the steamer to the Aruwimi, which was taking the men to Major Barttelot's camp at Yambuya. He was surprised at the number of sand-banks on the lower river, and the difficulties of navigation. After passing the town of Mokulu, the whole character of the country seemed to change, the islands stood higher out of the water and were covered with forest, which was crowded with palms, the crowns of which looked very pretty above the trees. The high banks on either side were lined with villages, or rather the sites of former villages, for the Arabs had been raiding here, and the natives were now living under roughly put-up sheds of leaves and sticks ; the conical huts described by Stanley had almost entirely disappeared, and during the time Mr. Werner was on this river he only saw six, four of which were inside Major Barttelot's camp at Yambuya, and the other two in the village of Irungu. On the high bluff on which Stanley had found the large town of Yambumba, there was not a single hut on the vast clearing where the town had been, while on the opposite bank of the river such of the natives as had not been killed or carried into slavery were living under sheds and awnings of sticks and palm-leaves. On this side of the river the bank was quite low, and offered a strange contrast to the precipitous bluff on which the town had formerly stood. Above Yambumba the Aruwimi runs between two ridges of low hills, which are covered with magnificent timber. There are no more villages on its banks until Yambuya is reached.

AFTER the reading of Mr. Werner's paper at the Geographical Society, there was a discussion on the letter from Mr. Stanley which was read at the previous meeting. In this discussion Sir F. De Winton, Sir Samuel Baker, Colonel Grant, Rev. Horace Waller, and others took part. Sir Samuel Baker's statement was of considerable geographical interest. Against Mr. Stanley's doubts, Sir Samuel maintained the accuracy of his original observations as to the southward extension of Lake Albert Nyanza. He pointed out that Mr. Stanley himself refers to the very marked decrease in the size of the lake in the last few years, a decrease quite analogous to that which has taken place in Lakes Tanganyika and Nyassa. This decrease has no doubt tended to diminish the southern extension of the lake, and bring to light the vast extent of Ambatch or Sud which Gessi and others refer to. Sir Samuel maintains, moreover, that it will most probably be found that the two lakes (Albert Nyanza and Mutta Nzigé) are really one, and are known among the natives by one name. The region which lies between them on our maps has never been visited by any European explorer. Sir Samuel pointed out the vast importance to Egypt of a precise knowledge of the laws which govern the increase or decrease of water in the Albert Nyanza, which is really one of the great sources of supply for the regions on the lower river.

IN the May number of the *Scottish Geographical Magazine* will be found a very complete account of Samoa and its people by Dr. G. A. Turner, who has lived many years on the islands.

THE town Kara-kol, on Lake Issyk-kul, has received the official name of "Prjevalsk" in commemoration of the explorer of Central Asia.

A GEOGRAPHICAL expedition, under the two brothers Grum-Grzimailo, has lately started for the exploration of the Eastern Tian-Shan. On April 19 it had reached Tchardjui, on the Trans-Caspian Railway. Its aim is to connect the explorations of M. Potanin in North-Western Mongolia with those of Prjevalsky. One of the two brothers is already well known for his explorations of the Pamir.

THE Russian Geographical Society is sending out the following expeditions :—M. Vilkitzki, who has made pendulum-observations on Novaya Zemlya, will continue the same measurements in Central and South-Eastern Russia. M. Faussek is sent out to the shores of the White Sea in order to make zoo-geographical explorations in the Kandalak Bay, as well as for observations upon the secular rising of the coasts of the White Sea. M. Andrusoff, whose interesting researches into the geological history of the Caspian Sea have attracted a good deal of attention, will continue the geological exploration of Daghestan and Kuban ; and M. Kuznetsoff will continue in the Caucasus his work upon the geography of plants. M. Antonoff is sent out to the Transcaspian region for the study of the conditions of animal and vegetable life in the desert ; and MM. A. P. Semenoff and Yaschenko will visit the same region for zoological and botanical researches. Of ethnographical expeditions that of M. Katanoff to North-Western Mongolia is worth noting. The investigation of the folk-lore of the White Russians (Byelorusses) will be continued by MM. Romanoff and Dobrovolsky.

THE expedition to Tibet, the departure of which was delayed by the death of Prjevalsky, is now at the town Prjevalsk (formerly Kara-kol), and it will start in a few days, *viâ* the Bedel Pass, to Kashgar. The original plan of reaching Lhassa has been abandoned, and the expedition will limit its explorations to Eastern Turkestan and North-Western Tibet. It is under the leadership of Colonel Pyevtsoff, who accompanied Prjevalsky in all his memorable journeys. It includes also two other travelling companions of Prjevalsky—MM. Roborovsky and Kozloff—and a geologist, M. Bogdanovitch, who is commissioned by the Russian Geographical Society.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual *conversazione*, held by the Royal Society on May 8, was in every way brilliantly successful. There was a numerous attendance, and the programme had been arranged with the greatest skill and care. We refer to some of the most novel and important objects exhibited. In addition to these, the results set forth in many recent papers to the Royal Society were illustrated by experiments.

Mr. C. V. Boys, F.R.S., exhibited :—(1) Portable Cavendish apparatus for demonstrating the attraction of gravitation. This apparatus differs only from the well-known apparatus of Cavendish in matters of detail. First, instead of the beam 6 feet long, carrying heavy weights, used by Cavendish, or half a metre long, used by Cornu, the beam consists of a piece of lead only 1 centimetre long, and this is inclosed in a round tube of metal, outside which the attracting weights are placed. This reduction of size has been rendered possible by the use of quartz threads, the production of which was shown two years ago. The advantages gained by the reduced dimensions are increased sensibility, and almost perfect elimination of temperature disturbances. The particular apparatus exhibited is designed to show the effect, and that it is the same from time to time, rather than to determine the constant of gravitation absolutely. By arranging the two attracting weights and the two ends of the attracted body at different levels, the deflection is nearly doubled.—(2) Experiment showing the insulation of quartz. A pair of gold leaves are supported by a short rod of quartz which has been melted and drawn out about three-quarters of an inch. The atmosphere is kept moist by a dish of water. Under these circumstances a glass insulating stem allows all the charge to escape in a second or two. With the quartz but little change is observed in four or five hours. The quartz may be dipped in water and put back in its place with the water upon it. It insulates apparently as well as before.—(3) Apparatus for testing the elasticity of fibres. One of these pieces of apparatus consists of a microscope cathetometer arranged vertically, and a gravity bob which is deflected by the vertical pull of the fibre on a side arm. The lower end of the fibre is made fast to a beam carried by the microscope. A scale, to which the upper end of the fibre is fixed, is viewed by the microscope, which thus shows the stretch of the thread ; the pulling force is found by subtracting the stretch from the vertical movement of the microscope and multiplying by a constant previously found. The second piece of apparatus is used to measure the fatigue of fibres after torsion.

Results of experiments with working model of the tidal Seine, exhibited by Mr. L. F. Vernon Harcourt. These experiments were undertaken with the object of obtaining an indication of the effects which the various schemes proposed for the improvement of the estuary of the Seine, by the prolongation of the training walls below Berville, would have upon the estuary if carried out. After ascertaining, by experiments, that the former and present conditions of the Seine estuary could be reproduced in miniature in the model, the various schemes proposed were successively introduced in the model, with the results shown upon the diagrams exhibited. The method of working this model has since been applied to the model of another estuary, which may be seen in operation at 6 Queen Anne's Gate, Westminster.

