THURSDAY, JUNE 26, 1890.

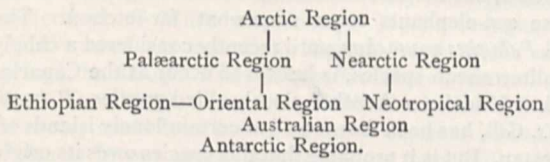
ZOOLOGICAL GEOGRAPHY.

La Géographie Zoologique. Par le Dr. E. L. Trouessart. Avec 63 figures intercalées dans le texte et deux cartes. (Paris: J. B. Baillière et Fils, 1890.)

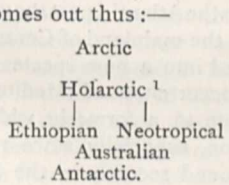
DR. TROUESSART, author of a "Catalogue des Mammifères Vivants et Fossils," and until recently Curator of the Museum at Angers, has enriched the Bibliothèque Scientifique Contemporaine with a most interesting and valuable book on zoological geography. This work must have caused its author a great amount of labour, to judge from the painstaking way in which he has worked in the facts collected by numerous specialists. Their results, and those of his many predecessors in the fascinating field of the distribution of animals, have been augmented by his own views, and have been condensed into a form which it is agreeable and easy to read.

The first six chapters are devoted to a description of the various zoo-geographical regions as they are now generally accepted. The different types of animals which are to serve as a basis for the investigation of the laws of geographical distribution are grouped in four classes, according to their means of dispersion and their usual habitats: terrestrial, fresh-water, aërial—*i.e.* provided with wings—and marine. The author has greatly increased the value of his book by the graphic method he has employed to show the distribution of given groups of creatures.

The general scheme is given on p. 175, the eight regions into which the author divides the globe being indicated by blocks, which are arranged and connected with each other as follows:—

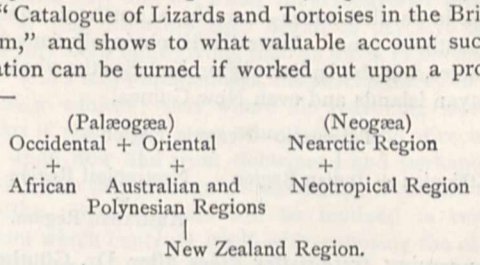


The *mammalian distribution*, when expressed by such a lucid scheme, comes out thus:—



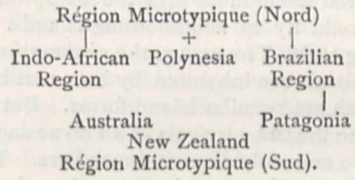
This indicates that, so far as mammals only are concerned, the Palæo- and Nearctic regions are practically one, while the Oriental is merged in the Ethiopian region. Australia stands, of course, alone; but that this continent must have been once connected with the Indo-Malayan countries is strongly indicated by the dingo and several other, chiefly rodential, placental mammals in Australia. The discovery by Prof. MacCoy of fossil bones of the dingo in Pliocene strata of Victoria disposes at once of the hypothesis of its having been introduced by man.

The distribution of *reptiles* (p. 204 *f*) is almost entirely based upon G. A. Boulenger's results, as published by him in the "Catalogue of Lizards and Tortoises in the British Museum," and shows to what valuable account such a publication can be turned if worked out upon a proper basis:—



This scheme indicates that in the distribution of reptiles the principal relationships range vertically, with few or hardly any (except, of course, in Europe and Asia) transverse or longitudinal similarities. The globe is practically divisible into two great regions—namely, into Neogæa and Palæogæa, or into an American, Oriental, and Occidental region, New Zealand being a remote and peculiar appendix of the Oriental portion.

On p. 215 *f*, *terrestrial insects*, especially Coleoptera, are discussed. The two Polar regions possess a few forms only, and need hardly be considered. The Holarctic region, connected by the broad vertical belt of Polynesia and the west coast of both Americas with the Australian, New Zealand, and Patagonian regions, is comparatively poor in Coleopterous types, and the forms which occur have certain resemblances in common. Two large centres of rich development in forms and numbers are the Indo-African or Ethiopian, and the Brazilian or typical Neotropical regions.



The division of the globe into Palæogæa and Neogæa is equally applicable to the *Arachnids*, the differences between Arcto and Notogæa being of by far less importance. Arachnid regions are: (1) Palæarctic, (2) Ethiopian, (3) Oriental, (4) Australian, (5) American. The whole of America has practically an Arachnid fauna from north to south, and it is divisible into eight sub-regions, which do not correspond with those of Wallace. The Ethiopian Arachnid region comprises the whole of Africa south of the Atlas, and Central Arabia; it has therefore been called the Libyan region, since it differs by the whole extent of the Sahara from the Ethiopian region of Wallace. The Oriental and Australian regions are those of Wallace, but the Oriental includes Madagascar and South-Eastern Africa as a sub-region. Certainly, so far as Coleoptera and Arachnida are concerned, Madagascar is much more Malayan than African. The Palæarctic region, as a whole, is that of Wallace, but the four sub-regions are differently arranged—namely, Europeo-Siberian, Hispano-Italian (Western Mediterranean and Canary Islands), Taurian or Eastern Mediterranean, with Asia Minor and the Turanian Steppes,

[1] For Holarctic the more convenient and more correct name of the Periarctic region might be substituted. Holarctic should logically include the Arctic together with its subdivisions. Triarctic, an American term, means, of course, Arctic + Palæo + Nearctic, while Periarctic would indicate what is wanted—namely, the Holarctic minus the Arctic region.—H. G.

and lastly the Manchurian sub-region, which consists of China and Japan.

The scheme which represents, after Boulenger, the distribution of *Amphibia*, strongly indicates their distribution in parallel zones—namely, a northern, equatorial, and southern zone. Australia is obviously American in character, but the Indian region includes the whole of the Malayan islands and even New Guinea.

Palæarctic—Nearctic Region
Ethiopian + Indian Region — Neotropical Region + Australian Region.

Concerning *fresh-water fishes*, after Dr. Günther, the diagram shows at a glance that the form of the continents has little influence upon the distribution. There are likewise parallel zones, one of which, the Arctic, contains no fresh-water fishes.

Northern Zone = Palæarctic + Nearctic Region.
Equatorial Zone =
African + Indian (Cyprinoid Section) — Pacific or Australian + Neotropical Region (Acyprinoid Section)
Antarctic Zone = Tasmanian, New Zealand, Patagonian Sub-regions.

The distribution of *terrestrial mollusks* is that of S. P. Woodward and P. Fischer's "Manuel de Conchyliologie," 1887. The six molluscan regions correspond almost exactly with those of Wallace, with this exception, that the Patagonian or Chilian sub-region is elevated to the rank of a seventh region.

In dealing with the distribution of *flying creatures*, the author rightly draws attention to the circumstance that the recent volcanic outbursts of Krakatáo might have killed all the terrestrial inhabitants with the exception of such animals as could fly to neighbouring islands. Therein lies, according to M. Trouessart, the explanation why the Polynesian islands are inhabited by bats and birds only, some of which are peculiar island forms. But these he considers to be the last survivals of a Polynesian fauna, of which we have now only dispersed members. This is one of those perplexing ideas which, although arrived at by a perfectly logical process of thinking, are nevertheless without any real justification.

For the distribution of *birds* Dr. Reichenow's six zones have been adopted; these zones are widely different from the now time-honoured six regions.

Arctic Zone
Oriental Zone — *Occidental Zone*
Oriental Temperate Region — Occidental Temperate Region
Ethiopian Region — Malayan Region — South American Region
Madagascar Zone — *Australian Zone*
Antarctic Zone.

The Oriental and Occidental zones are, of course, nothing but the Palæo- and Neogæa; the word zone should not be applied to eastern and western hemispheres, but rather to horizontal belts. Dr. Reichenow lays stress upon the idea that the annual migration of European and of Asiatic birds shows their connection with the Ethiopian and Malayan regions; hence their combination into one zone, together with what has been called hitherto the Palæarctic region. Madagascar has been elevated to separate rank, and so have the Arctic and Antarctic zones, so that on the whole the old arrangement (based by Dr. Sclater chiefly upon birds) has been completely altered. Birds are far less cosmopolitan than one might suppose, judging only by the strength of their wings.

The distribution of *Lepidoptera* is rather surprising, because the applied schematic representation shows that there are only three great regions. The New World, from Canada to Cape Horn, stands alone; Africa forms only a sub-region of the large Holarctic region, which includes Canada; while Australia forms a sub-region of the Indian region, which again gradually merges in the eastern half of the Holarctic. These results, however, are based upon the somewhat antiquated conclusions drawn by Koch and Staudinger in 1850.

Holarctic Region
American Region — African Sub-region — Indian Region
Australian Sub-region.

According to the Spanish naturalist, J. Bolivar, the distribution of the Orthoptera, which, being possessed of great power of flight, are given to long migrations, agrees rather with that of a part of the Coleoptera.

Pp. 280 and 281 contain a map of the world, on Mercator's projection, upon which the principal ocean currents are indicated, and by conventional signs the distribution of seals, sea-lions, penguins, and auks. The Spheniscidæ have been carried along the west coast of South America as far north as the Galapagos Islands by the cold Humboldt's current, a circumstance which, by the way, was first pointed out by the late Dr. Watson in his *Challenger* Report on the Spheniscidæ. The Pinnipede genus Macrorhinus follows strange lines across the Pacific Ocean, apparently in conformity with existing currents, but the conclusions as to the original home of these sea-elephants seem somewhat far-fetched. The seal *Pelagius monachus*, until recently considered a chiefly Mediterranean species, is known to occur at the Canaries and at Madeira. Another closely allied species, *P. tropicalis*, Gill, has been discovered at certain lonely islands off Yucatan. But is it probable that this species owes its origin to a small group of the Mediterranean species, which has been carried across the Atlantic, past the numerous Antillean islands, almost to the mainland of Central America, there to be transformed into a new species? Is it not more likely that the occurrence of Mediterranean seals in the Atlantic is due to a formerly wider extra-Mediterranean distribution, especially since remnants of such seals have been found recently in the Furfoz caves near Setubal?

The eleventh chapter deals with the faunas of deep seas, high mountains, coast zones, lacustrine and subterraneous regions.

The twelfth, the last chapter, gives a very short account of the distribution of animals in time. Hardly any types of fossil animals are known to have existed in all regions of the globe. The largest animals enjoyed the most restricted range, both in space and in time. The small size and the early occurrence of mollusks and insects explain their now almost cosmopolitan distribution, while the greater abundance of Tertiary mammals, with their subsequent local extermination, gives the clue to

their present often scattered range. The great divisions of the world into Palæogæa and Neogæa are confirmed by palæontology. Still more marked, however, is and has been the contrast between Arcto- and Notogæa: so that one feels inclined to suppose that the Neogæa is only an exaggerated extension of the Notogæa.

Such is a short outline of the contents of this book, which, we feel sure, everyone interested in the study of geographical zoology or of zoological geography, as the case may be, will be pleased to read.

H. GADOW.

JEVONS AND MILL.

Pure Logic and other Minor Works. By W. S. Jevons. Edited by Prof. Adamson and Harriet Jevons. (London: Macmillan and Co., 1890.)

THE services of the late Prof. W. S. Jevons to logic were so eminent that considerable interest attaches to his minor writings on that subject, which are now collected into a volume. The earlier works, "Pure Logic" and "The Substitution of Similars," which are contained in the first and larger part of the volume, possess, indeed, no more than a historic value. They expound his well-known theory of equational logic, but for all practical purposes they are replaced by the later and more interesting exposition which is contained in the "Principles of Science."

The second part of the volume is a reprint of the articles which Jevons contributed to the *Contemporary* in criticism of J. S. Mill. A short chapter on the method of difference is all that the editors were able to add to them out of the mass of manuscript which the author had in preparation for a systematic criticism. These essays do not add to Jevons's reputation. They are a passionate indictment of Mill's consistency: Jevons thought that "Mill's mind was essentially illogical," and in the name of logic he thought it his duty to undermine the authority of Mill's writings. It may be doubted whether any work of theory could bear such a strain of rigorous verbal precision as Jevons endeavours to impose upon Mill. However, not even the most devoted admirers of Mill would maintain that Mill was a consistent thinker; they would find his merit elsewhere. To them and to others it will seem that Jevons has left behind him a criticism far worthier both of himself and of Mill, in the positive advances which he made upon Mill's doctrines in his own work on the principles of science, in the light which he threw upon the fundamental nature of induction, upon the function of hypothesis, and upon Mill's so-called deductive method.

Among the generation which is now entering upon maturity many persons must have passed through a similar history in their feelings with regard to Mill. They became acquainted with his philosophy in youth, and were carried away by its apparent clearness, its freshness and youthful feeling, its love of truth, its dignity, and the large views it gave them of human thought and human life. It opened to them a new world of thought and feeling. Afterwards, as they reflected upon it, with the help of teachers anxious that enthusiasm should not blunt the edge of their pupils' powers of rigorous thinking, they discovered that it was riddled with contradictions real as well as verbal; was full of doctrines laid alongside of each other without adjustment. By and by, when they recovered from the shock of this discovery, they began to perceive that its very errors were light-giving, that its inconsistencies were due to Mill's large-mindedness, his susceptibility to every side of a subject; that where his reasoning was least rigorous it was often most stimulating, and directed inquiry upon new and truer doctrines; and perhaps they often fell into the paradox of cherishing its errors above its truths. Such persons will be inclined to resent a criticism which contents itself with exposing the obvious contradictions of Mill's philosophy.

It is paying poor respect to a thinker to excuse his want of consistency. But with a writer like Mill, above all others, a mere destructive criticism conveys a positively false impression. It is for any higher purpose of little value, because it fails to point out the real significance of the incriminated doctrines. And this is just the vice of Jevons's attack.

Let it be granted at once that Mill's doctrines of geometrical axioms, of the foundation of induction, of pleasure, contain glaring contradictions. Mill holds that geometrical axioms are derived from experience; but while he admits that there is no such thing in existence as a straight line, he declares that we can reason about straight lines because our ideas of spatial figures exactly correspond to the reality. He declared that all induction rests ultimately, in a syllogistic relation, upon the law of causation, and at the same time that this principle is itself derived from particular inductions by the process of simple enumeration, which he elsewhere stigmatizes as vicious. With a theory of pleasure not different in principle from that of Hume and Bentham, he at the same time asserts a distinction of pleasures in kind. In exposing these contradictions, as well as in pointing out the difficulties of the method of difference, Jevons is completely successful; but in leaving the reader to infer that Mill's doctrines are therefore valueless he omits the most necessary part of the critic's task. Mill distinctly says that the axiom that two straight lines cannot inclose a space represents the limit to which many actual experiences approximate. It is true that he did not solve the ultimate difficulty of the relation to reality of such a limiting proposition—call it a hypothesis, or call it an ideal experiment. But, in spite of the gratuitous inconsistencies he introduces into the argument, Mill's contention remains unassailed that geometrical truths derive their authority from the same source as all other truths. With regard to the basis of induction, a more impartial criticism would have pointed out that Mill failed because he was untrue to himself. His doctrine of the syllogism is one of the most important contributions ever made to logic, but if he had been true to it he would have given to the law of universal causation as major premiss of the inductive syllogism a function like that which he assigns to the major premiss of every syllogism, and both secured the consistency of his whole theory as well as the truth of this particular doctrine. His distinction of pleasures according to kind is impossible on his own theory, its real position in his mind uncertain, and its suggestiveness in any case small; but, with its appeal to the judgment of

the good man, it corresponds to a real fact that pleasures do differ according to the position they occupy in the whole moral order, and that this is reflected in the judgment of good men.

But while Jevons's critical attack is successful in the above points, it fails even of its limited object in the attack on Mill's doctrine of resemblance, which is a mere verbal criticism and a misinterpretation. Mill limits the name of propositions of resemblance to those which explicitly state resemblance, or the particular form of resemblance called equality. But because he shows that attributes, propositions, syllogisms, inductive methods, analogy, all involve resemblance, and the word is used on every page of the discussion of these subjects, Jevons accuses him of contradiction. The fallacy of the criticism is obvious. Though all argument and reasoning may depend on resemblance, they need not be concerned with resemblances as such. Who would say when he feels two similar impressions, and feels them therefore similarly, that he necessarily feels and thinks of their similarity as an explicit relation subsisting between them?

The sketch which Prof. Adamson gives of Jevons's full plan leads to the presumption that the rest of his criticisms would have been of the same kind as those published. As one of the subjects discussed is the theory of the syllogism, and of inference from particulars to particulars, reference may be made to the impartial and sagacious treatment of the same subject in Mr. Bosanquet's "Logic," made by a writer of a very different school from Mill. Those who look to what Jevons effected in political economy and logic will not be able to avoid regretting that he should have felt it his duty to bestow so much of the energies of his fine intellect upon a task for which, except for an acuteness not much greater than that of hundreds of students of Mill, he was disqualified by lacking the most essential requisite of a critic.

S. A.

THE WASHINGTON MEDICAL LIBRARY.

The Index Catalogue of the Library of the Surgeon-General's Office, U.S.A. Vol. X. O—Pfutsch. (Washington: Government Printing Office, 1889.)

IT has always been a pleasure to watch the steady growth of this unique Catalogue, and the pleasure increases when we see it now within four, or at most five, years of its completion with the same accurate finish in detail as when its first volume appeared in 1880. It bears on it throughout the stamp of Mr. J. S. Billing's hand, and the elaborate method of cataloguing both books and all signed journalistic articles under the subject-heading, as well as all the books and republished articles under the author's name also, has been fully justified in its results, and has shown its very high value in these ten volumes. This volume can give some clue to the labour that has been involved in that system by its article on "Periodicals," which has been most justly thought so remarkable, as well as useful, as to have been republished by itself. Room can just be found in 212 large quarto pages for the titles of the medical journals—daily, weekly, monthly, quarterly—and the annual reports not only of hospitals, but of all medical and surgical societies, on many matters touching more or less on professional matters. These amount to some 7250 entries, and some 43,670 volumes. That is a total of medical periodical literature which is not approximately reached by the British Museum, the Bibliothèque Nationale of Paris, or any other library, general or professional, in the world. Of course some thousands of these entries—about half, in fact—do not represent living current publications, but about 3600 may be calculated as the total of current medical periodicals catalogued, using the term periodical in the wide sense that will include such publications as the "*Theriaki*, a Magazine devoted to the interests of the opium-eater," the "*Revue Spirite*, ed. par Allan Kardec," and the "*American Rushlight*, by Peter Porcupine." We do not notice any single continuous periodical that has published more than 314 bound volumes such as are furnished by the *Annales de Chimie*, which has been uninterrupted since 1790. A few old Latin *Annales*, or *Acta*, date back to 1692-6, but do not run to any length.

Looking at them as distributed by the countries of their publication, the largest number of past and current together falls to the United States, viz. about 2000; but it must be admitted that on the whole they are smaller and shorter-lived than their fellows, and are more constantly changing their names, a point which is carefully and usefully noted in the Catalogue. The German Empire has rather more than France, viz. about 1100 to 900; Great Britain about 700, Italy about 450, and so on till we come to Syria with two, and Malta with only one. Among so many it can hardly be feasible to avoid every possible mistake. It is a pity, for instance, to enter two such similar publications as the Transactions of the Royal Medical and Chirurgical Society, and of the Clinical Society, the one under Medical and Chirurgical, and the other under Transactions.

This immense mass of literature, however, gives to anyone who looks into it a very striking impression of all the careful labour that must have been necessary to tabulate all the articles in these so-called periodicals under the subject-headings, as has been done, so that the inquirer under any of the commoner subjects may find himself at any moment referred back to an article in a Dutch paper more than 150 years ago.

The "Pest" is the name chosen under which to group all the ancient and modern accounts of the vague and terrible plagues. Under that heading are to be found four editions of Defoe's classical tract on the Plague of London. The collection under this heading of archæological works well illustrates the energy of the American librarians, and the funds that must have been placed at their disposal, for we find of books printed in the fifteenth century 6 dealing with it, of the sixteenth century 169, and of the seventeenth century 207—of themselves not an easy collection to make in the last 30 years on either side of the Atlantic.

A. T. MYERS.

OUR BOOK SHELF.

Food in Health and Disease. By J. Burney Yeo, M.D., F.R.C.P., Professor of Clinical Therapeutics in King's College, London, and Physician to King's College Hospital. (London: Cassell and Co., 1889.)

A GOOD book on food is greatly wanted, one treating of the varieties of food, and their arrangement in the dietaries of health and disease. In some respects Dr.

Yeo's small work fulfils the requirements of a satisfactory book on the subject. It will be found useful for reference by the busy practitioner, and it contains numerous facts, as a rule clearly stated; and it will perhaps also be found acceptable to the lay public, as, in many parts, the style is more or less popular. The chemistry of food-stuffs is not treated as accurately as it might be. Thus we have "syntonin or muscle fibrin; myosin, from muscle," placed in separate lines as food-stuffs. In the table (p. 10), "casein" (probably a misprint for ossein) is placed under "gelatigenous substances"; and gelatin is itself considered a "gelatigenous" substance. This, it must be confessed, is a somewhat loose way of describing these substances.

Dr. Yeo makes the statement (p. 16) that albumen, together with water and salts, is able "alone to support the vital processes," and can "replace in nutrition the fats and carbohydrates." With this statement most physiologists would disagree. Several more instances of somewhat vague statements might be quoted from the work. Milk is considered by all classical writers on the subject a complete or perfect food; but Dr. Burney Yeo goes further than this, and classes eggs as "the only other complete food afforded by the animal kingdom" (p. 51): "but when regarded in the light of a complete food, the shell must be taken into account" (p. 69). In a second edition of the work, the physiological and chemical portion wants careful revision.

In the discussion of the diet in disease, Dr. Yeo is more at home; and he has set forth the various modes of dietetic treatment of disease in a clear manner. The only fault to be found with this part of the book is that the style is somewhat too diffuse to be of great service to the general practitioner, for whose use the work is evidently chiefly intended. Although we have criticized the loose physiological and chemical statements in Dr. Yeo's work (some of which have been quoted), yet the book will no doubt be found useful by many.

Fifth and Sixth Annual Reports of the Bureau of Ethnology to the Secretary of the Smithsonian Institution. By J. W. Powell, Director. (Washington: Government Printing Office, 1887–88.)

THESE Reports, each of which is presented in a large, well-printed volume, contain the record of much solid and useful work. The first of them—the Report for 1883–84—includes an elaborate paper, by Prof. Cyrus Thomas, on burial-mounds of the northern sections of the United States. This is followed by an essay in which Mr. Charles C. Royce tells the story of the official relations of the Cherokee nation of Indians with the Colonial and Federal Governments of North America. In the third paper, Dr. W. Matthews gives an account of what Prof. Powell describes as one of the most illustrative ceremonies of the Navajo, a tribe formerly widely diffused, and now settled in parts of New Mexico and Arizona. Dr. Clay MacCauley deals with the Seminole Indians of Florida, and Mrs. Tilly E. Stevenson gives a vivid picture of the religious life of the Zuñi child. Of the papers associated with the Report for 1884–85, the first is on the ancient art of the province of Chiriqui, Colombia, by Mr. William H. Holmes. To this excellent paper we have already called attention. It is followed by another, by the same author, on textile art in its relation to the development of form and ornament. Dr. Franz Boas contributes to the volume an instructive and well-arranged paper, in which he sets forth the results of his observation and study of the central Eskimo. Prof. Cyrus Thomas gives some aids to the study of the Maya codices, and Mr. J. Owen Dorsey brings together interesting versions of two Osage traditions. These versions are printed in the original language, with an interlinear and a free translation of each, and with explanatory remarks.

Light, Heat, and Sound. By Chas. H. Draper, B.A. D.Sc. (Lond.). (London: Blackie and Son, 1890.)

THE syllabus of contents of this little work is that of the elementary stage of the Science and Art Department, some additions being made in the sections on light and Heat in order to bring them up to the standard of the London University matriculation paper. Viewed as an examinational text-book, there is much that is meritorious in the arrangement and general character of the work, the information being conveyed in the disintegrated fashion now so common. We would, however, point out to Dr. Draper that hoar-frost is not frozen dew, but water deposited in the solid form, and that hail is not simply rain-drops frozen as they fall through a cold stratum of air. The questions placed as exercises at the end of the chapters have been selected from papers set at the above examinations, and will serve not only as a test of the student's progress, but as a branch of his mental education worth cultivating.

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 Bourdon Gauge.

ALLOW me to suggest to such of your readers as are interested in this subject the following experiment. Cut out of cardboard two annular strips, each of somewhat more than a quadrant, the inner radius being say 7 inches, and the outer radius 9 inches. Along the middle of each strip—that is, along the circle of 8 inches radius—cut the boards half through, so as to render them flexible, and then join the two strips together with gum paper at the inner and outer edges. In this way we obtain a curved tube whose section is a rhombus, and whose curvature is connected with the magnitudes of the angle of the rhombus. The manipulation of such a tube gives definiteness to one's ideas, and enables one to recognize that internal pressure, tending to augment the included volume, and therefore to make the section square, must also cause the curvature of the axis to approach a definite associated value. In this case the deformations are practically by bending, principally, indeed, at the hinges; and I cannot doubt that in its main features the mechanism of an ordinary Bourdon gauge may be looked at in the same light.

RAYLEIGH.

The Optics of the Lightning Flash.

IN the extract from Mr. Shelford Bidwell's recent lecture on "Lightning" at the London Institution, which appeared in your issue of June 12 (p. 151), I notice the author says that the lightning flash of artists has no existence in nature, and that it is an artistic fiction or symbol. May I venture to trespass on your valuable space to refer to a paper which I had the honour of reading before the Royal Meteorological Society (published in the current Quarterly Journal of the Society) only a few days after the delivery of Mr. Shelford Bidwell's lecture? In this paper I endeavoured to show how the "zigzag" flash so often seen by observers, and frequently depicted by artists, may have its counterpart in nature, quite consistently with the evidence of the photographs of lightning flashes collected by the Royal Meteorological Society.

I suggested that such an appearance is not the flash itself, but the optically projected image of the flash formed on clouds, not of a smooth surface, but of the rocky cumulus type. The image of the flash takes the angles of the uneven surface and becomes zigzagged. I showed how this might be by casting the photograph of a lightning flash—the "streaming" flash—by means of the optical lantern, on model cumulus clouds, made of cotton wool. The "streaming" flash became distorted, and in fact zigzagged, so that it could not have been recognized as the type mentioned.

"Projection" lightning flashes surely must happen in nature, and might be accounted for in more ways than one. I will

mention now one simple way which I illustrated by experiment at the meeting referred to. It is fairly well recognized that sheet lightning is the reflection of a flash on a cloud, for example; but if there happens to be the presence of a cloud with a small opening in it somewhere between the actual flash and the distant surface of clouds, then, instead of "sheet" lightning appearing on the latter, there will be "projection" lightning—that is, the image of the flash, whose shape will depend upon the shape of the cloud on which it is cast.

In speaking of zigzag representations of lightning flashes, it is important to make some distinction between the artistic zigzag and a common pictorial type such as is seen on the covers of electrical books, in dissolving views, in scenic effects, and even in street advertisements. It is hardly fair to saddle the artists with the latter class. A good specimen of an artistic zigzag flash, and one which shows an observance of nature, can be seen in Wilson's famous picture of "Celadon and Amelia."

It certainly seems at first sight strange that the "projection" flash should not be included in the photographs of lightning flashes. Its non-appearance may be due (1) to the photographic plates not being sufficiently sensitive to register a flash of diminished brilliancy, for the projected image of any source of light has not the same intensity as the source itself. (2) The "projection" flash being of rarer occurrence, the number of photographs yet taken may not have included it. If the type is rarer, it may be objected that it is not likely that artists would generally depict a rare type in preference to the more common one; but the less dazzling nature of the "projection" would be sufficient to account for its adoption, rendering the form of the flash more distinct to the average eye. To take an illustration, if an electric arc light is suddenly flashed before our eyes, we fail to distinguish the form of the white-hot carbon points, but if its image were flashed upon a screen, their form would be distinctly visible.

It is worthy of note that some painters have chosen to represent other types than what I have termed the "projection" flash. See Turner's "Stonehenge," where "streaming" lightning is pictured. ERIC STUART BRUCE.

10 Observatory Avenue, Kensington, W., June 16.

The Bagshot Beds of Essex.

In the second part of the paper on the Westleton beds, by Prof. Prestwich, recently published in the *Quarterly Journal of the Geological Society* (vol. xlvi. p. 152), a section of the Brentwood railway cutting is given, which is, if possible, of more interest from the Eocene beds described than from its bearing on the questions dealt with in the paper.

Reading the new section together with what we already know, we get the following succession of beds at Brentwood:—

(1) *Pebble beds*, capping the plateau up to 15 feet thick.

(2) *Bagshot beds*, about 50 feet, consisting of—

(*a*) Yellow or white sands (bed 6 of Mr. Whitaker's section, "Geology of London," i. 274).

(*b*) The green sands and clays *with fossils* of the railway cutting.

(*c*) Yellow sand with seams of clay of the railway cutting.

(3) *London clay*, about 435 feet, the upper part consisting of dark grey clay, with one or more beds of loam and yellow sand, the so-called "passage beds" exposed in the brick-fields near the station.

The fossils which Mr. Herries and I found near Frierning (Whitaker, "Geology of London," i. 276) came from white sand probably answering to bed 2*a*.

This section seems to show pretty clearly that the Bagshot beds of Brentwood are more nearly allied to the marine Bracklesham (Middle Bagshot) series than to the Lower Bagshots of the Bagshot Heath district, which are probably freshwater. If this be so, the masses of pebbles which overlie them may well be the remains of the pebble beds which so often mark the base of the Upper Bagshot (Barton) beds, and the parallel drawn by Mr. Herries and myself between the pebbles which cap the Warley and Brentwood plateau in Essex and those which cap Hook Heath and other hills in the Bagshot district becomes the more marked (Proc. Geol. Assoc., vol. xi. pp. 13, 16, 20).

1 Hare Court, Temple. HORACE W. MONCKTON.

Electro-Magnetic Repulsion.

THOSE who have not the means of showing the striking effects produced by Prof. Elihu Thomson may be glad to know a simple illustration of the same principles.

A top consists of a soft iron disk with a brass axis put through it. A small magnet is held over the edge whilst spinning; each elementary sector as it moves up to and away from the poles of the magnet has currents induced which are repelled by the magnet; as the rotation dies out, the currents at a certain point become too feeble to overcome the attraction of the soft iron by the magnet. I bought the top two or three years back of M. Manet, 49 Rue Lourmel, Paris. W. B. CROFT.

Winchester College, June 21.

A Remarkable Appearance in the Sky.

THERE was an appearance in the sky last night, so remarkable that I am tempted to describe it, in case, our situation being high, it should have been better seen here than elsewhere. Along the horizon, from north to about north-east, a faint bank of cloud extended, above which was a space of light like that of the early dawn or of the rising moon. There was no quivering, or shooting upwards of rays, as in the ordinary northern lights; the light was steady, white tending to yellow, brighter at the lower part. Above it hung a purplish haze, through which the stars shone brightly, and occasional strips of dark cloud. It did not happen to be observed till 10.30 p.m., and it was hardly altered at 1.30 a.m., when it was still bright enough to mark the window-frame through a white blind, like moonlight. Besides the position, the fact of a solar eclipse occurring that day proved the moon to have nothing to do with it.

Sussex, June 18. M. E.

PROBLEMS IN THE PHYSICS OF AN ELECTRIC LAMP.[1]

I.

MORE than eighty years ago Sir Humphry Davy provided the terminal wires of his great battery of 2000 pairs of plates with rods of carbon, and, bringing their extremities in contact, obtained for the first time a brilliant display of the electric arc.[2] The years that have fled away since that time have seen all the marvellous developments of electro-magnetic engineering, have placed in our possession the electric glow-lamp, and brought the art of electrical illumination to a condition in which it progresses each year with giant strides. In addition to the importance attaching to their ever-increasing industrial use, there are many questions of purely scientific interest which present themselves to our minds when we proceed to examine the actions that take place when a carbon conductor is rendered incandescent in a high vacuum, or when an electric arc is formed between two carbon poles. It is to a very few of these physical problems that I desire to direct your attention to-night, but more especially to one which is particularly interesting from the bearing which it has on the general nature of electric discharge.