Profs. A. W. Rücker, F.R.S., and T. E. Thorpe, F.R.S., exhibited maps to illustrate the direction and magnitude of the regional magnetic disturbing forces in the British Isles. The British Isles can be divided into a comparatively small number of districts, in each of which the horizontal disturbing forces tend towards centres or loci of attraction, which are also regions of large vertical force. The shaded portions of the maps are districts of high vertical force, and it will be seen that the arrows which represent the horizontal forces on the whole point towards them. In Scotland the forces indicated by the dotted arrows were deduced from data collected in 1857–58 by Mr. Welsh. The five principal lines towards which the magnetic disturbing forces in Great Britain converge are in the immediate neighbourhood of (1) the Caledonian Canal; (2) the basalt of the Western Isles; (3) the centre of the Scotch coal-field, in which basaltic crystalline rocks occur; (4) the line in South-East Yorkshire, in which the Jurassic and Liassic strata thin out, and passing thence to the Lakes; (5) the Palæozoic ridge between London and the South Wales coal-field. There are well-marked centres of attraction, (1) between Reading and Windsor, (2) near the Wash, which have been specially studied. The disturbance which culminates in the first extends from Kenilworth to the Channel, and from Salisbury to the North Sea. The well-known anomaly in the difference of the declinations at Greenwich and Kew is thus accounted for. The maps also afford indications of other subsidiary centres.

Captain H. Capel L. Holden, R.A., showed:—(1) Chronograph for measuring the velocity of projectiles and small periods of time. This chronograph, of which the latest form with Captain Holden's most recent improvements is exhibited, is of the gravity type, originally invented by M. Le Boulengé; since its first introduction it has been improved by Captain Bréger, of the French Marine Artillery. Broadly speaking, it consists of a heavy pillar, to which are affixed two electro-magnets (the circuits of which are arranged to be interrupted by the action of the body whose velocity it is required to measure) which can support two rods, the shorter one of which, in falling, strikes a trigger table and releases a knife, which marks the other as it falls. The time elapsing from the commencement of the fall of the short rod until the knife strikes the other rod is obtained mechanically by means of the instrument called the disjunctor, which breaks both of the separate circuits simultaneously: a commutator in connection with this disjunctor enables errors due to the circuits not being broken simultaneously to be detected and corrected for. When an interval of time occurs between the two circuits being broken, the mark made on the rod by the knife will be more or less above that made when the disjunctor is used, and the space between the two marks gives the means of ascertaining the time, since the rod falls under the influence of gravity. In ordinary use, the screens, where the interruption of the circuit takes place, are made of a continuous wire in circuit, each with its electro-magnet and battery, and these screens are broken by the passage of the projectile through them. The disjunctor reading is arranged so as to be adjustable by altering the height of the magnet, so that, the screens being a fixed distance apart, a scale can be engraved on the micrometer bar of velocities in feet per second, thus saving time and avoiding frequent calculation.—(2) Holden hydrometer. This is intended more especially for use in connection with secondary batteries, for observing the density of the acid during charge and discharge. It consists of two parts—the hydrometer-float and the scale. In use, the scale is clipped to the battery plates or to the side of the containing vessel, the point being pushed down until it just touches the liquid, and the reading is then taken from the top of the hydrometer stem on the ebonite scale. The range of density and the size of the divisions can be varied according to the requirements. The advantages claimed for this form over the ordinary type of hydrometer are: greater sensitiveness, more open scale, and increased legibility owing to the reading being above the level of the liquid and side of the cell, freedom from adherence to the plates or side of the vessel, and the ready correction for temperature by means of a sliding scale.

A model illustrating the formation of ocean currents, exhibited by Mr. A. W. Clayden. This is practically a map of the Atlantic in which the land surfaces are raised about half an inch above the portions occupied by the sea. The continents and larger islands are made of wood cut into the required shape, while the smaller islands are represented by pins or small pieces of sheet metal driven into the board which forms the basis of the whole. This raised map forms the bottom of a shallow tray which can be filled with water up to the level of the land surfaces, thereby obtaining a map (on Mercator's projection) in which the seas are represented by the surface of water. Underneath the tray a wind chest is fixed, and a number of tubes are brought up from it through the continents, and bent over so that the jets of air delivered from them may impinge upon the water. These jets are so arranged as to approximately reproduce on a small scale the actual circulation of the atmosphere as laid down on a chart of the prevalent winds for the year. Care is taken to have as few tubes as possible, and they are so placed as to hide the least possible amount of the sea. The strong and persistent trades are simulated by bringing the openings of the tubes near to the surface of the water, while the fitful and uncertain winds of northern latitudes are imitated by allowing the jet to be considerably dispersed before coming into contact with the water. A foot-blower is attached to supply the wind, and any movement of the water is rendered visible by scattering over it some Lycopodium powder. A few moments after the blast is turned on, the whole surface of the model sea is in motion. All the principal currents of the North Atlantic are shown, including the return current between the great equatorial currents, and the northward stream along the west coast of Greenland. If a narrow opening is made in the Isthmus of Panama all that happens is that some of the return stream round the Mosquito Bay and Gulf of Darien flows into the Pacific, leaving the North Atlantic practically unaffected. But if a large part of Central America is removed, almost the whole of the tropical water passes through the opening, and the currents from Baffin's Bay and the Arctic Ocean are drawn down to the Azores and the Canary Isles. There is an absence of evident connection between the slack water close to the New England coasts and the Labrador current, but the apparatus does not attempt to imitate differences of temperature or differences of rotational velocity, hence any effect due to either of those causes must necessarily be absent. All that is attempted is to demonstrate the connection between the prevalent winds and general oceanic circulation, by showing that nearly all the movements of the water are determined by the direction of the winds and the contours of the coasts.

Mr. James Pitkin exhibited:—(1) Pitkin and Niblett's fire-damp meter. By means of these instruments it is possible to detect and estimate the percentage of oxygen or hydrogen in mixtures of these gases. In its simplest form it consists of two ordinary cylindrical bulbed mercurial thermometers. These are mounted on a suitable base, and are then graduated off in the ordinary way to Fahrenheit or Centigrade scale. One tube registers the temperature of the mixed gases. The other, which is the gas indicator, has its bulb coated with one of those metals which when in a very finely divided state have the peculiar property of occluding and facilitating the chemical combination of certain gases. When placed in a gaseous mixture and during the combination of the gases due to the above property of the metal, a considerable amount of heat is developed. The heat generated thus produces a corresponding rise in the mercurial column. To read the instrument the difference between the two scale readings is taken, and then, by comparison with a table supplied with each instrument, the percentage of gas may be read off. In the case of fire-damp and air or coal-gas and air, the amount of heat developed appears to correspond approximately to the explosive activity of the mixed gases. A sliding scale may be fixed on the instrument, which can be graduated in terms of percentages of any particular gas.—(2) Pocket electric lamp. This lamp is constructed for astronomical and other scientific purposes where a steady and a safe light is occasionally required. Its total weight is 1 lb. 13 oz., and it gives a light of 1 candle-power for a period of six hours. Its charging current is 1 ampere at a potential of 5 volts for four hours.

A series of ancient wreaths and plant remains from the cemetery of Hawara, Egypt, exhibited by Mr. Percy E. Newberry, by permission of the Director of the Royal Gardens, Kew. These wreaths and plant remains were discovered last year by Mr. Flinders Petrie, in coffins of the Ptolemaic period, and date from about the first century before Christ. They are fully described by Mr. Percy E. Newberry, in Mr. W. M. Flinders Petrie's "Hawara, Biahmu, and Arsinoë," and were presented to Kew some few months since.