We know as a very familiar fact that if we attempt to raise the temperature of a carbon conductor inclosed in a vacuum beyond a certain limit, not far removed from the melting-point of platinum, the carbon begins to volatilize with great rapidity. If an electric glow-lamp has passed through its carbon more than a certain strength of current, the glass bulb speedily becomes darkened by a deposit of this volatilized carbon condensed upon it; and experience shows us that we cannot raise the temperature of that carbon beyond a definite point without causing this waste of the conductor to become very rapid. In the highly rarefied atmosphere within the bulb of a glow-lamp, the carbon, when at its normal incandescence, must be con-

[1] Friday Evening Discourse delivered at the Royal Institution by Prof. J. A. Fleming, M.A., D.Sc., on February 14, 1890.

[2] Sir Humphry Davy laid a request before the managers of the Royal Institution on July 11, 1808, that they would set on foot a subscription for the purchase of a large galvanic battery. The result of this suggestion was that a galvanic battery of 2000 pairs of copper and zinc plates was set up in the Royal Institution, and one of the earliest experiments performed with it was the production of the electric arc between carbon poles, on a large scale. It is probable, however, that Davy had produced the light on a small scale some six years before, and, according to Quetelet, Curtet observed the arc between carbon points in 1802. See Dr. Paris's "Life of Sir H. Davy."

sidered to be projecting off molecules of carbon in all directions, partly in virtue of purely thermal actions, but probably also in consequence of certain electrical effects to be presently discussed. This scattering of the material of the carbon conductor takes place with disadvantageous rapidity from an industrial point of view at and beyond a certain temperature,[1] but it exists as well at much lower temperatures than that which is found to determine the practical limit of durability. A curious appearance is found in many incandescent lamps which have been "over-run," which shows us that this projection of carbon molecules from the hot conductor is not, perhaps, best described by calling it a vaporization of its substance, but that the surface molecules are shot off in straight lines, and that they reach the glass envelope without being hindered to any great extent by the molecules of the residual air.

If an electric current is passed through an otherwise uniform carbon conductor, which possesses at any one place a specific resistance higher than that of the remaining portion, the current, in accordance with a well-known law, there develops a higher temperature, and the molecular scattering at that spot may in consequence be greatly exaggerated. It may be that the detrition of the conductor at that locality will be so great as to cut it through after a very short time. When the carbon has the form of a simple horseshoe loop, and when this molecular scattering takes place from some point in the middle of one branch, the molecular projection makes itself evident by producing a "molecular shadow" of the other leg upon the interior of the glass. I will project upon the screen an image of the carbon horse-shoe loop taken from an old glow-lamp, and you will be able to see that the filament has been cut through at one place. At that position some minute congenital defect caused the carbon to have a higher resistance, the temperature at that point when it was in use became excessive, and an intensified molecular scattering took place from that locality. On examining the glass bulb from which it was taken, we find that the glass has been everywhere darkened by a deposit of the scattered carbon except along one narrow line (see Fig. 1), and that line is in the plane of the carbon loop and on the side opposite to the point of rupture of the filament.[2]

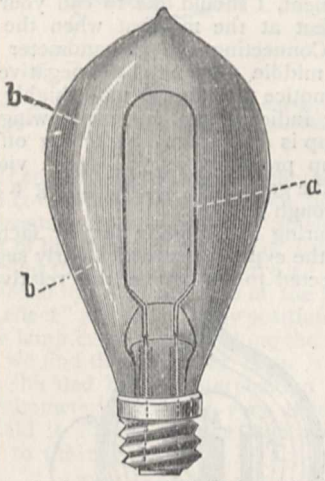


FIG. 1.—Glow-lamp, having the glass bulb blackened by deposit of carbon, showing the molecular scattering which has taken place from the point *a* on the filament, and the shadow or line of no deposit produced at *b*.

[1] When the rate of expenditure of energy in the carbon conductor is raised until it reaches a value of about 500 watts, or 360 foot-pounds per second per square inch of radiative surface, a limit of useful temperature has been reached for economical working, under the usual present conditions of steam-engine-driven dynamos and modern glow-lamps.

[2] The writer desires to express his indebtedness to the editor of the *Electrician* for the loan of the blocks illustrating this abstract.

I may illustrate to you, by a very simple experiment, the way in which that "shadow" has been formed. Here is a ∩-shaped rod: this shall represent the carbon conductor in the lamp; this sheet of cardboard placed behind it, the side of the glass receiver. I have affixed a little spray-producer to one side of the loop, and from that point blow out a spray of inky water. Consider the ink spray to represent the carbon atoms shot off from the overheated spot. We see that the cardboard is bespattered on all points except along one line where it is sheltered by the opposite side of the loop. We have thus produced a "spray shadow" on the board (Fig. 2). The existence of these molecular shadows in incandescent lamps leads us therefore to recognize that the carbon atoms must be shot off in straight lines, or else obviously no such sharp shadow could thus be formed. This phenomenon confirms in a very beautiful manner the deductions of the kinetic theory of gases. I may remind you that at the ordinary temperature and pressure the mean free path of a molecule of air is deduced to be about four one-millionths of an inch. This is the average distance which such a gaseous molecule moves over before meeting with a collision against a neighbour which changes the direction of its path. Let the air be rarefied, as in these bulbs, to something like a millionth of the ordinary atmospheric pressure, and the mean free path is increased to several inches. The space within the bulb—though from one point of view densely populated with molecules of residual air—is yet, as a fact, in such a condition of rarefaction that a carbon molecule projected from the conductor can move over a distance of three or four inches on an average

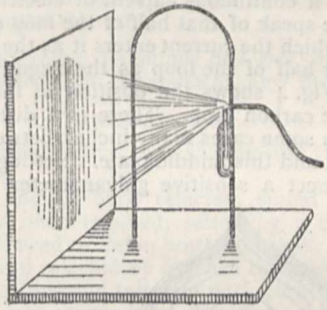


FIG. 2.—"Spray shadow" of a rod thrown on cardboard screen to illustrate formation of "molecular shadow" in glow-lamps.

without meeting with interference by collision with another molecule, and the facts revealed to us by these shadows show that this must be the case. I have also at hand some Edison lamps in which these "molecular shadows" are finely shown, but in these cases the deposit on the interior of the bulb is not carbon but copper, because the molecular scattering has here taken place by excessive temperature developed at the copper clamps by which the carbon filament is attached to the platinum wires. The theory, however, is the same. The deposit of copper shows a fine green colour by transmitted light in the thinner portions. One curious lamp also before me had by an accident an aluminium plate volatilized within the bulb. The glass receiver has in consequence been covered with a mirror-like deposit of aluminium, which on the thinner portions shows a fine blue colour by transmitted light, and a silvery lustre by reflected light. This lamp also shows a fine "molecular shadow."

These facts prepare us to accept the view that when a glow-lamp is in operation the highly rarefied residual air in the interior of the bulb is being traversed in all directions by multitudinous carbon atoms projected off from the incandescent carbon conductor. I now wish to pass in review before you some facts which indicate that these carbon atoms carry with them electric charges, and that they are charged, if at all, with *negative electricity*.

I may preface all by saying that much of what I have to show you will be seen to be closely related to the phenomena studied by Mr. Crookes in his splendid and classical researches on radiant matter. Our starting-point for this purpose is a discovery made by Mr. Edison in 1884, and which received careful examination at the hands of Mr. Preece in the following year,[1] and by myself more recently. Here is the initial experiment. A glow-lamp having the usual horseshoe-shaped carbon (see Fig. 3) has a metal plate held on a platinum wire sealed through the glass bulb. This plate is so fixed that

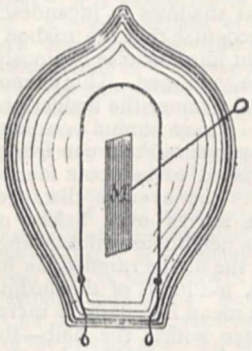


FIG. 3.—Glow-lamp having insulated metal middle plate M sealed into bulb to exhibit "Edison effect."

it stands up between the two sides of the carbon arch without touching either of them. We shall illuminate the lamp by a continuous current of electricity, and for brevity's sake speak of that half of the loop of carbon on the side by which the current enters it as the positive leg, and the other half of the loop as the negative leg. The diagram in Fig. 4 shows the position of the plate with respect to the carbon loop. There is a distance of half an inch, or in some cases many inches, between either leg of the carbon and this middle plate. Setting the lamp in action, I connect a sensitive galvanometer between the

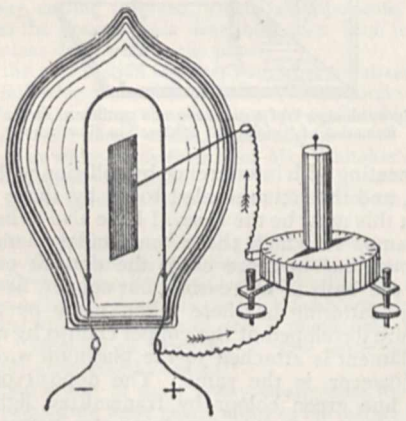


FIG. 4.—Sensitive galvanometer connected between the middle plate and positive electrode of a glow-lamp, showing current flowing through it when the lamp is in action ("Edison effect").

middle plate and the *negative terminal* of the lamp, and you see that there is no current passing through the instrument. If, however, I connect the terminals of my galvanometer to the middle plate and to the *positive electrode* of the lamp, we find a current of some milliamperes is passing through it. The diagrams in Fig. 5 show the mode of connection of the galvanometer in the two cases. This effect, which is often spoken of as the "Edison effect," clearly indicates that an insulated plate so placed in the vacuum of a lamp in action is brought down to the same potential or electrical state as the negative electrode of the carbon loop. On examining the direction of the current through the galvanometer we find that it is equivalent to a flow of negative electricity taking place through it *from* the middle plate *to* the positive electrode of the lamp. A consideration of this fact shows us that there must be some way by which negative electricity gets across the vacuous space from the negative leg of the carbon to the metal plate, whilst at the same time a negative charge cannot pass from the metal plate across to the positive leg. Before I pass away from this

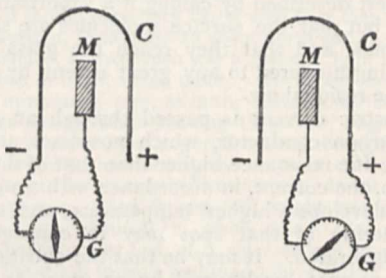


FIG. 5.—Mode of connection of galvanometer G to middle plate M and carbon horseshoe-shaped conductor C in the experiment of the "Edison effect."

initial experiment, I should like to call your attention to a curious effect at the moment when the lamp is extinguished. Connecting the galvanometer as at first, between the middle plate and the negative electrode of the lamp, we notice that though made highly sensitive the galvanometer indicates no current flowing through it whilst the lamp is in action. Switching off the current from the lamp produces, as you see, a violent kick or deflection of the galvanometer, indicating a sudden rush of current through it.

In endeavouring to ascertain further facts about this effect one of the experiments which early suggested itself was one directed to determine the relative effects of

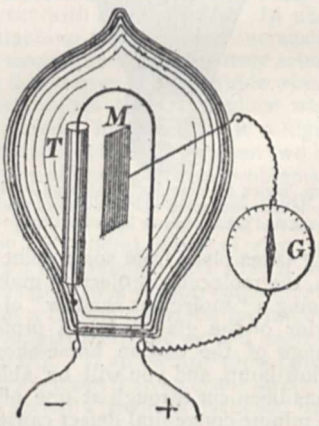


FIG. 6.—Glow-lamp having negative leg of carbon inclosed in glass tube T, the "Edison effect" thereby being annulled or greatly diminished.

different portions of the carbon conductor. Here is a lamp (see Fig. 6) in which one leg of the carbon horseshoe has been inclosed in a glass tube of the size of a quill, which shuts in one-half of the carbon. The bulb contains, as before, an insulated middle plate. If we pass the actuating current through this lamp in such a direction that the covered or sheathed leg is the *positive* leg, we find the effect existing as before. A galvanometer connected between the plate and positive terminal of the lamp yields a strong current, whilst if connected between the negative terminal and the middle plate there is no current at all. Let us, however, reverse the current

[1] Mr. Preece's interesting paper on this subject is published in the "Proceedings" of the Royal Society for 1885, p. 219. See also the *Electrician*, April 4, 1885, p. 436.

through the lamp so that the shielded or inclosed leg is now the negative one, and the galvanometer is able to detect no current, whether connected in one way or the other. We establish, therefore, the conclusion that it is the negative leg of the carbon loop which is the active agent in the production of this "Edison effect," and that if it is inclosed in a tube of either glass or metal, no current is found flowing in a galvanometer connected between the positive terminal of the lamp and this middle collecting plate.

Another experiment which confirms this view is as follows:—This lamp (see Fig. 7) has a middle plate, which is provided with a little mica flap or shutter on one

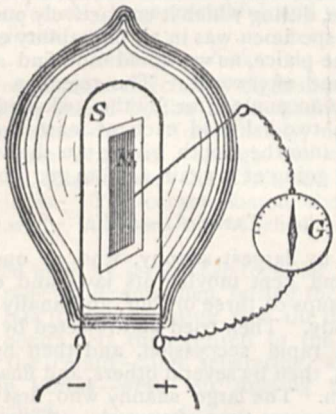


FIG. 7.—Glow-lamp having mica shield s interposable between middle plate M and negative leg of carbon, thereby diminishing the "Edison effect."

side of it. When the lamp is held upright the mica shield falls over and covers one side of the plate, but when it is held in a horizontal position the mica shield falls away from the front of the plate and exposes it. Using this lamp as before, we find that when the positive leg of the carbon loop is opposite to the shielded face of the plate, we get the "Edison effect" as before in any position of the lamp. Reversing the lamp current and making the same leg the *negative* one, we find that when the lamp is so held the metal plate is shielded by the interposition of the mica, and the galvanometer current is very much less than when the shield is shaken on one side and the plate exposed fully to the negative leg.

(*To be continued.*)

SOME EXPERIMENTS ON FEEDING FISHES WITH NUDIBRANCHS.

WITH the view of testing the theory that the remarkable shapes and colours of Nudibranchs are either of a protective or of a warning nature,[1] and are definitely related to the edibility or the reverse of the animals, I have been offering lately various kinds of Nudibranchs to the fishes in the aquarium of the Liverpool Free Public Museum,[2] and have carefully noted the result of each trial.

Although these experiments will have to be repeated, and additional evidence accumulated, still it may be interesting to other biologists working on similar lines to have this account of the inquiry, in its present stage, laid before them, and I need scarcely say that I would be glad of any suggestions which would be useful in future investigations.

Most of the experiments were made in three large fish-tanks, which may be called A, B, and C. A and B are rectangular slate and plate-glass wall-tanks, lit from the top, measuring 7½ feet long, 5¼ feet wide, and 3¼ feet high. A has a gravel bottom, and contains about 20 very healthy and active shannies (*Blennius pholis*) obtained from the Menai Straits; while B has a sandy floor, and is devoted to flat-fish. It contains a considerable number of soles and plaice, a few small thornback rays, turbot, and brill, and on one of the occasions had some young cod. The average size of these flat-fish is 6 inches in length, and there are over 60 of them in the tank. Both A and B have some rock-work. C is an octagonal centre-tank with a sandy bottom, measuring 4½ feet in diameter, and 17 inches in depth. It contains various small fishes, viz. bullhead, goldsinny, pogge, gemmeous dragonet, five bearded rockling, viper-weever, and young cod.

All these fishes are apparently in a healthy condition, and some of them have been living undisturbed in their tanks for periods varying up to four years. They are usually fed upon mussels, cockles, and occasionally worms, which are thrown in at the top of the tank and allowed to sink through the water. Such food-matters are usually seen at once, and eagerly pounced upon and eaten during their descent. I adopted the same plan in putting most of the Nudibranchs into the tanks, and as the fishes were not fed on the days I intended to experiment with them, and had usually been fasting for 24 hours when I began, they may be regarded as being unusually eager to seize any object dropped into the water. At the beginning and again at the end of each day's experiments, we threw a couple of cockles or mussels into the tanks, and found that they were at once caught and bolted in the usual manner.

I. *October* 29, 1889. [A supply of *Doris*[1] *bilamellata* was obtained from the rocks at New Brighton.]

TANK A.—*Doris.*

(1) Seized, when falling, by a shanny, and taken at once to dark corner.

(2) Seized and at once rejected, seized by another shanny and at once rejected, seized by a third and rejected, then allowed to lie on bottom of tank.

(3) Seized and rejected by two fish in rapid succession, then seized by third and taken to dark corner.

(4) Seized and rejected by first fish, taken to dark corner by second.

(5) Seized and rejected by three fish in rapid succession, and then left.

TANK B.—*Doris.*

(1) Seized and rejected in rapid succession by a turbot, a sole, another sole, and a plaice, and then left lying on the sand.

TANK C.—*Doris.*

(1) Seized and rejected by a goldsinny, tried again by same and again rejected, then left.

(2) Seized and rejected by a bullhead and by a dragonet in rapid succession, and then left.

Finally, another *Doris* was dropped gently into a fourth tank containing a conger eel, so as to fall in front of its nose; but although the fish passed close to the Nudibranch several times while under observation, it apparently took no notice of it.

From these nine experiments it seems probable that *Doris bilamellata* is distasteful to at least most of these eight kinds of fishes tried. This was an unexpected result, as *Doris* has no stinging apparatus, and certainly seems to be protectively coloured. The distastefulness may be due to the spicules in the skin or to the abundant mucus covering the body.

[1] *Quart. Journ. Microsc. Sci.*, vol. xxxi. p. 41.

[2] With the kind permission and assistance of Mr. T. J. Moore, the curator, and his assistants, who were present at all the experiments.

[1] I use throughout this article the old well-known generic names *Doris* and *Eolis*, instead of the modern genera, only known to specialists, in which the species I am dealing with have been placed. No possible confusion can arise from doing so.

II. *February* 21, 1890. [Large supply of *Ancula cristata*, and a few *Dendronotus arborescens*, *Eolis rufibranchialis*, and *Eolis picta* from Hilbre Island.]

Mr. Moore and I each ate an *Ancula*. The specimen was placed alive upon the tongue. No stinging or other disagreeable sensation was perceived. It was then chewed slowly and swallowed. The taste was pleasant, and distinctly like that of an oyster.

TANK A.—*Ancula*.

(1) Seized and rejected by a shanny, and then bolted suddenly by a second.
(2) Seized and rejected by ten fish in rapid succession.
(3) Seized, when falling, and swallowed by a fish.
(4) Seized and rapidly rejected by five fish in succession.
(5) Seized and rapidly rejected by four fish in succession.

TANK B.—*Ancula*.

(1) Seized and rejected by a young cod and six plaice in rapid succession.
(2) Seized and rejected by seven plaice, and left lying on sand.
(3) Seized and rejected by four plaice, and left lying on sand.

The fish were then tried with some cockles, which, when thrown in, were eagerly pounced upon and eaten.

(4) Then four specimens of *Ancula* were dropped in together, and were tried and rejected by two young cod and three plaice.

TANK C.—*Ancula*.

(1) Touched by a young cod, but not taken, then tried and rejected by goldsinny.
(2) Touched and rejected several times by young cod.
(3) Touched and rejected by first cod, bolted suddenly by second.

The shannies at once take an object into the mouth, even though they reject it again immediately, but the young cod usually approach it very closely, and appear to smell it or feel it with the lips, and then turn away from it, or else suddenly bolt it, in which case it does not reappear. The shanny seems to test the edibility inside its mouth, the cod outside.

Some crabs (*Hyas araneus*) in two small tanks were then tried with specimens of *Ancula* with the following results :—

(1) Seized at once by crab, but eaten very slowly, and only partially.
(2) Taken no notice of.
(3) Taken up with chela, then dropped and left.
(4) Apparently not noticed by crabs.

The three last specimens of *Ancula* were found alive and fully expanded next day, and crawled about the two crab tanks undisturbed for some time afterwards.

Finally, a few specimens of *Ancula* were offered to two large anemones (*Actinoloba*), but were not taken.

In all, then, *Ancula* was rejected by 53 animals and taken by four. These experiments gave us the distinct impression that *Ancula* was distasteful to the animals tried, although we did not at that time understand why, and had expected to get a contrary result.

TANK A.—*Dendronotus*.

(1) Seized at once by shanny, and carried off to back of tank ; shortly afterwards two shannies were found fighting over it, each having hold of an end, as they do with a large worm ; finally, they each ate a part of the *Dendronotus*.

TANK B.—*Dendronotus*.

(2) Tried and rejected by brill and young cod. Then seized by plaice and kept in mouth for a long time (five to ten minutes), during which it was pursued by other fish.

TANK C.—*Dendronotus*.

(3) Touched and left by young cod ; taken partly into mouth and rejected by two bullheads four or five times.

The general impression we received was that *Dendronotus* was more acceptable to the fish than *Ancula*, but that they were incommoded by the size. Our specimens were large ones—over two inches in length—and none of the fishes tried seemed able to get the whole of the *Dendronotus* comfortably into the mouth, at once. Several took half the body into the mouth, and swam about with the other half hanging out. This was well seen in the case of the two shannies, who each ate half of the specimen, and of the plaice which carried about its prey for a considerable time, during which it was actively pursued by the others. That specimen was in all probability eaten by one or more of the plaice, as we could not find any trace of it a short time afterwards. The rejection by the bullheads may be accounted for by the awkward size of the morsel. The two fish had each at least two tries at it, taking it half into the mouth, giving it a shake, sending it out, and then going at it again as if to get a better hold.

TANK A.—*Eolis*.

(1) Seized by largest shanny, who at once shook it vigorously, and kept moving its jaws and ejecting the cerata[1] in groups of three or four, and finally put out the rest of the body. Then tried and rejected by four or five other fish in rapid succession, and then by the large shanny again, then by several others, and finally left lying on the bottom. The large shanny who first tried it was going about for some time afterwards with the mouth held open.

TANK C.—*Eolis*.

(2) Touched or tried, and rejected at once by cod, bullhead, and weever. The cod came very near it, or touched it with its snout, several times afterwards, but never took it into the mouth.

Eolis is undoubtedly distasteful. The cnida (stinging cells) on the tips of the cerata probably sting the lips of the fish. As it had occurred to me that the natural conditions would be more nearly reproduced if the Nudibranchs were not dropped into the tanks, on the following day, February 22, a few specimens of *Ancula* were placed upon pieces of stone and lowered cautiously into tanks A and B in such a way as not to attract the attention of the fish. The Nudibranchs reached the rockwork safely, and were seen crawling over various parts of the tanks for several days untouched by the fish (shannies and flat-fish). Woods, the aquarium attendant, tells me that the fish sometimes went up close to the *Ancula*, and looked at them, but never attempted to touch them. The Nudibranchs were last seen about a week after being put into the tanks. They then disappeared, but may possibly have retreated into the back part of the tank, or have crawled up out of the water, as *Ancula* is very liable to do when kept in captivity.

III. *March* 22, 1890. [*Dendronotus*, *Eolis*, and *Doris* from Hilbre Island.]

TANK A.—*Dendronotus*.

(1) Seized at once by the large shanny and kept in the mouth, half the Nudibranch projecting. This shanny was pursued by others, one of which caught the projecting end of the prey, and in the ensuing struggle tore half the body off and ate it. The large shanny at once retreated with the remainder to the back of the tank, came out shortly afterwards with the *Dendronotus* still in mouth, and was again pursued and retreated to the dark, appearing again soon without the Nudibranch.

[1] The coloured dorsal papillæ which contain the stinging cells.

TANK C.—*Dendronotus.*

(2) Pounced upon at once by three bullheads (*Cottus*), which made rapid dabs at it successively, until one secured it and carried it off to a quiet place, where he seized it in his mouth and ejected it nine times in succession, each time taking it half into the mouth and keeping it there for some seconds, then spitting it out and at once pouncing upon it again. Finally, the now somewhat mangled remainder of the *Dendronotus* was taken out and put into tank A, where one of the shannies at once seized and swallowed it. This *Dendronotus* was large. It was larger than the head of the *Cottus*, and caused the mouth-cavity to bulge out greatly when it was taken in. The general impression was that the *Cottus* found the *Dendronotus* desirable food, but an uncomfortably large mouthful, and was trying to worry it to pieces.

TANK A.—*Eolis.*

(1) Tried, and at once rejected by three shannies in rapid succession, then seized by the large shanny and carried behind some rock-work. Immediately, numerous red cerata were seen scattered through the water in that neighbourhood, showing that the *Eolis* had been forcibly ejected in pieces. The cerata floated about for some time in the water, but were not touched by any of the fish.

(2) Pounced upon by several fish together; one secured and at once rejected it, and then, seizing the white body, managed to bite it across, setting free the dorsal portion with all the cerata. It then retired to the back of the tank, while the cerata—after separating, as they very readily do in Eolids—were left floating about in the water, untouched.

TANK A.—*Doris.*

(1) Tried and rejected by two shannies, then seized by the largest shanny and carried off to the back of the tank.

TANK B.—*Doris.*

(2) Several fish darted at the Nudibranch, but a large sole suddenly slipped up vertically between them and bolted it.

(3) Tried and rejected by six or eight plaice, and finally left on the sand.

(4, 5, 6) These three specimens were gently lowered into the tank by a net, so as to reach a shelf of the rock-work without attracting attention. They soon began to expand and move. One plaice swam up and looked or smelled at them, but did not touch them.

The action of the large sole in bolting *Doris* No. 2 above may possibly be explained as a result of the habit of competing for their food. Three or four other fish were darting at the Nudibranch, and the sole took the only possible course by which it could secure the prey—it made a rapid movement upwards between the snouts of its competitors and swallowed the *Doris* entire; there was evidently no time for examination.[1]

In the above experiments I have used altogether 53 Nudibranchs, offered to twelve different kinds of fish and other predaceous shore animals, and there have been over 130 distinct transactions between the fishes and the Nudibranchs. My general impression is that the order of edibility of the Nudibranchs offered to the fishes is: *Dendronotus*, *Doris*, *Ancula*, *Eolis*; *Eolis* being the most distasteful form, *Ancula* next, *Doris* less so, and *Dendronotus* edible, but, from its size, offering difficulties to the rather small fishes which we tried.

[1] The last number of the Journ. Mar. Biol. Assoc., containing Mr. Bateson's paper on the sense-organs and perceptions of fishes, only reached Liverpool after this article had been sent to NATURE. In regard to the sole being one of those fishes which hunt for their food and recognize it by the sense of smell alone, I would remark that the specimens in the aquarium here certainly seem to perceive their food as the plaice do by sight, the two kinds of fish often darting together at a food morsel—and, as I have just shown above, the sole being sometimes more alert than its competitors. Possibly these soles have changed their habits like the rockling described (p. 238) by Mr. Bateson.

The Nudibranchs were all healthy and good-sized specimens, and the fish were probably the right kind, being nearly all shore fishes found in the immediate neighbourhood of where the Nudibranchs live. Still, the conditions were, of course, to a certain extent artificial, and that must be taken into account in drawing conclusions. Dropping the Nudibranchs into the tank from above is unnatural, and may give rise to a misleading result, especially where the fish are accustomed to have their food thrown in from above, and *only receive edible food.* Then, again, at least some of the fish—those that have been some time in captivity—have been educated to compete with one another for the food. When *anything* is thrown in—a bit of white shell will do—there is at once a rush made upon the falling object, and no time is allowed for inspection or consideration. I would account for the seizing of *Eolis* by the shannies (very active, voracious, and apparently impulsive fishes), even when the prey is evidently distasteful and has brilliant warning colours, as a result of this acquired habit of competition, and of pouncing upon anything thrown into the tank. Still, there is a marked difference between the manner in which they take a cockle and say an *Ancula.* The cockle is taken right in and swallowed at once, while the distasteful Nudibranch, even if seized, is usually only partly taken into the mouth; in some cases, it is seen to be held by the very front of the jaws, and is then ejected with force.

Ancula has been a particularly interesting case. Start with the general opinion that *Ancula* is a perfectly defenceless soft-bodied animal, I have been astonished to find that it is sometimes present on the rocks at Hilbre Island in great abundance, in very prominent and exposed situations, and that its colouring was not protective, but rendered it conspicuous. The experiments at the aquarium next showed me that this Nudibranch is distasteful to fishes and other shore animals, but for a time I did not understand why. Lately, however, Mr. Clubb and I have found[1] that, besides the abundant mucous glands scattered over the integument, *Ancula* possesses special large glands occupying the apices of the cerata, and opening to the exterior. These glands are placed just where an offensive organ would be most useful, and where the stinging cells are found in *Eolis*, and it seems probable enough that it is the presence of their secretion on the most outstanding parts of the body which renders the animal objectionable to fishes.

The protective colouring of *Doris bilamellata* may be accounted for in one or both of two ways: (*a*) it may serve to protect the animal from certain other shore animals which have not yet been experimented with, and to which the spicules and mucus of the *Doris* are not objectionable; and (*b*) it may save the animal from being tried by fishes, &c., not sufficiently aware of its (to them) distasteful nature.[2] It is obvious that, if an animal is not *thoroughly* objectionable, and has not yet become conspicuous with warning colours, it will be better for it to be protectively coloured. So we need not be surprised to find that some inconspicuous protectively coloured animals have certain offensive organs, and are distasteful to certain of their enemies. *Eolis* is a most distasteful form, and has conspicuous colours of a warning nature. *Ancula* is also distasteful, and is conspicuously coloured. *Doris* is less distasteful, and is still protectively coloured; while *Dendronotus*, which is, I believe, edible, is very effectually concealed, amongst the red seaweeds it lives on, by its large branched cerata and red-brown colours.

W. A. HERDMAN.

[1] See "Third Report on the Nudibranchiata of Liverpool Bay" (Trans. Biol. Soc. Liverpool, vol. iv.).

[2] What seems to be a very similar case has been pointed out by Mr. Garstang (Journ. Mar. Biol. Assoc., October 1889, p. 191), viz. the two British species of *Hermæa*, which are both protectively coloured, and have no stinging cells, and yet seem to possess the power of emitting, when irritated, an offensive fluid. I would expect to find that they were distasteful to at least some fishes.

THE PULKOVA REFRACTOR.

ON the completion of the Pulkova Observatory, the jubilee of which has recently been celebrated, the late W. Struve published his "Description de l'Observatoire," which made the scientific world acquainted with the complete equipment of that institution. The additions which have been recently made to the Observatory, in order to preserve its high character and deserved reputation, have induced the authorities to publish what may be regarded as a supplement to that work, and the details now given of the history of the erection, and the results of a systematic examination, of the new refractor are not less interesting than were those of the old 15-inch.

The optical work of this recent addition, as is well known, is the work of Messrs. Alvan Clark, and the parallactic mounting that of Messrs. Repsold, and both of these eminent firms appear to have given, in their respective departments, complete satisfaction to the Russian authorities. Considerable difficulty was experienced in procuring the necessary disks for the object-glass, but eventually M. Feil, of Paris, supplied both flint and crown. The former appears to have given perfect satisfaction, but in the latter, near to the centre of the disk, there is collected, about a quarter of an inch below the surface, a quantity of small air-bubbles, which cover a space one and a half inch long by one-eighth broad. As in the opinion of the opticians, as well as of Prof. Pickering, this defect would not introduce any inconvenience, it was determined to proceed with the manufacture, rather than to wait for a more satisfactory casting. This defective spot, of elliptical shape, has no bad effect on the images of stars in the general use of the telescope, but bright objects, such as *a* Lyræ, are accompanied by two streams of false light, some minutes in length, in opposite directions, which appear to be produced by this defect in the crown lens. The position angle of these rays is found to be 114°–294°, and this direction is almost exactly perpendicular to the major axis of the air-bubble, which has been measured 23°–203°. Moreover, as this peculiarity is the more noticeable when the diameter of the object-glass is diminished by diaphragms, there can be no doubt that it is the result of diffraction produced by this spot.

The mounting of the object-glass in its cell differs in two respects from the plan generally adopted. The internal surfaces of the two lenses are separated by about six inches. Though this separation does not render the telescope available for photography, it doubtless tends to improve the achromatism; and, further, since openings are left in the cell for the purpose of cleaning the inner surfaces, currents of air can pass between the lenses and promote an equality of temperature between them and the atmosphere outside. The two lenses are not rigidly mounted in their cell of cast-iron, but, to prevent any risk of pinching or strain that might arise from the unequal expansion of metal and glass, a space of 0·5 mm is left. It was conjectured that a displacement of the lenses, relatively to each other, through this small amount would exercise no bad effect on the quality of the images, and this anticipation has been found correct.

The constants of the object-glass are as follows:—

	m.
Radii of the crown-glass lens ...	− 5·1054
	+ 5·2831 (computed).
	mm.
Thickness of the crown	42·42
Thickness of the flint	26·06
	m.
Radii of the flint	+ 4·8386
	− 140·130

The focal lengths computed from these data, one of which, however, has been inferred, give the following results:—

		m.
Red,	λ = 636 ...	Focal length 13·892
Yellow,	λ = 589 ...	,, ,, 13·885
Green,	λ = 535 ...	,, ,, 13·884
Blue,	λ = 481 ...	,, ,, 13·892

from which it will be seen that the achromatism is satisfactory for the brighter parts of the visible spectrum, and in fact accords with that part of the spectrum which was originally selected for the minimum focal length, viz. λ = 0·00057.