Gramme ring, rotating under the influence of the magnetism of the earth, exhibited by Mr. J. Wilson Swan. It is a motor of the type of the ordinary dynamo-electric machine, but without field magnets other than the north and south magnetic poles of the earth. The current passing in the ring is about half an ampere.

Preparations of the new element gnomium, recently discovered by Gerhard Krüss and F. W. Schmidt, of Munich, exhibited by Dr. Hugo Müller, F.R.S. Gnomium oxide; gnomium chloride (in aqueous solution); nickel from which the gnomium, which up to the present always accompanied it, has been separated; nickel oxide free from gnomium. Gnomium is a metallic element which, according to the discovery of Krüss and Schmidt, is always associated with cobalt and nickel, and consequently neither of these metals have up to the present been known in the pure state.

Illustrations of the new and the old astronomy, exhibited by Mr. Isaac Roberts. Among these was the photograph of the nebula 51 M. Canum Venaticorum; the original negative being shown under the microscope.

Mr. H. J. Chaney showed a hollow cylinder and sphere, used in the re-determination of the weight of a cubic inch of distilled water, 1889. $t = 62°$, B = 30 inches. One cubic inch = 252·286 grains.

Voltaic balance, exhibited by Dr. G. Gore, F.R.S. Used for measuring voltaic energy in chemical analysis; strength of aqueous solutions; effect of light and heat on aqueous solutions; detecting chemical changes in liquids and measuring their rates: detecting chemical compounds and their combining proportions; measuring losses of voltaic energy during chemical combination; measuring chemical energy. By means of it the influence of 1 part by weight of chlorine in 500,000 million parts by weight of water has been detected.

Films of metals and metallic oxides deposited by electric sparks, exhibited by Prof. W. N. Hartley, F.R.S.

Hair from the Yenisei Mammoth, obtained by F. Schmidt, of the Academy of Sciences, St. Petersburg, exhibited by Prof. G. H. Seeley, F.R.S.

Drawings illustrating the feeding of Scrobiculariæ, exhibited by Dr. H. C. Sorby, F.R.S. The feeding of Scrobiculariæ, as also of Tellinæ, is by actively taking in mud by the indraught syphon and afterwards discharging it by the same, unlike the quiet habit of most other Conchifera.

Mr. J. Young showed—(1) a cluster of nests of a species of Swift (Collocalia) taken in one of the Society Islands; (2) a specimen of *Pluvianellus sociabilis*, a plover obtained in South America, of which only two specimens (obtained fifty years ago) were previously known in Europe; (3) the tail of a Japanese barndoor cock, 11 feet long.

Mr. W. H. Preece, F.R.S., exhibited—(1) calcedonified tree-trunk, from Arizona, U.S.A.; (2) transverse, tangential, and radial microscopical sections of the wood, to illustrate the original vegetable structures and the mineralogical changes which have taken place during and subsequently to the silicification of the woody tissues.

Egyptian blue ("Vesterien") artificially prepared by Prof. F. Fouqué, of the Collège de France, Paris, exhibited by Prof. J. W. Judd, F.R.S. This substance is shown to have the formula CaO, CuO, 4SiO. It has been obtained, not only in a glassy form, but in crystals, which are remarkable for their intense pleochroism (dark blue to rose pink), as was shown in specimen under microscope. For comparison specimens of ancient objects (Scarabei and ornaments used in mosaic work) were exhibited by Mr. R. H. Soden Smith, to illustrate the method in which this blue enamel was employed by the Egyptians. Other specimens of antique ornaments glazed with the Egyptian blue, exhibited by Mr. John Evans, Treasurer of the Royal Society.

A revolving stage for the microscope, exhibited by Prof. R. J. Anderson.

Prof. H. Marshall Ward, F.R.S., exhibited various parasitic fungi, and specimens of diseased timber showing characteristic symptoms of injury caused by them. The chief of these are:—(1) piece of larch stem, affected with the "larch disease," and exhibiting the cups of *Peziza* (*Helotium*) *willkommii* on the cancerous cortex; (2) specimen of fructification of *Polyporus sulphureus*; (3) piece of larch timber attacked by *Polyporus sulphureus*, showing the characteristic symptoms of the injury; (4) piece of oak timber, exhibiting the characteristic symptoms of disease due to the ravages of *Stereum hirsutum*; (5) piece of oak attacked by *Thelephora perdix*, showing the very different mode of injury due to this fungus; (6) piece of spruce fir, attacked by the mycelium of *Trametes radiciperda*, and exhibiting the very characteristic dark spots which serve to diagnose the disease; (7) piece of pine injured by *Agaricus melleus*, and showing the very different symptoms which betray the presence of this fungus; (8) piece of deal with grey mycelium of *Merulius lacrymans*, causing the common "dry rot" of timber; and a similar piece of timber attacked by the white mycelium of *Polyporus vaporarius*, another and quite different fungus, which produces a form of "dry-rot"; (9) portion of pine stem infected with *Peridermium pini*, the Æcidium form of *Coleosporium senecionis*,—the other form of this parasite is found on various species of groundsel (it does much damage to the pines in some forests, producing so-called "cankers" as disastrous as those of the "larch disease"); (10) specimen of wheat infested by *Ustilago carbo* (*U. segetum*), showing the destruction of the ears by the fungus, the black spores of which completely occupy the interior of the grain; (11) specimen of grass attacked by *Epichloe typhina*, a destructive ascomycetous fungus which infests the flowering shoots of pasture grasses; (12) culture specimens of *Sclerotia* developed from species of *Botrytis*, which destroy certain garden plants. Microscopic preparations of these are also exhibited.

Models illustrating a cause of contortions of strata, exhibited by Dr. Charles Ricketts. To induce these flexures, dry and powdered clay of different colours is spread in consecutive layers in a trough, when by the access of water, the clay becomes plastic, sand is poured on some special part, its weight in the experiment being supplemented by extra pressure; this causes the heavier substance to subside into the plastic mass; at the same time the clay-beds are squeezed outwards, the layers underneath being formed into films still continuous with those at the sides, which are rendered considerably thicker than in their original state, and are curved into folds, representing on a small scale such as frequently occur in stratified rocks. The experiment so exactly coincides with natural phenomena that it is reasonable to expect it will afford a true explanation of a frequent cause of contortion, and also of cleavage of strata (see "On some Physical Changes in the Earth's Crust, Part 3," *Geological Magazine*, April 1889, p. 165).

Amorphophallus campanulatus, exhibited by the Director of the Royal Gardens, Kew.

New optical apparatus for lecture demonstration, invented and exhibited by Mr. Eric Stuart Bruce:—(1) Apparatus for projecting Crookes's radiometer in action on the screen, so as to render its effects visible to large audiences.—(2) "The electro-graphoscope." A striking method of showing the illusions produced by persistence of vision to large audiences. In this apparatus a narrow lathe of wood, about an inch wide, is made to revolve rapidly by means of an electric motor, the effect being an almost invisible haze, but when the revolving lathe is placed in the path of the rays of light proceeding from an oxyhydrogen lantern, in which there is a transparent picture or photograph, the image is apparently cast upon the air, in the case of a statue giving the effect of bold relief. In reality minute portions only of the image are cast upon the revolving plane, in such rapid succession that they are united into the perfect whole by the retentive action of the retina of the human eye.

Mr. Eadweard Muybridge exhibited projections by the electric lantern of automatic electro-photographs, exposed at regulated intervals of time, illustrating the consecutive phases of bipedal locomotion, as synchronously viewed from two or more points of sight.

SCIENTIFIC SERIALS.

American Journal of Science, May.—The electrical resistance of stressed glass, by Carl Barus. Following up Warburg's experiments, which have thrown so much new light on the thermal relations of the resistance of glass, the author here deals specially

with the effects of stress on electrolyzing glass kept as nearly as possible at different constant temperatures between 100° and 360°. He finds generally that a solid electrolyte like glass is a better conductor of electricity when in a state of strain or torsion than when free from strain. The influence of temperature in changing the value of the electrolytic effect of stress is not marked; the same pull per unit section does not apparently increase the conductivity of glass more at 350° than at 100°, if indeed it increases it as much.—On the formation of siliceous sinter by the vegetation of thermal springs, by Walter Harvey Weed. These researches on the origin of the deposits of siliceous sinter found in the basins of the Yellowstone National Park make it evident that such deposits are largely formed by the vegetation of the hot spring waters. Waters too poor in silica to form sinter deposits by any other cause may be accompanied by beds of siliceous sinter formed by plant life; the extent and thickness of these deposits establish the importance of this form of life as a geological agent.—Marine shells and fragments of shells in the Till near Boston, by Warren Upham. These fossils, occurring in drift deposits near Boston, are usually regarded as evidence of a marine submergence within the Pleistocene or Quaternary period. But Mr. Upham's observations made last year show that they were transported from the bed of the sea on the north by the ice-sheet in the same manner as the materials of the drift have been carried southwards and often deposited at higher elevations than the localities from which they were brought. Hence these shells afford no proof of the former presence of the sea at the level where they are now found.—A platiniferous nickel ore from Canada, by F. W. Clarke and Charles Catlett. The careful analysis here made of these ores from the mines at Sudbury, Ontario, places beyond all doubt the presence of platinum in appreciable quantities. It probably exists in the ore as sperrylite, though this point has not yet been determined.—Stratigraphic position of the Olenellus fauna in North America and Europe, by Chas. D. Walcott. The general result of these researches is to remove the Olenellus fauna both in the Old and New World from the Middle Cambrian to the base of the whole Cambrian system. The paper, which is not concluded, gives full tables of this fauna, with its areas of geographical distribution east and west of the North Atlantic.—Earthquakes in California, by Edward S. Holden. The statistics of seismic disturbances in this region with incidental remarks are brought down to the end of the year 1888.—Chemical action between solids, by William Hallock. In his recent note on a new method of forming alloys, the author undertook to carry out some additional experiments, the results of which are here given. He infers generally that chemical action may take place wherever the products are liquid or gaseous, even though the reagents are solid, with perhaps the added condition that one or both reagents be soluble in the liquid produced.

Revue d'Anthropologie, troisième série, tome iv., deux^e^. fasc. (Paris, 1889).—On the colour of the eyes and hair of the Aïnos, by M. Lefèvre. These notes were drawn up at the suggestion of Dr. Colignon, while the author was acting as Professor at the Military College of Japan. The principal point commended to his notice was to determine whether there was any foundation for the statement, made by various travellers, that many of the Aïnos present the anomalous condition, that while the hair of the head is red, the beard, and the hair with which various parts of their bodies are profusely covered, are deep black, the skin being sallow, and the eyes light. This coloration is completely at variance with all known physiological relations, and it is obvious from the author's observations that the statement must have arisen from a misconception, due, perhaps, in part to the practice pursued by the Aïnos of colouring their heads a bright red, and tattooing the lips in circular rings of black and blue. The interest of racial coloration is considerable when judged from an ethnological point of view, and special importance attaches to the subject in regard to the Aïnos, who, although undoubtedly a white race, have undergone various modifications in accordance with the different parts of the empire in which they were settled. Thus, while in some districts the people have been forced to adopt the dress and habits of the Japanese, in the neighbourhood of Sapporo, the capital of the Island of Yesso, they have hitherto been enabled to retain their old customs, and keep themselves far more free than elsewhere from intermixture with the Japanese. It is, therefore, the more worthy of notice that in this district no blonde or blue-eyed Aïnos are to be met with, while the people generally have absolutely black hair. It would, in fact, appear that the hair of the normal Aïnos is of a jay-like blackness, coarse and stiff, but bright and lustrous, although in the case of a few of those who have long occupied the sea-coast, the hair is of a dark brown, presenting almost the same softness as that of Europeans. In no section of the people is there the slightest evidence of any anomalous colouring of the hair, eyes, and complexion. M. Lefèvre considers that the stature of the Aïnos is somewhat higher than that of the normal Japanese, while their cranial index, which is found to range from the extremes of dolichocephalism to that of brachycephalism, would seem to give very strong weight to the assumption that these people are not a pure race, and that they differ in accordance with the extent to which Mongolian or other ethnic elements have modified their primitive character.—On the writings and opinions of Samuel Zarza, by M. Salomon Reinach. Considerable interest was excited by a statement made in 1877 by Dr. Topinard, in one of his lectures, afterwards published in the *Gazette Médicale*, according to which a Jew, named Samuel Zarza, was burnt alive in 1450, for having maintained the antiquity of man. This statement excited much attention, and M. Cartailhac, who doubted its accuracy, appealed to his *confrères* for information in regard to the documents from which M. Topinard had quoted. This appeal remained unanswered until the question was lately taken up by M. Reinach, who associated with himself in the necessary investigations a learned Russian Jew, M. Salomon Fuchs. To the latter we are indebted for a commentary on the numerous works of Zarza, surnamed Ben S'né, which, according to his own report, were undertaken in the hope of reviving among his co-religionists in Spain their interest in philosophical and theological inquiries, which had nearly died out amid the miseries they had endured during the civil wars between Peter the Cruel and his brother, Henry II. M. Fuchs has failed to find in these works any opinion expressed concerning the antiquity of man, although the writer appears to have adhered to the belief of the eternity of the world. It is, moreover, obvious from his reference to his age when he completed his second work, entitled "Mikhalal-Yophi," *i.e.* "Perfection of Beauty," in 1369, that he could not have survived until 1450, which is given by the commentators of the seventeenth century, from whom Dr. Topinard borrowed his references, as the date of his presumed martyrdom. While M. Fuchs thus supplies another proof of the inaccuracy of many of the earlier commentators, he at the same time shows by his summary of Zarza's writings that Hebraists might throw interesting light on the early dawn of scientific inquiry by a careful study of the numerous still unprinted remains of Zarza, and of his Spanish co-religionists, who undoubtedly exercised an active influence on the progress of learning in the Middle Ages.—On the belief in familiar household spirits and other forms of superstition, by Dr. Berenger-Feraud. The interest of this paper to the student of folk-lore depends upon the writer's detailed narratives of the local superstitions still prevailing, or only recently exploded, in the rural districts of France; his elaborate exposition of the superstitions of other countries has little value for the English reader.—On questions regarding the Aryans, by M. de Lapouge. The author believes that, at the present stage of our knowledge, we are justified in assuming that in the ancient Aryans we have a blonde dolichocephalic race, whose cradle was in the north-west of Europe as it existed in the second half of the Quaternary age.—On the steatopygia of the Hottentots in the Garden of Acclimatization by M. Topinard.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 7.—"On the Wave-Length of the Principal Line in the Spectrum of the Aurora." By William Huggins, D.C.L., LL.D., F.R.S.