The relative position at the focus for rays of different refrangibility was more accurately determined by the method of Prof. Vogel with the aid of a small spectroscope, as well as with the great spectroscope attached to the instrument. It was then seen that the part of the spectrum between D and *b* was so nearly linear that no certain determination of the difference of lengths for the different colours could be effected. For more distant parts of the spectrum the following measures were made of the distances of the three hydrogen lines from the normal position D − *b*:—

		mm.		
C	df =	3·0 ...	$\frac{df}{f}$ =	0·00021
F	=	6·4 ...	=	0·00045
H_γ	=	32·9 ...	=	0·00233

It is not uninteresting to compare this result with that which Prof. Vogel obtained from measurements on the Vienna refractor of 26 inches, where the general character of the achromatism is very similar to that of the Pulkova refractor, since in both the red images are joined between D and F, and beyond F a rapid increase in the secondary spectrum is exhibited—a defect common to all objectives of silica glass.

In the Vienna object-glass the distances of the focus of the three rays before mentioned from the focal plane D − *b* are—

	mm.
C	2·7
F	6·0
H_γ	23·5

Consequently the diameters of the circle of chromatic aberration, reckoned on the same plane, are, for the two telescopes, as follows:—

Pulkova.		Vienna.	
	mm.		mm.
Aperture	762	Aperture	675
Focal length	14,120 "	Focal length	10,360 "
Diameter C	0·162 or 2·37	Diameter C	0·176 or 3·51
,, F	0·345 ,, 5·05	,, F	0·391 ,, 7·81
,, H_γ	1·775 ,, 25·95	,, H_γ	1·831 ,, 30·48

The advantages of a proportionately greater focal length in the case of the Pulkova instrument are shown by the somewhat smaller values of the angular diameter. This want of perfect achromatism makes itself felt in the Pulkova instrument in the images of stars remote from the optical axis. For a circle about 16′ in diameter, no appreciable effect is noticeable, but outside this radius the image has a tendency to exhibit a red fringe on the side turned towards the optical axis, and a violet on the side more remote.

The parallactic mounting appears to possess and retain a very satisfactory stability. In the case, however, of exceptionally heavy object-glasses, it is of interest to rigidly investigate the flexure of the tube. The total weight of the object-glass and cell is in this case 400 lbs. approximately, and considering the great distance from the centre of the instrument at which it is supported, the coefficient of flexure might be expected to be large. As a

matter of fact, this constant when derived from the observed zenith distances of known stars is 40″, but this amount, of course, refers only to the difference of flexure at the eye and object-glass ends. Direct measurements have, however, been made of the deflection of either end. For this purpose a small telescope was attached to the cradle of the instrument, with which a scale placed at either end could be read, the instrument being in both a vertical and horizontal position. The result was that the object-glass dropped 5·48 mm., and the eye end 3·22 mm.; when all necessary corrections have been made, this gives a flexure of 34″, a satisfactory agreement with that obtained from observations of stars. This deflection from the straight line was observed at eight different angles with reference to the horizon, and the results are fairly represented by supposing the flexure to vary simply as the sine of the zenith distance.

As regards the light-collecting capacity, it may be mentioned that the satellite of Neptune can be observed in an illuminated field without difficulty, and that the satellites of Mars were observed on fifteen evenings in 1886, a year in which the opposition fell very unfavourably for their observation. Hyperion is visible on a feebly illuminated red field, while Enceladus and Mimas are visible till quite close to the planet's disk. That there are difficulties in the employment of such large telescopes goes without saying: it is, however, satisfactory to notice that the number of evenings on which the telescope cannot be used from bad definition or adverse meteorological conditions is not larger than in the case of the 15-inch equatorial. W. E. P.

SIR WARINGTON W. SMYTH, F.R.S.

MINING has suffered an irreparable loss by the death of Sir Warington Smyth, which occurred suddenly at his house in Inverness Terrace on the 19th inst. He was the eldest son of Admiral W. H. Smyth, F.R.S., and was born at Naples 73 years ago. He was educated at Westminster and Bedford Schools and at Trinity College, Cambridge, where he exhibited great skill as an oarsman, being one of the winning University crew on the Thames in 1839. In that year he graduated, and obtained a travelling fellowship which enabled him to devote more than four years to a journey through the chief mining districts of Europe, and thus to lay the foundation of that practical knowledge which subsequently made him the greatest British authority on mining matters. Continental travelling in 1839 was by no means the easy matter it is now, and his journey through the Harz, Saxony, Austria, Hungary, Turkey, and Asia Minor, was not devoid of risk and adventure. As a result of his travels through the European and Asiatic dominions of the Sultan, he published in 1854 a work entitled "A Year with the Turks." In subsequent years he visited during his vacations the more important mines of France, Belgium, Spain, Italy, and Norway. His official career began in 1844, when he was appointed by Sir Henry De la Beche to a post on the Geological Survey, and while holding this position he explored and geologically mapped the metalliferous districts of Devon and Cornwall, North Wales, and Ireland, and the coal-fields of Lancashire and Yorkshire, North Staffordshire and Derbyshire. In 1845 he joined the Geological Society, and in 1866 was elected President of that body. For the last 17 years he has acted as foreign secretary, in which post his rare linguistic powers proved of great service to the Society. On the foundation of the Royal School of Mines in 1851, he was appointed the first lecturer on mining and mineralogy. On the reorganization of the School in 1881, he gave up the Chair of Mineralogy, but acted as Professor of Mining until his death. He held the office of inspector of the mines in the Duchy of Cornwall, and in 1857 he was also appointed comptroller of all the mineral properties belonging to the Crown. It would be tedious to enumerate the long list of Royal Commissions and International Exhibitions with which Sir Warington was prominently associated. His report as Secretary of the Jury on the mining industry at the Exhibition of 1862 is a model of what such a work should be, and to his energy on the Council of the Inventions Exhibition of 1885 the success of the mining section was largely due.

In 1879 a Royal Commission was appointed to inquire into accidents in mines and the possible means of preventing their occurrence and of limiting their disastrous consequences. Mr. Smyth was appointed Chairman, and, in order to secure time to attend to the duties of this arduous and honorary office, he resigned the post of Examiner to the Science and Art Department—an office he had held for several years. The Commission ended its work in 1886, and during the seven years it was in existence some thousands of experiments were made, and the Report, covering 858 pages, definitely settled many important questions bearing upon the diminution of accidents in mines.

To his scientific attainments, Sir Warington added singular literary skill. His early classical training enabled him to write with an elegance and vigour unfortunately rare in technical works. He spared no pains, and neglected no details. As a teacher he was very popular with his pupils, his success as a lecturer being due not only to his finished delivery, but also to his skill as a draughtsman, which enabled him to dispense with the aid of elaborate diagrams, and to rely merely on accurate blackboard sketches, which he drew with great rapidity in the presence of his class. His reputation as Professor attracted to the School of Mines students from all parts of the world, and no better evidence of the excellence of his teaching could be adduced than that afforded by the important positions so many of his pupils occupy in the mining world. Of his literary works, the most important is his "Rudimentary Treatise on Coal-Mining"—a standard work, bearing internal evidence of not being mere extracts of books, written in 1867, and now in its seventh edition. Besides this, he wrote the articles on mining for "Ure's Dictionary" and for Stanford's series of "British Manufacturing Industries," 1876.

For his labours on the Accidents in Mines Commission, and for his other public services, he received the somewhat tardy acknowledgment of knighthood on the occasion of Her Majesty's Jubilee. Throughout his life he refused the great pecuniary rewards offered by the commercial branches of mining, and preferred to devote the half-century during which he was engaged in business connected with mines to the service of science and of the State. Although he had been in ill-health for some time, he never neglected his official duties. He died in harness, with a partially corrected examination paper on the table before him. He was buried yesterday at St. Erth, in Cornwall, not far from his home at Marazion, in the centre of the mining district with which he was so long associated. B. H. B.

NOTES.

WITH the consent of the Prince of Wales, the President, the Council of the Society of Arts has awarded the Albert Medal to Dr. W. H. Perkin, F.R.S., "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilization of large quantities of a previously worthless material."

THE Essex Field Club and the subscribers to the Gilbert Club will hold a meeting at Colchester on Saturday, July 5, in memory of William Gilbert, the founder of the science of

electricity, who was born and died at Colchester. A visit will be made to Gilbert's house and tomb, and Prof. Silvanus P. Thompson will lecture on "The Early Magnetic Experiments of Gilbert of Colchester." The chair at the public luncheon will be taken by Lord Rayleigh, F.R.S., Vice-President of the Essex Field Club and the Gilbert Club. Any persons wishing to attend the meeting may obtain full particulars on application to Mr. W. Cole, Hon. Sec., Buckhurst Hill, Essex.

THERE is no foundation for the report that Dr. G. J. Romanes is a candidate for the Linacre Professorship of Human and Comparative Anatomy, Oxford.

THE Photographic Convention of the United Kingdom is now holding its annual meetings at Chester. The series of meetings was opened on Monday, and will not be concluded until Saturday. At the official welcome of the Convention by the mayor, on Monday, Mr. A. Pringle, the retiring President, introduced his successor, Mr. C. H. Bothamley. In the course of his address, the new President said that the events of last year contained nothing of first-rate importance in photography; no discoveries of far-reaching influence had disturbed the photographic world. But a good deal of interest had been excited by the announcement that advances had been made towards the solution of the problem of photographing objects in their natural colours. Coloured photographs, more or less imperfect, had been made several times, but whether they should ever get a chromatic negative process was at present entirely a matter of conjecture, and so far even the direction in which the solution was to be looked for was not apparent. Photo-mechanical printing had not presented any new feature during the past year, but the processes already in operation had been taken much greater advantage of. The applications of photography to science were becoming every day more and more numerous, and he did not hesitate to say that it was here that photography had won, and probably would win in the future, its greatest triumph.

THE Elizabeth Thompson Science Fund, which has been established by Mrs. Elizabeth Thompson, of Stamford, Conn., "for the advancement and prosecution of scientific research in its broadest sense," now amounts to 26,000 dollars. As accumulated income will be available in December next, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but *Science* says it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from the fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points: (1) precise amount required; (2) exact nature of the investigation proposed; (3) conditions under which the research is to be prosecuted; (4) manner in which the appropriation asked for is to be expended. All applications should reach, before December 1890, the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. It is intended that new grants shall be made at the end of 1890. The trustees are disinclined for the present to make any grant exceeding 300 dollars: decided preference will be given to applications for smaller amounts.

THE U.S. National Academy of Sciences is considering whether it might not be expedient to divide its membership into classes. The following classification has been proposed: mathematics, physics, astronomy, geodesy and mechanics, chemistry, geology, botany, zoology, anthropology, and political economy and statistics. The *American Naturalist*, commenting on this list, suggests that a special place should be reserved for psychology. It also expresses a hope that the division into classes will not be made a pretext for increasing the membership to above one hundred persons.

LAST week Mr. Mundella asked the Vice-President of the Council of Education whether he had received remonstrances from the principal educational authorities and managers of higher elementary schools in England and Scotland against Article 40 of the Science and Art Department, which excluded scholars in public elementary schools from being henceforward examined or earning grants in science; whether he had seen the statement of the National Association for the Promotion of Technical Education, which described this circular "as one of the most serious blows which had been struck for some years at the development of scientific and technical education"; and whether, having regard to the feeling with which the circular had been received, he would cause it to be withdrawn. Sir W Hart Dyke replied that the matter was under consideration; and he has since issued an official letter, stating that the Department had anticipated the objection which had been made, and had decided to substitute a provision which would not in any way interfere with the present system of science instruction so admirably carried out by many School Boards. With reference to a complaint that in another circular dealing with the question of manual instruction in public elementary schools, a proviso had been inserted requiring such instruction to be given out of school hours, Sir W. Hart Dyke states that a supplementary circular will be shortly issued in order to remove the doubts which exist on the subject. Sir William believes there will be no difficulty in continuing the plan now adopted, providing the time devoted to manual instruction by any scholar for the purposes of the grant is outside the minimum period required to constitute an attendance under Article 12 of the Code, which does not prevent any further time from being given to the subject within the ordinary school hours.

THE *Kew Bulletin* publishes every year a complete list of the garden plants annually described in botanical and horticultural publications, both English and foreign. In Appendix II., which has just been issued, there is a list of all the introductions recorded during 1889. It is pointed out that these lists are indispensable to the maintenance of a correct nomenclature, especially in the smaller botanical establishments in correspondence with Kew, which are, as a rule, only scantily provided with horticultural periodicals. Such a list will also afford information respecting new plants under cultivation at the Kew establishment, many of which will be distributed from it in the regular course of exchange with other botanic gardens.

THE *Botanical Gazette* informs us that the first Annual Report of the Director of the Missouri Botanic Garden has been issued. It contains a statement of the changes that are being made in the Gardens, or that are in immediate prospect; and a map of the grounds on a large scale is being prepared. The Director requests from authors copies of their publications for the library, from collectors specimens for the herbarium, and promises all feasible assistance in work calculated to promote botanical knowledge.

THE first number is published of a new quarterly journal, *Le Diatomiste*, specially devoted to the natural history and literature of diatoms. It is published at 168 Rue Saint-Antoine, Paris, under the editorship of M. J. Tempère, assisted by MM. Brun, Bergon, Cleve, Dutertre, Grove, and Peragallo. The present number (quarto, with two plates) contains descriptions of a number of new species, and a bibliography of recent diatomological literature.

IN the *Journal of the Straits Branch of the Royal Asiatic Society*, Mr. Alfred Everett has just published a most important list of the birds of the Bornean group of islands. Hitherto the work of Salvadori has been the standard record for Bornean ornithology, but the numerous discoveries of recent years have rendered that author's "Uccelli di Borneo" considerably out of date, and the Catalogue of Bornean birds published by Dr. Vorderman in 1886 is a list of names merely. The work just completed by Mr. Everett will therefore be of great assistance to ornithologists, as it gives references to all the recent scientific memoirs on Borneo, published in England and in Germany. 570 species have now been recorded from the islands, the numbers having been considerably increased by the recent discoveries of the author himself and Mr. John Whitehead's expedition to Kina Balu. Mr. Everett has given a carefully compiled list of the localities where the species have been found by himself and other travellers. Two very good maps of Borneo are given, one "showing roughly the distribution of highlands and lowlands," with all the best-known collecting stations indicated as well; and the other being a map of Palawan, showing by the soundings that this island is intrinsically a part of Borneo rather than of the Philippine archipelago.

IN the current number of the *Board of Trade Journal*, it is stated that the French Consul-General at Warsaw has informed his Government of the establishment of a commercial museum in Warsaw. This is to form a permanent exhibition of specimens of the products and manufactures of Poland, as well as a bureau of information for Russian or foreign merchants. At a small charge all persons can be supplied at the office of this museum with information on any subject connected with trade. The museum is at present at No. 66 Faubourg de Cracovie, Warsaw.

A METEOROLOGICAL SOCIETY is to be established in New York, where many persons are giving attention to weather science, owing to the relations existing between some branch thereof and their own vocation. It is intended that the Society shall be purely local at first.

Das Wetter for May contains an article by Dr. P. Perlewitz upon the influence of the town of Berlin upon its climate. He finds that the difference of the mean temperature between the town and the open country outside differs, in various months, from 0°·7 to 2°·3, the town being always warmer. The smallest differences are in spring and winter. The greatest daily differences are found to be in the evening, owing to a retardation of radiation in the town; from this time the difference decreases until about midday, when there is no perceptible difference between the two localities. Dr. Hann has found similar results for Vienna, but the differences there are smaller, owing to the better exposure of the town station. The humidity is less in the town than in the country; in the evening, in June and July, the difference amounts to above 19 per cent. No appreciable effect appears to be exerted by the town upon the rainfall, as compared with that of the country stations.

DR. G. HELLMANN, to whom meteorologists are indebted for various interesting investigations into the history of that science, has contributed to *Himmel und Erde* (Heft. 3 and 4, 1890) two instructive articles on "the beginnings of meteorological observations and instruments." He divides the history of the development of observations into three periods: (1) that ending with the middle of the fifteenth century, up to which time they were of a very fragmentary and almost aimless character; (2) that in which observations were taken, at least once a day; and (3) that in which they were systematically taken with instruments, dating from about the middle of the seventeenth century. It is not exactly known who first kept a regular meteorological journal, but Humboldt attributes it to Columbus, on his first voyage to America in 1492, while the Italians also appear to have made daily observations from the middle of the fifteenth century. The wind-vane is by far the oldest of the meteorological instruments. In the periods of Homer and Hesiod, in the ninth and eighth centuries B.C., the qualities of the winds were correctly described. The first arrangement for observing the wind-direction is the Temple of Winds at Athens, which was built about 100 years B.C. A picture of this tower is given by Dr. Hellmann. Eginhard, in the reign of Charlemagne, denoted the winds by the four cardinal points, and their variations. The first instrument for denoting the *force* of the wind is ascribed to Robert Hooke (1667); this instrument is essentially the same as that now used and known as Wild's pendulum anemometer. The absorption or organic hygrometer was invented about the middle of the fifteenth century, by N. de Cusa, although the invention is generally ascribed to L. da Vinci. The first condensation hygrometer is attributed to the Grand Duke Ferdinand II. of Tuscany. The first continuous hygrometrical observations appear to have been by R. Boyle, at Oxford, in June 1666. The first thermometer is attributed to G. Galilei, towards the end of the sixteenth century. Some few years later, the instrument was improved, although the freezing-point was the only fixed point determined, and the graduation was made by means of little knobs in the glass, every tenth one being enamelled. The first rain-gauge was used by B. Castelli in 1639, although usually a later date is quoted. The discovery of the Torricellian tube, in 1643, is too well known to require special remark. These are only a few of the very interesting points referred to in Dr. Hellmann's instructive investigations.

IN an interesting paper contributed to the May number of the Ottawa *Naturalist*, and now reprinted separately, Dr. G. M. Dawson brings together some striking facts with regard to the extent of Canadian territory which is still unexplored. The entire area of the Dominion is computed at 3,470,257 square miles, and he calculates that an area of 954,000 square miles of the continent alone, exclusive of the inhospitable detached Arctic portions, is for all practical purposes entirely unknown. In this estimate the area of the unexplored country is reduced to a minimum by the mode of definition employed, and Dr. Dawson thinks we may safely assume that it is about one million square miles, or between one-third and one-fourth of the whole. That the aggregate of unknown territory is so vast is not quite creditable to Canadian energy; but Dr. Dawson hopes that the task of exploration will be undertaken by no one who has not the necessary scientific qualifications. "The explorer or surveyor," he says, "must possess some knowledge of geology and botany, as well as such scientific training as may enable him to make intelligent and accurate observations of any natural features or phenomena with which he may come in contact."

THERE is a disease in Japan known as *kakké*, a disorder of the kidneys communicated by bacilli, and closely related to the more virulent *beri-beri*. From the distribution of *kakké*, M. Gueit has recently drawn conclusions as to the ethnic composition of the present population of Japan. The fact that Chinese always escape the disease, even in localities where it is very prevalent, indicates (in his opinion) that the Chinese or Mongolian element is not the dominant one. He finds three constituents in the population: (1) descendants of Ainos; (2) of Negritos; and (3) a Malayan element, which is the most prominent. Wherever the Malayan goes, he brings with him the *beri-beri* order of disease his liability to this being probably due to the Hindu blood in him. From India we find *beri-beri* spread, like the Malays, to Madagascar on the one side, and to Japan on the other; we meet with it also in Java, Sumatra, &c. According to the proportion of Malay blood in the natives of Japan is the frequency of the malady, which occurs in various forms and under different names. As to the Negrito element in Japan, M. Gueit

found an interesting proof of it in the island of Sikok, in the form of a small statuette of Buddha, having the characteristic nose and hair of the Negritos.

IT is a well-known fact in biology that bacteria and bacilli absorb anilin and are killed by it. Two German observers—Stilling and Wortmann—have recently considered the possibility of utilizing this property in medical treatment (*Humboldt*). The diffusibility and harmlessness of violet anilin dyes (called, for brevity, "methyl-violet") without arsenic, in small doses, were first demonstrated on rabbits and guinea-pigs. Then certain eye-disorders were produced in those animals, and treated with anilin solution, the results being excellent. The authors proceeded to operate on the human subject. A skin-ulcer on a scrofulous child, which had been treated for a month with the ordinary antiseptic agents without success, was gradually healed by daily dropping a little anilin solution on the sore; and similar good results were had with bad cases of eye-disease. It soon appeared that many surgical cases were open to successful treatment in this way; and that, in general, wounds and sores developing suppuration could be sterilized w ith anilin. It is also thought that cases of internal inflammation, as in pleuritis and peritonitis, may prove to be not beyond the reach of this order of treatment.

MESSRS. FRIEDLÄNDER AND SON, Berlin, have issued an important monograph, by Dr. Max Blanckenhorn, on the development of the Cretaceous system in Central and Northern Syria. The author devotes especial attention to palæontological phenomena.

A MONOGRAPH, by Dr. L. Tausch von Gloeckelsthurn, on the fauna of the "gray chalk" of the Southern Alps, has been issued by A. Hölder, Vienna. The work is illustrated with nine lithographic plates.

IN the Statistical Report of the Colony of Victoria, just issued, the following are given as the latitudes and longitudes of the capitals of the Australian colonies, corrected by Mr. Ellery, the Government Astronomer of Victoria:—

Colony.	Capital City.	Latitude S.	Longitude E.
		° ′ ″	° ′ ″
Victoria	Melbourne ...	37 49 53	144 58 32
New South Wales ...	Sydney ...	33 51 41	151 12 23
Queensland	Brisbane ...	27 28 0	153 1 36
South Australia ...	Adelaide ...	34 55 34	138 35 4
Western Australia ...	Perth	31 57 24	115 52 42
Tasmania	Hobart ...	42 53 25	147 19 57
New Zealand	Wellington ...	41 16 25	174 46 38

WE are glad to learn that after eight years' cessation, Mr. John Fryer, of Shanghai, has revived his Chinese periodical, the title of which is best translated *Science Quarterly*. The first number of the re-issue contains 128 pages of reading matter of great variety. From a review in the *North China Herald*, by Dr. Martin, of Pekin, we gather that the science articles open with a chapter on appliances for illustrating the principles of mechanics. This paper forms a connecting link with the last number of the series, taking up the subject where it was dropped, and promising to carry it on to completion. The second paper begins a treatise on the principles of mechanical drawing, a subject in which the Chinese are beginning to take much interest. This is followed by the great topic of the day—railways. The steps necessary for the initiation and conduct of a railway enterprise are pointed out, the question of gauge is discussed, and statistics of cost are supplied. Then comes an elaborate paper on the state of the silk trade in China, pointing out the way to improvement, and stimulating the Chinese by the example of Japan and Italy. There is a paper on the sanitary conditions to be observed in the construction of dwellings, and one on medicinal plants, one on several strange vegetable productions, and one on entomology. Besides these, there are short papers on Edison's phonograph, the Eiffel tower, and on observatories and telescopes. The dessert which closes the feast is a profound disquisition by Dr. Edkins on the evolution of the Chinese language. It will no doubt surprise the natives to find that a foreigner has something to teach them in respect to their own language, both written and spoken. At the end are mathematical problems, in the estimation of native scholars the first essential of a scientific magazine. Nearly all the papers are profusely illustrated.

THE additions to the Zoological Society's Gardens during the past week include two Lions (*Felis leo*, juv. ♂ ♀) from Kattywar, India, presented by H.R.H. the Duke of Clarence and Avondale; a Grey Ichneumon (*Herpestes griseus* ♂) from India, presented by Mrs. H. F. Pollock; a Common Badger (*Meles taxus*), British, presented by Mr. W. H. B. Pain; a —— Galago (*Galago* sp. inc.) from South Africa, presented by Mr. Walter Carlile; a Spur-winged Goose (*Plectropterus gambensis*) from West Africa, presented by Mrs. Quayle Jones; two Common Rheas (*Rhea americana*) from South America, presented Mr. A. W. Neeld; three Grey Sparrows (*Passer simplex*) from West Africa, a Tintillon Chaffinch (*Fringilla tintillon*), two Yellow-throated Rock Sparrows (*Petronia petronella*) from Teneriffe, a Rosy Bullfinch (*Erythrospiza githaginea*) from the Canary Islands, presented by Mr. Edmund G. Meade-Waldo; a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, presented by Mr. F. C. S. Roper, F.Z.S.; a Leadbeater's Cockatoo (*Cacatua leadbeateri*) from Australia, presented by Mrs. Obbard; two Common Barn Owls (*Strix flammea*), British, presented respectively by Mr. Charles Faulkner and Mrs. Frederick Tibbs; an American Box Tortoise (*Terrapene carinata*), a Horned Lizard (*Phrynosoma cornutum*) from Mexico, presented by Mr. John Pettit; an Alligator (*Alligator mississippiensis*) from the Mississippi, presented by Mr. C. S. Morris; four Houbara Bustards (*Houbara undulata* 2 ♂ 2 ♀) from the Canary Islands, a Bonnet Monkey (*Macacus sinicus* ♂) from India, deposited; six Speigel Carp (*Cyprinus carpio*, var.), European Fresh Waters, purchased; two Bennett's Wallabys (*Halmaturus bennetti* ♀ ♀), a Derbian Wallaby (*Halmaturus derbianus* ♀), two Four-horned Antelopes (*Tetraceros quadricornis* ♀ ♀), a Burrhel Wild Sheep (*Ovis burrhel* ♀), a Thar (*Capra jemlaica*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on June 26 = 16h. 19m. 54s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 4230	—	—	16 37 45	+36 41
(1) β Lyræ	Var.	—	18 46 0	+33 14
(3) α Scorpii	1	Redddish-yellow.	16 22 40	+26 14
(4) β Herculis	2	Yellow.	16 25 30	+21 44
(5) δ Herculis	3	Bluish-white.	17 10 30	+24 58
(6) S Leonis	Var.	Yellowish.	11 5 9	+ 6 3'5

Remarks.

(1) This is the bright cluster of stars in Hercules which is probably well known to every possessor of a telescope. Seeing that it certainly consists of separate and distinct stars, no nebulosity being shown in Mr. Roberts's photograph of it, Dr. Huggins's observation of its spectrum in 1866 is very remarkable. He says:—"Spectrum of the central blaze continuous.

Spectrum ends abruptly in the orange. The light of the brighter part is not uniform; probably it is crossed either by bright lines or by lines of absorption" (Phil. Trans. 1866). As yet we know nothing of the spectra of the components of any star cluster except in the case of the loose cluster of the Pleiades, and in that case we know that the spectra are all of the same type—namely, Group IV. It seems pretty evident that the stars of the cluster in Hercules cannot have spectra of this kind; otherwise, their integrated light would not end abruptly in the orange, and the irregularities would only be obvious in the blue end, where the thick hydrogen lines ought to be visible. The absence of red light would lead rather to the supposition of bright lines than dark ones. Further investigations, with considerable optical power, may therefore lead to interesting results. It may be noted that Vogel, in 1872, recorded simply a continuous spectrum, but his attention had probably not been directed to Dr. Huggins's statement.

(2) The question of the periodicity of the appearance of the bright lines in β Lyræ cannot yet be said to have been satisfactorily settled, and as the star will be visible for some months, further continuous observations are desirable. It is not necessary here to recapitulate all the observations which lead to the conclusion that there is a periodicity in the spectrum. Gothard has probably given more attention to the star than any other observer, and he succeeded in following the variations of the line D_3 through several periods "from a bright, almost dazzling light to complete disappearance. . . . The variation is most marked in the case of D_3; it is much less striking in the hydrogen lines, although they, and probably also the dark bands in the red, are subject to a periodical variation." The period has been provisionally estimated as 7 days, but it does not seem to depend upon the fluctuations in the brightness of the star. In my own observations I have found that the bright lines in this star are best seen when no cylindrical lens is employed, and this has also been noted by other observers. Further observations, to be of any value, should be made as frequently as possible, and over a long period.

(3) Dunér describes the spectrum of this star as one of the most magnificent of Group II., the bands 1–9 being wide and dark. He also states that there is a narrow band between bands 3 and 4. As the spectrum is a bright one, this is a good opportunity for comparing the dark flutings with the brightest flutings of manganese, lead, and magnesium. In the recently issued volume of spectroscopic observations at Greenwich, Mr. Maunder states that he has found the bright green band in α Herculis coincident with the brightest carbon fluting and possessing the same characteristics. A similar comparison should also be made with α Scorpii.

(4 and 5) These stars, according to the observations of Gothard and others, have spectra of the solar type and of Group IV. respectively. The usual more detailed observations are required in each case.

(6) The spectrum of this variable has not yet been recorded. The magnitude ranges from about 9 to <13 in a period of about 188 days. There will be a maximum about July 2.

A. FOWLER.

GREENWICH SPECTROSCOPIC RESULTS.—These results for 1888 contain observations of γ Cassiopeiæ, Mira Ceti, α Orionis, α Herculis, β Lyræ, R Cygni, P Cygni, β Pegasi, and Comets *a* and *e* 1888. On October 5, 1888, ten measures were made of a bright line in the violet part of the spectrum of Mira Ceti; the mean wave-length found was 4343·37, indicating that it was the third line of hydrogen. F and D_3 were searched for on this occasion, but without success. The spectrum of α Herculis was compared with those of carbon and manganese, as given by a Bunsen flame on several occasions, and it is noted: "The green band of the carbon spectrum accorded, both as to position and appearance, with the bright interspace or 'zone' to the blue of Band VII. (Dunér's numeration). So far as the dispersion employed would show, no accordance could be more complete, both as to the position of the edge and the gradation of the fading." The blue carbon band was also found to present an approximation in position and appearance to a bright zone in the blue. The wave-length of the brightest bands in the manganese spectrum was determined as 5579, and that of the more refrangible edge of Dunér's Band IV. as 5592, whence it is concluded that the connection of the spectrum of the star with the manganese spectrum did not appear to be made out. A bright line at 5873·92, that is, D_3, was measured in β Lyræ on August 10, 1888, was seen less distinctly a month later, and was found again to be quite distinct on September 19; two days later, D_3 was seen very bright, and C and F were also visible. D_3 was visible, but faint, on October 1; F could not be seen, and C was only suspected. On October 19, C and F were not visible as bright lines, but were first suspected as dark lines, whilst D_3 was glimpsed occasionally as a feeble bright line. R Cygni was observed on September 21, D_3 was identified with probability in its spectrum, and F with certainty; and, on October 1, ten measures were made of the F line in P Cygni. Comet *a* 1888 was observed on April 19, 1888; its spectrum appeared mainly continuous; two bright bands were just glimpsed, coincident with the bands in the green and yellow of the spectrum of a Bunsen flame, the band in the blue being suspected. On May 3 the spectrum was practically wholly continuous, traces of the green band only being suspected. Comet *e* 1888, observed on November 27, showed a local ill-defined brightening, corresponding nearly to the great carbon band, but apparently further towards the blue, otherwise it was perfectly continuous.

THE ROTATION OF VENUS.—Signor Schiaparelli has recently made an extended inquiry into the question of the rotation of the planet Venus, and has brought many facts to light concerning it (*Rendiconti del R. Istituto Lombardo*, vol. xxiii.). He finds, from observations of very definite spots, that the time of rotation of the planet is 224·7 days—that is to say, Venus, like the moon, and probably Mercury, rotates on her axis in the same time that she takes to make a sidereal revolution around the sun; the axis of rotation being nearly perpendicular to the plane of the orbit. By investigating the writings of previous astronomers who have estimated the rotation period, Signor Schiaparelli concludes that those observations which have been supposed to fix the time as about 24 hours are open to question. Domenico Cassini's observations of bright markings in 1866–67 are shown to have been wrongly interpreted, a discussion of them indicating that they also support a period of rotation of 224·7 days.

GEOGRAPHICAL NOTES.