I think it is very desirable that I should put on record some observations of the spectrum of the aurora which I made in the year 1874, but which, up to the present time, have remained unpublished. These observations were made with a powerful spectroscope, and under conditions which enabled me to determine the wave-length of the principal line within narrow limits of error. The spectroscope was made by Sir Howard Grubb, on the automatic principle of his father, Mr. Thomas Grubb. It is furnished with two "Grubb" compound prisms; each has 5 square inches of base, and gives nearly twice the dispersion of a single prism of 60°—namely, about 9° 6′ from A to H.

The observations were made on February 4, 1874. There was a brilliant aurora, showing a whitish light; a direct-vision spectroscope resolved this light into a brilliant line in the yellow and a faint continuous spectrum.

The "Grubb" spectroscope was directed from the window of the Observatory upon the brightest part of the aurora. In the first instance, an estimation by eye was made of the position of the bright line by comparing it in the instrument with the spectrum of a spirit-lamp. The bright line was seen to fall on the more refrangible side of the line for which Watts gives the wave-length 5582 (*Phil. Mag.*, vol. xli., 1871, p. 14), Ångström and Thalén 5583 ("Spectres des Métalloïdes," *Nov. Act. Soc. Sci. Upsal.*, vol. ix., 1875, p. 29), by from one-fifth to one-fourth of the distance of this line from the beginning of the band. If we take one-fourth, we have λ 5569·6; one-fifth gives λ 5572·3. The mean of these values gives for the

Aurora line λ 5570·9 . . . . . (1)

The cross-wires of the spectroscope were then brought upon the line, and the reading 3476 showed the line to fall about midway between two strong lines in the spectrum of tin, λ 5564 and λ 5587 respectively, according to my measures ("Spectra of the Chemical Elements," Phil. Trans., 1864, p. 139). The position of the cross was then compared directly with those lines in the spectrum of an induction spark taken between electrodes of tin. The further details of this comparison are not given in my note-book, but the result only, which placed the

Aurora line at λ 5571 . . . . . (2)

"Consulting my map of the chemical elements, I found that there was a line of tellurium very near this place—namely, at λ 5575; I therefore brought the spark from tellurium before the slit, when the cross appeared on the more refrangible side of the tellurium line. The measure of the distance of the cross from this line came out equal to λ 0003. The place given in my paper for this line of tellurium is 5575. Thalén gives for the same line 5574·1 (Brit. Assoc. Rep., 1885, p. 292). If we take the mean of these values and deduct 0003, we get for

The line of the aurora λ 5571·5 . . . . . (3)

There are strong lines of iron very near this position in the spectrum, and I made use of these also for a further determination of the place of the aurora line. The cross, after having been placed upon the line of the aurora, was confronted with these lines in the spectrum of iron.

The condensed account in my note-book does not give further particulars of this comparison, but states only that the place of the

Aurora line came out λ 5571·5 . . . . . (4)

Summing up these determinations we have—

(1) Eye-estimation	λ 5570·9
(2) From tin	5571·0
(3) From tellurium	5571·5
(4) From iron	5571·5

From these values I think that we are justified in taking for the aurora line, as a position very near the truth,

λ 5571 ± 0·5 . . . . . (5)

Among the numerous determinations of other observers, those of Prof. H. C. Vogel in 1872 (*Leipzig Math. Phys. Berichte*, vol. xxii. p. 285) seem to me to have great weight. A direct-vision spectroscope with a set of five prisms was used. The reduction of the readings of the micrometer into wave-lengths was based upon the repeated measures of 100 lines of the solar spectrum.

The screw had been thoroughly examined. After each observation of the aurora line, readings were taken of the lines of sodium or of hydrogen. The observations extended over four nights. On three nights four separate readings were obtained; on the fourth night two only. Vogel gives as the mean result of the fourteen observations—

Aurora line λ 5571·3 ± 0·92 . . . . . (6)

The recent observations on the spectrum of the aurora by Gyllenskiöld, at Cap Thordsen, in 1882, deserve special mention.[1] With a Hoffmann spectroscope, furnished with a scale, he obtained at Cap Thordsen in 1882 a mean result of λ 5568 ± 1·6; later, in 1884, at Upsala, with a Wrede spectroscope furnished with a micrometer screw, a mean value for the aurora line, λ 5569 ± 6·2.[2] Gyllenskiöld discusses in detail nearly all the recorded observations of the spectrum of the aurora from 1867 to 1882, and then brings them together in a table, with such probable errors as the original statements of the observers enabled him to assign to them.

Gyllenskiöld then calculates by the method of least squares the mean value of all the determinations, and finds the following result :—[3]

Mean value of the 23 observations, λ 5570·0 ± 0·88 . . (7)

The recent measures by C. C. Krafft,[4] depart largely from Gyllenskiöld's mean value. Krafft found on

1882 November 2	λ 5595
,, ,, 11	5586

and measures with the same instrument made by Schroeter, on November 17, gave λ 5587.

Now, though Ångström's original value, λ 5567, may not be quite accurate, his observation fixed a limit towards the red beyond which the aurora line cannot lie. Ångström says: "Sa lumière était presque monochromatique, et consistait d'une seule raie brillante située à gauche" (on the more refrangible side) "du groupe connu des raies du calcium" ("Spectre Solaire," Upsal, 1868, p. 42). The position of the most refrangible line of this calcium group is accurately known; according to (Brit. Assoc. Rep. 1884, p. 372)

Kirchhoff	λ 5580·9
Thalén	5580·9
Huggins	5581·0

It is certain therefore, from Ångström's first observation in 1867, alone that the aurora line lies well on the more refrangible side of wave-length 5580. This limit towards the red was confirmed afterwards by Ångström himself; he says later that the yellow line falls almost midway between the second and third line of the shaded carbon group (NATURE, vol. x. p. 211). The positions of these lines of comparison are, according to Ångström and Thalén, λ 5538 and λ 5583 (*Acta Upsal.*, vol. ix. 1875, p. 29).

It follows that Krafft's values, λ 5586, λ 5587, and λ 5595, must be from some cause inaccurate. A possible explanation may be found in the small number of solar lines employed by Krafft for the reduction of the measures into wave-lengths. The curve was drawn through the six Fraunhofer lines, B, C, *a*, D, E, and *b*. There was no control for the curve between D and E, and a very small deviation of the curve from its true position here would be sufficient to account for the position of less refrangibility of from λ 0016 to λ 0024, which his measures give for the aurora line.

It should be stated that Krafft expresses regret that more attention could not be given to the spectroscopic observations. He says :—"Leider gestatteten die obligatorischen Beobachtungen nicht, den spectroscopischen Untersuchungen die gehörige Aufmerksamkeit angedeihen zu lassen. . . . Ich glaubte ausserdem diese Messungen um so mehr auslassen zu können, als der Platz der gewöhnlichen Nordlichtlinie oft und sehr genau bestimmt ist."

To sum up, we have the following values for the principal line of the aurora :—

(6) 1872, Vogel	λ 5571·3 ± 0·92
(5) 1874, Huggins	5571·0 ± 0·5
(7) Gyllenskiöld's mean of twenty-three observers from 1867 to 1884 . . .	5570·0 ± 0·88

These values agree closely, and fix within very narrow limits, the position in the spectrum where we have to seek the chemical origin of the line.

Gyllenskiöld, from his observations of the changes which occur in the spectrum of the aurora, comes to the conclusion

[1] "Observations faites au Cap Thordsen, Spitzberg, par l'Expédition Suédoise," vol. ii. part 1, "Aurores Boréales," par Carlheim-Gyllenskiöld (Stockholm, 1886).

[2] *Ibid.* p. 166. [3] *Ibid.* p. 169.