THE Russian Geographical Society has received fresh news from M. Grombchevsky as to his attempts to penetrate into Tibet from the north. In the autumn of 1889 the expedition explored the Uprang, a tributary of the Raskem-daria, tried to enter again into Kanjut, and, having failed to do so, explored the tributaries of the Raskem river which flow from the Himalayas. On November 21, M. Grombchevsky, accompanied by two men only, crossed the Kara-korum Pass, and went to the Pahnu mountaineers, who live by sheep-breeding, and suffer a good deal from the Kanjut robbers. On December 7 the expedition was at the small fort of Shahi-dulla-hodja; the winter had come, and the thermometer fell in the nights to − 20° Celsius. Nevertheless, M. Grombchevsky, with two men only and a guide, explored the passes leading to Kara-korum across the Raskem ridge. The tent had to be abandoned, although the temperature was − 35°, and the party was soon obliged to return. On January 7, after having followed for some distance the Kara-kash river, the small party began its ascent of the steep slopes of the Tibet border-ridge. The plateau itself proved to be a desert, 17,000 feet high, upon which a few yaks, *Kulangs*, and mountain sheep were grazing. A very high ridge, called by M. Grombchevsky the Yurung-kash ridge, was crossed, the pass receiving the name of "Russian." But the horses of the expedition were quite attenuated, and on January 13 the party was brought into a perilous condition by a frightful snow-storm and a temperature of − 27°, without having either a tent or any kind of fuel. M. Grombchevsky was compelled to return, marching all day long. After having made another unsuccessful attempt at crossing the Hindu-tash Pass, the expedition went to Kilian, and thence to Polu, thus connecting its surveys with those of Prjevalsky. A telegram received from New Marghelan, in Russian Turkestan, announces that the explorer and his men have returned safely, and are making new schemes for further exploration. A map, annexed to the last issue of the *Izvestia* of the Russian Geographical Society, embodies the surveys made by M. Grombchevsky in 1888 and M. Grum-Grzimailo in 1887.

IN the course of last year the Geographical Society of Berlin published no fewer than thirty-nine remarkable maps. Three of them are reproduced from those of Mercator, now in the

town library of Breslau. Two others—a map of Europe (finished in 1554) and one of England (of 1564)—are unique. Another is the large map of the world, of which there are only two copies in existence, the second one being at the Paris National Library. The Society has agreed to publish the details of Dr. Konrad Kretschmar's journey to Rome, undertaken in the Middle Ages for purposes of research.

THE LADIES' CONVERSAZIONE OF THE ROYAL SOCIETY.

THE Ladies' *Conversazione* of the Royal Society was held on June 18, and was, as usual, a great success. Many of the exhibits were the same as those shown at the *conversazione* on May 14. Among those which had not been previously shown were the following :—

Exhibited by the Director-General of Ordnance Factories :—Magazine rifle, Mark I. The new magazine rifle now being made for the British Army. It has a calibre of 0″·303, is on the bolt principle, and is provided with a detachable magazine underneath, to hold eight cartridges ; a cut-off on the right side enables it to be used as a single loader. It has two sets of sights, the ordinary ones are graduated up to 1900 yards, the long-range sights on the left side up to 3500 yards. The sword-bayonet, which is attached underneath the barrel, has a double-edged blade 12″ long.

Exhibited by the Director-General of the Geological Survey :—Diagrams illustrating some of the most ancient topography of the British Isles. (*a*) Corry on Ben More, Assynt. The rough bossy ground in the middle is the Archæan gneiss, the most ancient rock in this country. Above it to the left comes the Torridon sandstone, forming a range of cliffs, and lying unconformably on the gneiss. At the summit of the Corry, on the crest of the ridge, lies the early Palæozoic quartzite, which steals across the sandstone until it rests directly on the gneiss. (*b*) Sleagach, Loch Maree. The pinkish bossy rock is the old gneiss, which rises into a group of hills that have been buried under the Torridon sandstone. By prolonged and enormous denudation of the overlying sandstone, the gneiss hills have been uncovered, and now reveal a portion of the oldest known topography of Britain. The gneiss hill to the right rises to a height of 2500 feet, and in ascending it one can walk along the ancient shore-line and traverse beach after beach that was piled up over the sinking land. (*c*) View from the south shoulder of Sleagach looking east. The bossy hills of gneiss rise towards the left hand to a height of 3000 feet above the sea. The overlying cover of Torridon sandstone, though enormously denuded, still forms a range of lofty hills, beneath which knobs of gneiss at different elevations may be seen protruding. The quartzite (coloured yellow) caps the mountains to the right until a mass of the old gneiss overlies it. This cake of the most ancient rock of the region has been torn up and thrust over the younger formation. The line of junction or "thrust-plane" between them descends into the plain, and runs for miles to the westward. (*d*) Meall a Ghubhais, Loch Maree. The upper part of the mountain is a cake of Torridon sandstone, which has been driven westward by the same gigantic terrestrial movements just referred to, and has been placed upon the quartzite group of rocks which ought really to lie above it. In the lower part of the diagram the sandstone is seen in its normal position below the quartzite. (*e*) Section of Meall a Ghubhais, to show the detailed geological structure of the mountain. It will be observed that the upper shifted mass of Torridon sandstone is traversed by several thrust-planes, and that portions of the old gneiss have likewise been driven westward underneath it.

Exhibited by Mrs. F. W. H. Myers :—(1) Platinotype photographs. (2) Photographs on fabrics.

Exhibited by Sir William Bowman, Bart., F.R.S. :—(1) Jubilee portrait of the late Prof. Donders, For. Mem. R.S., painted by Mrs. Donders (Hubrecht). Gold Medal awarded at the Exposition International, Munich, 1888. Ultimately destined for the National Museum, Amsterdam. (2) Uncompleted portrait of the same, 1873, by G. F. Watts, R.A.

Exhibited by Prof. W. C. Roberts-Austen, C.B., F.R.S. :—Measurement of high temperatures. Experimental determination of the melting-point of gold (1045° C.) and of silver (945° C.), by means of Le Chatelier's pyrometer. This consists of a thermo-couple, composed of wires of platinum and platinum alloyed with 10 per cent. of rhodium, connected with a dead-beat galvanometer. The pyrometer scale has been calibrated by heating the thermo-couple to certain known temperatures determined by the air thermometer.

Exhibited by Prof. A. M. Worthington :—An apparatus for stretching a liquid and measuring simultaneously the stress and strain.

Exhibited by Mr. P. L. Sclater, F.R.S. :—Portrait of Dr. Emin Pasha, C.M.Z.S., and original letter from him, addressed to Mr. Sclater, dated Wadelai, April 15th, 1887.

Exhibited by the Postmaster-General :—Hughes's type-printing telegraphs, working to the Continent. This apparatus is mainly mechanical, the electrical action being confined to the sending a single short pulsation of current at the instant the type-wheel is in the proper position, and only one wave of current is needed to produce a letter. The sending and receiving instruments are combined. The key-board consists of as many keys as there are letters and signs to be printed. Connecting with the keys and corresponding with them, and also with the type-wheel, is a set of pins arranged radially in a circular horizontal plate. An arm revolves over these pins without touching them until a key is depressed, when a current is sent into the line. The instruments are caused to run approximately isochronously by means of suitable adjustments, and they are afterwards maintained in synchronism automatically by the actual working. The instrument is eminently suitable for Continental message traffic, for which purpose it is largely used. The three working instruments shown were connected with Paris, Berlin, and Rome. In the course of the evening the President held communication with Profs. Helmholtz and Du Bois-Reymond in Berlin, Prof. Mascart in Paris, and Prof. Cannizzaro in Rome.

Exhibited by Mr. Walter Gardiner, F.R.S. :—(1) Specimens of aquatic fen plants and algæ occurring in the neighbourhood of Cambridge. (2) Specimens illustrating the exhibitor's paper on a new method of printing photographic negatives, employing living leaves in place of sensitive paper.

Exhibited by Dr. Pole, F.R.S. :—Diagrams in illustration of colour-blindness.

Exhibited by Dr. Karl Grossmann :—Tests for colour-blindness.

Exhibited by Prof. J. W. Judd, F.R.S. :—Specimens of a remarkable nickel-iron alloy (awaruite), of terrestrial origin, from New Zealand, and of the minerals and rocks with which it is associated. Sent by Prof. G. H. F. Ulrich, of the Dunedin University, N.Z. This curious mineral, consisting of $2Ni+Fe$, was analyzed and named by Mr. W. Skey, in 1885, having been detected by him in specimens of sands obtained from streams in the south-western part of the South Island of New Zealand. Prof. Ulrich has since been able to show that the grains of this alloy are found over a considerable area, disseminated in peridotite and serpentine rocks ; which rocks are intrusive in the metamorphic schists of the district, and form the Red Hill and Olivine Ranges. The substance which awaruite most closely resembles is the Oktibbehite meteorite, consisting of $Ni+Fe$: and the occurrence of this remarkable alloy in terrestrial rocks is comparable to the presence of nickel-iron alloys in the basalts of Ovifak and other localities in Greenland.

Exhibited by Prof. A. H. Church, F.R.S. :—A selection of Japanese sword guards, or *tsuba*, made of malleable iron, and variously decorated with chased, hammered, and pierced work, or with incrustations in gold, silver, shakudo, shibuichi, and bronze. The majority of the examples shown represent plant forms, and were executed between 1650 and 1850.

Exhibited by Prof. W. C. Roberts-Austen, C.B., F.R.S. :—Japanese art metal-work. The specimen is interesting as a modern example of flat inlaying in metals. The plate is of bronze, and the bird is of *shakudo*, or copper alloyed with a small quantity, about 2 or 3 per cent., of gold. The isolated feathers are of a darker variety of this alloy.

Exhibited by Dr. W. J. Russell, F.R.S. :—Ancient Egyptian colours discovered by Mr. Flinders Petrie in the Fayoum, and modern imitations of them ; and colours from Hawara in the Fayoum.

Exhibited by Mr. A. P. Laurie :—Colours used by the fifteenth century painters.

Exhibited by Mr. W. F. R. Weldon, F.R.S. (on behalf of the Marine Biological Association) :—Larvæ of certain food-fishes, together with other animals of interest inhabiting Plymouth Sound.

Exhibited by Prof. A. C. Haddon, on behalf of Mr.

A. Haly, Director of the Colombo Museum:—Some tropical fishes preserved in a mixture of gum and glycerine, as a means of displaying their natural colours. The results, although not as good as with some of the specimens located in the museum itself, represent the outcome of a series of experiments extending over a number of years, full details of which are to be found in the "Ceylon Administration Reports." Gum and glycerine have long been used in combination in microscopy, as a substitute for Canada balsam; on account, however, of the difficulty experienced with air-bubbles, their use is now very generally given up. Mr. Haly's experiments have shown that if the specimens preserved in the mixture which he employs be placed in a medium which will precipitate the gum, all colour is quickly lost, wherefore the preservation of the latter would appear to be due to the gum's influence. Mr. Haly is still prosecuting his experiments, and his latest researches show that the employment of pure glycerine for mounting (a well-nigh prohibitory condition) is no longer indispensable. He now finds that gum and glycerine are miscible with alcohol in all proportions necessary for his purposes, provided certain precautions be taken in the manipulation. He is thus enabled to check the ravages of fungoid organisms which earlier impeded his progress; and, by reducing the syrup to the necessary specific gravity with proof spirit, he is enabled to successfully preserve frogs, reptiles, and other organisms with which he originally failed, to no small degree as the result of the excessive dehydrating powers of his original medium. Mollusks, sea anemones, and jelly-fish, are among those forms of life with which the method has been least successful. Mr. Haly tells us, however, that for the Alcyonidæ his mixture is a good preservative, and that sea-water saturated with bichromate of potash has been found excellent for hardening jelly-fish. The power to preserve the natural colours of plants and animals is now the desideratum of the museum curator. Some of Mr. Haly's exhibits have stood the test of from two to three years' exposure to the light in a tropical climate. The outlook is a hopeful one; and the facts show the colonial worker, who is apt to be lost sight of in these days of competition and aggrandisement, to be fully abreast of the times, and alive to the best interests of the public.

Exhibited by the Zoological Society of London:—Eggs of a large python (*Python molurus*) laid in the Zoological Society's reptile-house. The pythons lay about thirty to fifty eggs at one time, and incubate like birds. The female python on the present occasion has "declined to sit," but on former occasions this process has been carried on in the gardens (see Proc. Zool. Soc., 1862, p. 365). Abnormal heat is developed by the sitting python as by the sitting hen.

Exhibited by Prof. A. Macalister, F.R.S.:—Two mummy heads of priests (12th and 18th Dynasties) from tombs near Assouan, Upper Egypt.

Exhibited by Sir Archibald C. Campbell, Bart:—Photographs of musical sparks, done at Blythswood, Renfrewshire, by the exhibitor.

Exhibited by Dr. Augustus D. Waller:—Demonstration of the electrical variations of the heart of man and of the dog.

The following demonstrations by means of the electric lantern took place in the meeting room:—

Animal and bird studies, photographed from life, exhibited by Mr. Gambier Bolton.

The orientation of some ancient temples, exhibited by Prof. J. Norman Lockyer, F.R.S.

Experimental demonstrations on electro-magnetic repulsion phenomena, and a series of experimental demonstrations illustrating the principal facts of the phenomena of electro-magnetic repulsion, discovered by Prof. Elihu Thomson, and their applications in alternate current electro-magnetic motors, as exhibited in the Paris Exhibition, exhibited by Prof. J. A. Fleming and Mr. Ernst Thurnauer.

THE SUNDAY SOCIETY.

ON June 21 the Sunday Society held its fifteenth annual meeting in Prince's Hall, Piccadilly. Prof. G. J. Romanes delivered his address as President of the Society. After a brief analysis of the Sunday question in general, he spoke as follows:—

As you will see from the fifteenth Annual Report which is now in your hands, the present year is one of unusual activity on the part of our Society. First of all, it has been marked by a wise stroke of policy in sending a deputation to the French Ministry for the purpose of obtaining information as to the practical results of opening the great Exhibition of Paris on Sundays. Moreover, as explained in the Report, the Committee desired to ascertain whether there be any reality in "the great bugbear of the Sabbatarian mind"—viz. that the Continental Sunday is a day of irreligion to the masses, and of overwork to the Government *employés*. As you will see from the Report, the result has been conclusively to prove the unreality of the bugbear, so far at all events as the specific question of the opening of national galleries and museums is concerned. With the more general aspects of the Continental Sunday we have not, as a Society, anything to do; but I may remark in passing that we must here remember differences of national taste and feeling. What would be irreligious levity in one community need not be so in another; and it would be absurd to attribute these differences of sentiment to differences in the matter of Sunday observance.

Next, you will find from the Report that the Trustees of the People's Palace received a memorial from the Working Men's Lord's Day Rest Association, which was promptly responded to by a counter-memorial from this Society. The latter document may best be left to speak for itself; and as it speaks with so much good English common-sense, I scarcely feel it desirable to move a vote of thanks to the Trustees of the People's Palace for having listened to us rather than to our opponents: I prefer to take it for granted that the Trustees perceive as plainly as we do on which side of this matter the truth and the wisdom lie.

Again, you will learn from the Report that, in addition to the public institutions previously opened on Sundays, several others have been this year added to the list, which now comprises 23 in all. Moreover, this year has likewise witnessed the great reform of throwing open the British Museum on certain week-day evenings; while both the authorities there and those at the National Gallery have expressed, not only their willingness, but their desire to throw open to the public on Sundays these by far the greatest of our national collections. In my opinion it is impossible for us as a Society to over-estimate the importance of having thus gained the express and cordial support of the most representative museum on the one hand, and of the most representative art gallery on the other. It now only remains that the Treasury should allow a small grant to defray the comparatively nominal expenses, and our cause would be won throughout the length and breadth of the land. For if once the British Museum and National Gallery were opened on Sundays, no other museum or art gallery could afford to resist any pressure that might be put upon them to follow so overwhelming an example. Our big guns, therefore, are at last fully charged and ready to fire; only the trigger waits to be pulled, and this it is that we are now about to attempt.

For you will observe, in the last place, that the Report in your hands contains a very weightily worded memorial which was sent to the Chancellor of the Exchequer in the middle of April. Where so many forcible considerations are comprised within so small a compass, one is much tempted to read the whole. But as other speakers are to follow me, I shall merely indicate one or two of the points in this memorial which appeal to me as of most importance.

First, then, I would have you observe how strong a ground the appeal is based upon, where it calls attention to the fact that the House of Commons has already and amply recognized the principle of their obligation to open on Sundays our national museums, galleries, gardens, &c., by having already furnished the funds requisite for the purpose to Kew, Hampton Court, Greenwich, Dublin, and Edinburgh. Again, as another very notable feature in this memorial, I may mention the enormously strong support to which it draws the attention of Mr. Goschen as having recently been given to the objects of this Society by the London County Council, who passed an almost unanimous resolution in favour of our policy. Yet once more, can anything be more calculated to sway the mind of a Minister than the anomalous state of matters to which the memorial draws attention, where it indicates that the governing bodies of the British Museum and National Gallery are expressly desirous of making arrangements whereby the priceless collections under their charge may at last become in very truth, or without any restriction, the property of the British public? When provincial institutions of incomparably less importance have already succeeded in obtaining funds from the Treasury for this purpose, is it right or fitting that the great Metropolitan institutions should be

denied a similar privilege, when their governing bodies unite with the London County Council in the petition which this memorial sets forth?