[4] "Beobachtungs-Ergebnisse der Norwegischen Polarstation," &c. A. S. Steen (Christiania, 1888).

that "le spectre de l'aurore boréale résulte de la superposition de plusieurs spectres différents," and that "la raie principale forme un de ces spectres élémentaires ; elle apparaît très souvent seule." A similar view was taken many years ago by Ångström (NATURE, vol. x. p. 210) and by Vogel (*Leipzig Math. Phys. Berichte*, vol. xxiii. p. 298).

[After consideration, I think that I ought to point out that Mr. Lockyer's recent statement (Roy. Soc. Proc., vol. xlv., 1889, p. 234), that "the characteristic line of the aurora is the remnant of the brightest manganese fluting at 558," is clearly inadmissible, considering the evidence we have of the position of this line.

In support of this statement Mr. Lockyer says :—"Ångström gave the wave-length of the line as 5567, and since then many observers have given the same wave-length for it, but probably without making independent determinations. Piazzi Smyth, however, gives it as 558, which agrees exactly with the bright edge of the manganese fluting. R. H. Proctor also gives the line as a little less refrangible than Ångström's determination. He says: 'My own measures give me a wave-length very slightly greater than those of Winlock and Ångström' (NATURE, vol. iii. p. 468)."

By reference to Gyllenskiöld's table it will be seen that the probable errors of the determinations by Piazzi Smyth and Proctor, 5579 ± 9·5 and 5595 ± 25·0 respectively,[1] are too large to entitle these measures to special weight.

Mr. Lockyer says, further :—"Gyllenskiöld's measures with the Wrede spectroscope also give 5580 as the wave-length of the characteristic line. I feel justified, therefore, in disregarding the difference between the wave-length of the edge of the manganese fluting and the generally accepted wave-length of the aurora line."

Gyllenskiöld's single measure of 5580, on which Mr. Lockyer relies, differs widely from the values which Gyllenskiöld himself assigns to this line—namely, from observations at Cape Thordsen in 1882, λ 5568 ± 1·6, and from observations at Upsala in 1884, with the Wrede spectroscope, λ 5569 ± 6·2.

Speaking of Krafft's observations, Mr. Lockyer says (Roy. Soc. Proc., vol. xlv., 1889, p. 241) :—"The wave-lengths obtained for the aurora line were 5595, 5586, and 5587. Unlike most observations, these place the aurora line on the less refrangible side of the manganese fluting. Hence, we have an additional reason for neglecting the difference between the wave-length of the brightest edge of the manganese fluting, and the commonly accepted wave-length of the aurora line, as given by Ångström. . . . These observations are the latest which have been published, and were obviously made with a full knowledge of all previous work, so that their importance must be strongly insisted upon."

I have already pointed out that Krafft's measures were not made under circumstances which assured to them a high degree of accuracy ; and Krafft's own words, which I have quoted, disclaim expressly any special attempt on his part to redetermine the position of the principal line with a higher degree of accuracy than the observers who preceded him.—March 4.]

May 2.—"The Accurate Determination of Carbonic Acid and Moisture in Air." By J. S. Haldane, M.A., M.B., and M. S. Pembrey (Physiological Laboratory, Oxford). Communicated by Prof. J. Burdon Sanderson, F.R.S.

The authors show that, in spite of the efforts which have been made in recent years to improve the method of Pettenkofer for determining CO_2 in free air, the results obtained by different observers still seriously disagree. They also point out the serious defect in the ordinary "chemical" method of determining moisture in air, that in spite of its superior accuracy it only gives accurate results over a long period, while the proportion of moisture in the air is constantly changing.

A method is then described for determining simultaneously the CO_2 and moisture in air. The method is gravimetric. The CO_2 is estimated by the increase in weight of an apparatus of simple construction containing soda lime, through which a known volume of the air has been passed. The moisture is similarly estimated by means of an apparatus containing pumice soaked in sulphuric acid. The increased accuracy and convenience of the method depend on the facts: (1) that a very rapid current of air may be passed through the apparatus without fear of non-absorption of either CO_2 or moisture ; (2) that by the method of counterpoising with a dummy apparatus during weighing the "errors of weighing" are reduced to about a tenth of what they would otherwise be. It is shown that with these two improvements the method for moisture gives in a period of experiment of one minute a result equal in accuracy to that obtained with the ordinary method in a period of two hours.

Using their own method for CO_2 as a standard, the authors have also tested the Pettenkofer method. They find that the latter method usually gives results for free air about a fifth too high, but that the error is less in proportion with air containing larger amounts of CO_2.

As a number of sets of absorption apparatus can easily be carried about, the new method is well suited for experiments in hygiene, and especially for cases in which a series of experiments require to be made in rapid succession. Both kinds of absorption apparatus last over a large number of experiments without refilling.

Physical Society, April 13.—Prof. Reinold, President, in the chair.—Mr. Shelford Bidwell, F.R.S., showed a lecture experiment illustrating the effect of heat on the magnetic susceptibility of nickel, and an experiment showing an effect of light on magnetism. In the first experiment a piece of nickel was attached to one side of a copper pendulum bob, which was held out of the vertical by bringing the nickel in contact with a fixed magnet. On placing a spirit-lamp flame below the nickel, the bob was, after a short time, released, and oscillated until the nickel had cooled, when it was again attracted and the operation repeated itself. The second experiment had been recently shown before the Royal Society. One end of an iron bar, which had been magnetized and then demagnetized, was placed near a magnetometer needle. On directing a beam of light on the bar an immediate deflection of the needle resulted, and on cutting off the light the needle promptly returned to near its initial position. The direction of magnetization induced by the light is the same as the previous magnetization, and the bar seems to be in an unstable magnetic state. That the effect is due to light and not heat, the author thinks is rendered probable by the suddenness of the action. The President said he had tried the experiment himself and failed to get any effect, but after seeing the arrangement of apparatus used, he believed his non-success due to the comparatively great distance between his bar and needle. Mr. C. Richardson asked if the results were different for different coloured rays, and Prof. S. P. Thompson inquired whether the magnitude of the effect varied with the intensity of illumination as in selenium, and also if any change was produced by altering the direction of vibration of the incident light. Mr. G. M. Whipple wished to know whether any difference was produced by blackening the bars, and as bearing somewhat on the same subject mentioned an induction magnetometer in which an iron bar used was demagnetized by plunging in hot water. The results obtained were very irregular after the first magnetization, and this may have been due to the instability shown to exist by Mr. Bidwell's experiment. In reply, Mr. Bidwell said red light produces most effect, and blackening the bar makes the action much slower. As regards selenium, the character of the effect is similar, but he believes the causes to be different. Polarized light produces no change. In answer to Prof. Herschel, he said that any part of the bar is sensitive to light, and showed that illuminating both sides of the bar increased the effect.—Mr. G. M. Whipple read a note on the dark flash seen in some lightning photographs. After expressing his dissent from the explanations offered in the report of the Lightning Flash Committee of the Meteorological Society and Prof. Stokes respecting ribbon lightning and dark flashes, the author described some experiments he had made on the subject. Ribbon lightning he conceived to be an effect produced by taking the photographs through windows, and to test this, lines on a blackboard were photographed, (1) direct ; (2) through good plate-glass placed obliquely ; and (3) through window-glass, the result being that the double, triple, and ribbon flashes were closely imitated. As regards "dark flashes," the author believes the appearance due to the prints being taken in oblique light, and to be produced by successive reflection from the reduced silver forming the dark line on the negative and the upper surface of the glass of the negative. Prof. Perry suggested that this might be easily proved by examining a negative, the prints from which show the dark flash. Mr. Baily pointed out that, if the explanation given were correct, the dark line should be parallel to the bright one, and this he understood was not always the case. Mr. Boys remarked that one dark flash exhibited minute wriggles not seen in the bright one, and Mr. C. V. Burton thought these might be due

[1] Gyllenskiöld's statement of Proctor's value is based on NATURE, vol. iii. p 347 and p. 68.

to irregularities in the upper surface of the negative. Dr. Gladstone said he was not satisfied with Prof. Stokes's nitrous oxide explanation, but thought the phenomenon may be due to some kind of reversion. He also mentioned that a negative might probably be obtained from Mr. Shephard, of Westbourne Grove. As regards multiple flashes, Mr. Boys said he had often seen seven or eight flashes traverse the same path in rapid succession. On the motion of the President, the discussion was adjourned until the next meeting, when Mr. Whipple hopes to exhibit the negative referred to, together with photographs of his experimental dark flashes.—On quartz as an insulator, by Mr. C. V. Boys, F.R.S. In making quartz fibres the author observed that the ends of fibres broken during the shooting process coiled up into screws, and projected themselves against anything brought in their vicinity. After a short time they released themselves and sprang back to their original position. This could be repeated indefinitely, and the only explanation he could think of was that the fibre was electrified. If so, then to exhibit such phenomena the insulating qualities of quartz must be very great, and experiments were shown to demonstrate this deduction. A small pair of charged gold leaves were suspended from a short quartz rod in a moistened atmosphere, and the deflection fell one-quarter the original amount in about five hours. A clean glass rod under the same conditions would discharge the leaves in a few seconds. Dipping the quartz into water did not seem to diminish its insulating properties, and ordinary chemicals produced no permanent prejudicial effect. The author considers that quartz will be very useful in electrostatic apparatus, for the troublesome sulphuric acid may be dispensed with.—On a refraction goniometer, by Mr. A. P. Trotter. The goniometer, which was designed when determining the figure of a refracting surface to effect a special distribution of light, is practically a movable four-bar linkwork, representing the figure given in Deschanel (p. 924); two of the bars are parallel to the incident and emergent rays, and the other two normals to the faces of the prism. By its means the angle of a prism to produce a given deviation, when the index of refraction and angle of incidence are known, can be readily found. A series of curves expressing the relation between incidence and deviation for prisms of various angles were shown, and the same curves show the minimum deviation and limiting angle for prisms of all angles represented. The author thinks the instrument will be useful in physical laboratories for adjusting optical apparatus and for the calculation of lighthouse and other polarized lenses, Fresnel prisms, &c. Prof. Herschel said he found a wooden model illustrating the relations between the angles of incidence and refraction very useful in teaching; and Mr. Blakesley sketched an arrangement of links and cords devised for the same purpose. Mr. Boys considered that all such relations were best seen on a slide rule.—A note on apparatus to illustrate crystal forms, by Prof. R. J. Anderson, was read by Prof. Perry. The apparatus is constructed of cords, pulleys, and weights arranged to produce the required figure when in equilibrium. By increasing or decreasing some of the weights the corresponding axes of the crystal forms can be lengthened or shortened, and the passage from one system to another effected. In one arrangement the forces may be divided or united, and the pulleys are carried by rings capable of rotating on different axes. By this apparatus the various conditions are said to be beautifully illustrated, and methods of deriving the oblique from the rectangular systems are shown in photographs which accompany the paper.

Entomological Society, May 1.—Mr. Frederick Du Cane-Godman, F.R.S., Vice-President, in the chair.—Mr. W. L. Distant announced the death of Dr. Signoret, of Paris, one of the Honorary Fellows of the Society.—Dr. Sharp exhibited male and female specimens of *Rhomborhina japonica*, in which the thorax was abnormal; also, a specimen of *Batocera roylei*, which he had kept in a relaxed condition in order to be able to demonstrate the power of stridulation possessed by this species.—Dr. N. Manders exhibited a small collection of Coleoptera, including several remarkable and very interesting species, recently made by him in the Shand States, Burmah.—Mr. C. O. Waterhouse exhibited, for Mr. Frohawk, a series of wings of British butterflies, prepared in accordance with a process (described by Mr. Waterhouse in the Proc. Ent. Soc., 1887, p. xxiii.), by which they were denuded of their scales so as to expose the neuration.—Dr. P. B. Mason exhibited cocoons of a species of spider—*Theridion pallens*, Black.,—from Cannock Chase, distinguished by the presence of large blunt processes on their surface.—Mr. H. Goss exhibited, for Mr. N. F. Dobrée, a number of scales of *Coccidæ*, picked off trees of *Acacia melanoxylon* and *Grevillea robusta*, growing in the Market Square, Natal. These scales had been referred to Mr. J. W. Douglas, who expressed an opinion that they belonged to the family *Brachyscelidæ*, and probably to the genus *Brachyscelis*, Schrader. He said that most of the species lived on *Eucalyptus*.—Captain H. J. Elwes exhibited a long and varied series of specimens of *Terias hecabe*. He remarked that all the specimens which had strongly defined markings were taken in the cold and dry season, and that those which were without, or almost without, markings, were taken in the hot and wet season; further, that he believed that many specimens which had been described as distinct were merely seasonal forms of this variable species. Mr. W. L. Distant, Mr. F. D. Godman, F.R.S., Prof. Meldola, F.R.S., Mr. H. T. Stainton, F.R.S., and Mr. G. Lewis took part in the discussion which ensued.—Mr. H. Burns exhibited, and made remarks on, a number of nests of living ants of the following species, viz. *Formica fusca*, *Lasius alienus*, *L. flavus* *L. niger*, *Myrmica ruginodis*, *M. scabrinodis*, &c. One of the nests contained a queen of *L. flavus*, which had been in the exhibitor's possession since September 1882.—Mr. W. Dannatt exhibited specimens of *Thaumantis howqua*, West., from Shanghai.—Mr. G. C. Bignell communicated a paper entitled "Description of a New Species of British *Ichneumonidæ*."—Mr. A. G. Butler communicated a paper entitled "A Few Words in reply to Mr. Elwes's statements respecting the incorporation of the Zeller Collection with the General Collection of Lepidoptera in the Natural History Museum." Captain Elwes, Mr. Stainton, Mr. Godman, and others, took part in the discussion which ensued.

PARIS.

Academy of Sciences, May 7.—M. Des Cloizeaux, President, in the chair.—On elliptical polarization by vitreous and metallic reflection; extension of the methods of observation to the ultra-violet radiations, by M. A. Cornu. The principles on which Cauchy has established the theory of these two orders of phenomena and the form of the laws controlling them differ so greatly that most physicists regard them as essentially distinct. But these experiments show that this is not the case, and that the same substance may present a continuous transition from one to the other according to the nature of the reflected radiation. It follows that the phenomena presented by transparent substances with metallic sheen (fuchsine, platinocyanides, &c.), far from being exceptional, merely constitute particular forms of the general phenomenon of reflection.—On the origin of bronze, by M. Berthelot. The author has analyzed specimens from a statuette from Tello in Mesopotamia, and from the sceptre of the Egyptian king Pepi I. (sixth dynasty), both dating back to about 4000 B.C., and both consisting of pure copper. From this he argues that, as in the New World, the Stone Age was followed by a Copper Age in the eastern hemisphere, and that the bronze period cannot be more than some fifty or sixty centuries old.—On the thionic series; action of the alkalies, by M. Berthelot. Having already determined the heats of formation of the thionic compounds (*Comptes rendus*, cviii. p. 773), the author here deals with the reciprocal transformations of these compounds under the influence of the alkalies. The pentathionates, tetrathionates, and trithionates are treated in detail, and it is concluded that these as well as other compound substances, such as metaphosphoric and pyrophosphoric acids, hitherto regarded as isolated and exceptional, all come within the same general theories as the organic acids.—Note on an iron meteorite discovered buried in the ground at Haniet-el-Beguel in Algeria, by M. Daubrée. This meteorite, found at a depth of 5 metres, while sinking a well in the Wed Mzab district, appears to be of great age, having fallen probably during the Quaternary epoch. It shows the Widmanstätten figures quite distinctly, and its other characteristics place its extra-terrestrial origin beyond all doubt.—Remarks accompanying the presentation of the third part of the *Bulletin international de la Carte du Ciel*, by M. Mouchez. In these remarks special attention is called to Mr. Isaac Roberts's *pantograveur stellaire*, an ingenious and valuable process, by means of which the photographic impressions of the stars can easily be transferred to metallic plates, and thus preserved from all danger of perishing. The method is simple and economical, and allows of an unlimited number of copies being taken for general use. By this invention all risk is removed of the labours of the International Association for photographing the Heavens being lost to future generations.—Researches on the application of the measurement of rotatory power to

the study of the compounds formed by the action of the magnesium and lithium molybdates on the solutions of tartaric acid, by M. D. Gernez. The present series of experiments are analogous to those already described in previous communications, demonstrating the great increase experienced by the rotatory force of certain active compounds when their solutions are placed in contact with various substances without proper action on polarized light. Here M. Gernez studies more particularly the action of the neutral magnesium molybdate on solutions of tartaric acid, and the action of the neutral lithium molybdate on the same solutions. Combining these with the results already obtained, he is now able to formulate the following general conclusion: The simplest combinations which are produced in aqueous solution between tartaric acid and the neutral molybdates and tungstates hitherto studied, and which correspond to a maximum rotatory power, are formed by the union of the acid with the salt molecule for molecule.—On the atomic weight of ruthenium, by M. A. Joly. In a previous communication (*Comptes rendus*, cvii. p. 994) the author announced that the analysis of compounds of nitric oxide with rutheno-chlorides led to a reduction of about two units in the atomic weight of ruthenium (104–103·5) as determined by the latest researches of Claus. He now finds this view confirmed by his own studies, and provisionally fixes the atomic weight of this element at 101·4. In its preliminary transformation into compounds containing nitric oxide the ruthenium was completely freed from osmium, the atomic weight of which, according to Seubert's last determinations, is nearly double (191), and this would explain the considerable reduction in the atomic weight of the ruthenium itself.—On α-oxycinchonine, by MM. E. Jungfleisch and E. Léger. A detailed description is given of the preparation, properties, salts, and various derivatives of this substance, the formula of which is $C_{38}H_{22}N_2O_4$.—On the alcoholic fermentation of the juice of the sugar-cane, by M. V. Marcano. The object of these studies has been to determine the agent of the alcoholic fermentation, as well as the nature of the products accompanying the alcohol yielded by the juice of the sugar-cane.—Action of zinc chloride on isobutylic alcohol in the presence of hydrochloric acid, by MM. H. Malbot and L. Gentil. The points here chiefly studied are the part played by the isobutyl chloride, and the properties of the polybutylenes.—On an artificial silk, by M. de Chardonnet. The author has prepared from a pure cellulose octonitrate a silk-like fabric of great elasticity and softness, more lustrous than the silk of cocoons, and capable of being dyed by the ordinary processes. Specimens will be shown at the Universal Exhibition.—M. Daubrée paid a tribute to the memory of the late M. Lory, Corresponding Member of the Section for Mineralogy, who died at Grenoble on May 3.

BERLIN.

Physical Society, April 5.—Prof. von Helmholtz, President, in the chair.—Prof. Rosenthal, of Erlangen, described his calorimeter and the experiments he had made with it on the heat-production of the animal body. (See report of the Physiological Society in NATURE of April 25, p. 624.) He then showed a small experiment on making flames non-luminous. This result can be obtained either by means of a strong current of air or by considerable cooling. The speaker, however, produced the same effect in the following way. A small gas-flame is made to burn brightly inside a cylindrical chimney; it becomes non-luminous as soon as a platinum crucible is placed on the chimney so as to incompletely close the upper end of the cylinder. Prof. Rosenthal believes that in this case the current of air through the chimney is very considerably slowed, hence the gas issuing from the burner becomes disseminated throughout the whole mass of air, and as a result of this, the temperature being low, it burns without giving any light. Several other explanations of the phenomenon were suggested by the members present at the meeting.—Dr. Fröhlich made a further communication in connection with his older, resultless experiments on the objective demonstration of the vibrations of a telephone-disk, in order to describe his new method by which positive results had been obtained. In his earlier experiments he employed manometric flames, and endeavoured to photograph their movements with the help of a rotating mirror; now, however, he attaches a small mirror to the iron plate of the telephone, and from this the light of an electric lamp is reflected on to a polygonal rotating mirror, from which it falls upon a screen. The vibrations of the plate were thus made visible on the screen, and since each side of the polygonal mirror cast its own image, when the mirror was rotated the curves were seen moving over the screen. The more rapidly the mirror was rotated the slower did the curves move over the screen, and when the rotation was as rapid as the vibration of the plate, the curves became stationary and could thus be exactly observed and drawn. These luminous curves could also be photographed. The speaker had employed this method in a series of researches on certain electrical phenomena which might influence the efficiency of the telephone. Thus the action of alternating currents, of self-induction, of the rise and fall of the current on making and breaking, of the introduction of electro-magnets, and of other conditions, were studied by means of the altered mode of vibration of the telephone plate. The speaker had further obtained a graphic record of the vibrations of the telephone plate when vowels and consonants are sung and spoken into it. Many other problems may, by the above method, be brought nearer to their solution.—Dr. Reichel showed a lecture-experiment with a water-hammer. When the bulb in which the fluid is contained is grasped in the warm hand, the fluid is driven over to the other side by means of the vapour which is then formed. When all the fluid has thus passed over, bubbles of vapour finally make their way through the fluid, and at this moment the hand which is grasping the bulb experiences a distinct sensation of cold.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Illustrations of Zoology: W. R. Smith and J. S. Norwell (Pentland).—South Africa as a Health Resort, 2nd edition: A. Fuller (Whittingham).—A Dictionary of Explosives: Major J. P. Cundill (Mackey, Chatham).—Three Cruises of the *Blake*, 2 vols.; Bulletin of the Museum of Comparative Zoology at Harvard College, in Cambridge, vols. xiv. and xv.: A. Agassiz (Cambridge, Mass.).—Bibliography of Meteorology—Part 1, Temperature: edited by O. L. Fassig (Washington).—Mr. Stranger's Sealed Packet: H. MacColl (Chatto and Windus).—Travels in the Atlas and Southern Morocco: J. Thomson (Philip).—A Treatise on Trigonometry: W. E. Johnson (Macmillan).—Darwinism: A. R. Wallace (Macmillan).—Life of Charles Blacker Vignoles: O. J. Vignoles (Longmans).—Gleanings from Japan: W. G. Dickson (Blackwood).—Celestial Motions, 6th edition: W. T. Lynn (Stanford).—Our Fancy Pigeons, cheap edition: G. Ure (Stock).—Natural Science Examination Papers—Part 1, Inorganic Chemistry: R. E. Steel (Bell).

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