Seeing, then, that our position has now grown to be one of such well-nigh irresistible strength, I think you will all agree with me in holding that a policy which has gained such results during the past fifteen years of our existence as a Society ought to be the policy which we shall continue to follow. Having achieved this large measure of success by our quiet persistence in the way of enlightening public opinion, and patient gaining of all the strategic points of importance which we now hold, I, for one, would strongly deprecate the more noisy methods of popular agitation, with their Hyde Park processions, and so forth. But there is one piece of machinery which we have used with considerable effect on several occasions in the past; and this piece of machinery we intend once more to put into motion.

Three times in the fifteen years of its existence the Sunday Society has convened a National Conference, and in the opinion of our Committee the time is ripe for the convening of another. Therefore arrangements have been made for this the fourth Conference to meet in London during the present year. I must express my gratification that the Committee have thought fit to elect me President of the Society in a year which is thus destined to be one of unusual prominence in its annals, and I may be permitted to record my thanks for the honour which has thus been conferred, even while expressing my regret that the duty of presiding over the coming Conference has not fallen into abler hands.

As you are probably well aware, the importance of these Conferences consists in their bringing together, and combining in a collective manner, representative opinions upon the Sunday question from all parts of the kingdom. Not only are invitations issued to institutions which are already opened on Sundays to send their delegates, but statements of opinion are solicited from eminent men in all departments of science, art, and letters, as well as of public life and social organization. In this way we are able to focus the best thought of our time upon the objects which we have in view, and to deliver the result in the form of printed papers to the public, and of weighty resolutions to the Government. Time does not admit of my dwelling as fully as I should have desired upon this the most important feature of our programme for the current year, and therefore I will ask you to read an instructive historical sketch which has already been published by our Hon. Secretary, touching the work that has been accomplished by the three previous Conferences. You will find this sketch in the *Sunday Review* for January of the present year, and in order to give you a general idea of its substance, I will conclude by making two short quotations. The first I give as a sample of the opinions obtained from eminent men, and the second I give as a brief epitome of the work that we hope to accomplish by means of the fourth Conference.

The sample of opinion which I select for quotation is taken from what was said by Sir Joseph Hooker at the last Conference; and I select this expression of opinion, not only because its author, like his illustrious ancestor, is proverbially gifted with one of the best judgments that has ever helped to raise a man to the highest rank of eminence, but also because his opinion is, in this case, founded upon a statement of the most cogent facts.

Speaking as Director of the Royal Gardens at Kew, Sir Joseph Hooker said:—

"If there is one matter that gratifies me more than another, in respect of the administration of the Kew Gardens and Museums by the Government, it is the opening them to the public on Sundays. On no day of the week have we more interested visitors, or more of that class which we should wish to see profiting by the instructive contents of this institution. The Museums especially are crowded, and, when it is considered that the exhibits in them are not of articles that strike the eye or gratify the senses of colour or form, the interest they excite is almost to be wondered at. The artisan classes are great frequenters of these Museums, with their wives and families, and it is pleasing to see the delight with which the children recognize such articles as the sugar-cane, the coffee-plant and its products, and the various implements used in their preparation, manufacture, &c. I should add that this interest in the instructive character of the Gardens is largely on the increase, and is mnnifest to the most careless observer. It is further accompanied by a marked improvement in the conduct of certain classes, which were formerly troublesome in many ways, and a nuisance to quiet visitors. It speaks volumes for the moral effect of the Sunday opening when I add that such classes no longer exist at Kew. Whether it is that such no longer come, or that, coming, they now behave themselves, is immaterial—the moral gain is great. During the last two years we have had in each year a million and a quarter of visitors, of whom the greater proportion are Sunday afternoon arrivals from every quarter of the metropolis and its surroundings. Let the numbers speak for themselves:—1882, Sunday visitors, 606,935; week-days, 637,232. 1883, Sundays, 616,307; week-days, 624,182."

The other quotation is taken from the close of our Hon. Secretary's paper on National Conferences, already alluded to:—

"Thus the Fourth National Conference will be able to point to the friendly action of the Government in providing funds for opening the British Museum to those who desire to visit it on week-day evenings; it will have a friendly Chancellor of the Exchequer to appeal to in Mr. Goschen, who is backed up by the vote of the London County Council, and meets Parliament with a surplus which, there is a general opinion, should in part be devoted to education.

"Could education be better or more equitably promoted than by furnishing the Trustees of the National Museums and Galleries in the Metropolis with the funds necessary for throwing open these avenues of culture and refinement to the millions of people surrounding then? The people have already not only the inclination to become better acquainted with the contents of these Museums and Galleries, but they have for the most part the necessary leisure for this purpose on the fifty-two Sundays throughout the year, when the Trustees are precluded from opening them solely from want of funds, which it is just as much the duty of the Government to provide in London as outside of it, and for those who wish to visit the Museums on Sundays as well as for those who wish to do so on week-day evenings. Should the Conference make a strong appeal to Mr. Goschen, and through him to the Government, to deal justly by London in this matter, the time cannot be far distant when the reproach to the nation of having all such institutions as the National Museums and Galleries in the Metropolis closed on Sundays will be removed."

These, as I have said, are the words of our Hon. Secretary. And I cannot refer to him from the chair which I have now the honour to occupy without asking you, in conclusion, to join with me in heartily recognizing the unique value of his indefatigable work in promoting the objects of this Society. For I know it is not too much to say, that at whatever time the reproach to the nation of which he speaks will eventually be removed, its removal will have been due much more largely to one Englishman than to any other, and that the name of this Englishman is Mr. Mark H. Judge.

SCIENTIFIC SERIALS.

Studies from the Biological Laboratory of the Johns Hopkins University, Baltimore, vol. iv., Nos. 5 and 6.—No. 5 contains:—Some observations on the effect of light on the production of carbon dioxide gas by frogs, by H. Newell Martin and Julius Friedenwald. The influence exercised by light on the metabolisms of the animal body has been recognized for the last fifty years. Following up the researches of Moleschott, the authors experimentally proved that, in frogs deprived of their cerebral hemispheres, a greater quantity of carbon dioxide is given off in the light than in the dark; that, therefore, the influence of light in producing greater oxidations in normal frogs is simply reflex, and not due to greater bodily activity brought about by psychical conditions dependent on the light; that the cerebral hemispheres do not take any direct part in regulating the oxidations of the frog's body; and that this reflex action of the light, though mainly effected through the eyes, is produced partly also through the skin.—On the comparative physiological effects of certain members of the ethylic alcohol series (CH_4O to $C_5H_{12}O$) on the isolated mammalian heart, by John C. Hemmeter.—On the ventricular epithelium of the frog's brain, by A. C. Wightman. The author concludes that the epithelial layer of the frog's brain and spinal cord forms a continuous lining to the central nervous system. It is everywhere a single layer thick. The epithelium of the ventricles forms a central zone of cells, about which the brain-cells are concentrically arranged. The cells of the epithelium and of the brain are connected by processes which extend from the tips of the former. The epithelial layer consists

of cells of several varieties—the columnar, the spindle, and intermediate forms; all are ciliated.—On the temperature limits of the vitality of the mammalian heart, by H. Newell Martin and E. C. Applegarth.

No. 6 contains :—On the morphology of the compound eyes of Arthropods, by S. Watase (plates 29 to 35). In studying the structure of the ommatidium of the compound eye of Serolis it was found that it might be reduced to a simple ectodermic invagination of the skin. Extending his researches over several other Arthropods, the author found that the same interpretation could without exception be applied, and he thinks this view of the ommatidium finds its strongest support in the fact that in Limulus the ommatidium is an open pit of the skin. If these views be correct, the unit of the compound eye of an Arthropod is not so complex as has generally been conceived, and the total result is but the vegetative repetition of a similar structure. In an appendix the author alludes to his investigations into the structure of the eye in Echinoderms, the result of which he hopes shortly to publish.—On the anatomy and histology of *Cymbuliopsis calceola*, Verrill (plates 36 to 39), by J. I. Peck. A few specimens of this rare Pteropod were found in the Gulf Stream, off Cape Charles.—On the amphibian blastopore, by T. H. Morgan (plates 40 to 42), concludes that in some forms it becomes altogether or in part the neurenteric canal; in some it becomes the anus; in some, again, it closes and a new anus is formed, while he believes that in Amblyostoma it becomes both the neurenteric canal and the anus.—On a new Actinia, by Dr. Henry V. Wilson (plate 43). This new form was found on the small reef which fringes the shore of No Name Key, Abaco, Bahamas. It was discovered in a perforation on the under surface of a porites-like asteroid coral, and, though constantly looked for, but the one specimen was found. It has been called *Hoplophoria coralligens*. Below the twelve long tentacles are cycles of smaller ones, and below these four remarkable large organs, which give the animal a most *bizarre* appearance; these are diverticula of the gastro-vascular cavity, and are stinging weapons. The genus is placed provisionally with the Antheadæ.

Bulletins de la Société d'Anthropologie de Paris, tome xii. (série 3), fasc. 4, 1889.—Continuation of M. Variot's paper on pigmentation of the skin in the region of cicatrized lesions in the negro.—Descriptive ethnographic summary of the course of distribution of different races in Europe, by M. Lombard. Starting from the Neanderthal race as the only one referable to the Quaternary period, the author attempts to show that as early as the age of their descendants—the Cro-Magnon men—various alien races had already appeared contemporaneously with the latter in Central Europe. From this point, M. Lombard undertakes, on very vague premises, to trace the advance westward of successive and intersecting streams of brachycephalic and dolichocephalic peoples bringing with them their own special civilization of the dolmen, polished stone, or other, period. His view that the Pamir plateau is the cradle of the Aryans, and that they belonged primarily to the blonde races, is strongly combated by Mme. Clémence Royer, whose able refutation of his somewhat crude opinions gives to his paper its sole claim to notice.—Communications on the silex of Breonio, near Verona, and on spurious French and Italian flint implements, by M. de Mortillet, who shows the extent to which the manufacture of so-called palæontological objects is carried on.—On a case in which the gray commissure of the third ventricle was absent; and on the concomitant psychic characteristics of this anomalous condition, by Dr. F. de Marcedo.—On the mummified brain of an ancient cranium found in Venezuela, by M. Chudzinski.—On venous circulation in stumps, by Dr. Lejars.—On a rabbit with only one ear, by M. Chervin.—On the effects of the artificial deformity of the skull in a Bolivian infant, by M. Manouvrier.—On various prehistoric stations in the Department of Seine-et-Oise, by M. Vauvillé. The finds at Crespières included three implements of a sandstone not found in the district, the remainder being of cut flint. At Grancières evidence exists of the extensive manufacture of extremely small flint implements similar to those found in India, and in the neighbourhood of Tunis and Algiers, as well as in parts of South-Western Europe. The objects generally would seem to belong to the Palæolithic and Neolithic ages.—On the skeletons found at Castenedolo in Lombardy, and assumed by M. de Marcedo to be of Tertiary origin, by M. de Mortillet.—On the utility of family burying-places in reference to the study of the influence of heredity on anatomical characteristics, by Mme. Clémence Royer.—On the megalithic remains of the Department of La Somme, by M. Pouchon. The author points out the inaccuracy of the official lists published for the district, and describes a number of interesting, so-called polishing stones, and other monoliths, which demand immediate protection from the Government to save them from wanton destruction.—On the distribution of muscular force in the hand and foot, observed by means of a new form of dynamometer, by M. Féré.—Final Report of the Eighth Congress of Orientalists at Stockholm, by M. O. Beauregard.—The prehistoric stations of Coucouteni, Roumania, by M. Dimandi. The finds here are of special interest, as showing the advanced civilization of a people, probably of Greek origin, who as early as the fourth or fifth century B.C. occupied this region. The enormous number of idols, chiefly female, was a marked characteristic of the station. Besides anthropomorphic idols, a few animals, as cows and bulls, were used to represent some forms of divinities.—On the various forms of projectiles of the Neolithic age, by Dr. Capitan.—On bronze objects found in the bed of the Marne, by M. P. Masson.—On the flint knives and arrows of the Department of Aisne, by M. Vauvillé.—On the prehistoric station of Lengyel, in Hungary, by M. Nadaillac.—On a case of a pseudo-male hermaphrodite, by Dr. Pozzi.—On artificially induced deformity of the head as still practised in the Haute Garonne, and other parts of France, by Dr. Delisle (with illustrations).—Report of the Sixth Broca Conference.—On the erroneous establishment of a distinct order of true Bimana, by M. Hervé. The object of the essay is to prove that the Simians have, like man, two hands and two feet, and cannot therefore be classified as true Quadrumana, or true Bimana.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 5.—"On the Passive State of Iron and Steel. Part I." By Thomas Andrews, F.R.S., M.Inst.C.E.

The passive state of iron appears first to have been observed just a century ago by Keir, and brought before the notice of the Royal Society in 1790 (Phil. Trans., 1790, p. 379); he observed that strong nitric acid had no action on iron when the metal was placed therein. Since then, Bergmann, Schonlein, Faraday, Herschel, and others, have conducted investigations in relation to this phenomenon. In the present paper are presented the results of a study of certain magnetic, temperature, and other conditions which the author found to affect the passive state of iron and steel. The experiments of Part I. are classified under the following heads :—

Series I., containing the results of observations on the influence of magnetization on the passive state of steel in cold nitric acid, specific gravity 1·42.

Series II., treating of the influence of magnetization on the passive state of steel in warm nitric acid, specific gravity 1·42, the experiments showing that magnetized steel bars were less passive in warm nitric acid than unmagnetized ones.

The chemical composition and physical properties of the steel used are given in detail in the paper, together with the methods employed in the investigation, and detailed illustrations of the various apparatus used in course of the research. The results of the investigation are given in detail in Tables I. and II. The whole of the results on Table I. afford an indication that magnetization of comparatively low intensity, acting during considerable periods of time, exerts only a limited modifying influence on the passivity of iron or steel in the cold, though the influence is discernible when employing a delicate galvanometer. Magnetization, with the nitric acid at a higher temperature, produces a quicker effect (see results in Series II., Table II.). In a recent research by the author "On Electro-chemical Effects on Magnetizing Iron, Part II." (Roy. Soc. Proc., vol. xliv. p. 152), it was noticed that local currents were set up between the polar terminals and central portions of steel magnets exposed as electrolytes; and this class of local action, together with the slight alteration of the physical structure of the magnet bars consequent on their magnetization, may possibly be involved in producing the effects due to magnetism on passive steel or iron in conc. nitric acid.

"Observations on Pure Ice, Part II." By Thomas Andrews, F.R.S., M.Inst.C.E.

The experiments contained in the paper form a continuation of a previous research by the author. The experiments were

made to investigate the relative plasticity of pure ice at various temperatures ranging down to − 35° F., and also of pond ice. The arrangements of apparatus used in determining the plasticity of pure ice and pond ice are illustrated in detail in the paper. The ice for the pure ice experiments was frozen from distilled water; the coolest freezing mixture used, consisting of three parts by weight of crystallized calcium chloride and two parts by weight of snow, yielded a constant temperature of − 35° F.; other freezing mixtures were used for the temperatures above this. The cylinders of pure ice employed were 2 feet 1½ inch long, and 2 feet 1½ inch diameter, and weighed 470 pounds. The plasticity was ascertained by measuring the relative penetration, during equal periods of time, of the polished steel rods into the ice, care being taken to avoid errors from conductivity. A large number of experiments were also made on the plasticity of natural lake or pond ice. The influence of the composition of water on the plasticity of the ice frozen therefrom was investigated, and a number of experiments were made to ascertain the proportion of the saline constituents of the lake water taken up into the ice during crystallization. Roughly speaking, it was found that the proportion of inorganic matter in the melted ice was about ten per cent. of the total inorganic salts contained in the lake water from which it was frozen. The general summary of results of the experiments on the plasticity of pure ice at the various temperatures employed are plotted out in four curves on Diagram I., and the results of the experiments on the plasticity of pond ice are shown in detail on Diagram II. In the majority of instances, it was found that, if the plasticity of the ice at − 35° F. be called 1, at 0° F. it would be about twice as much, and at 28° F. the plasticity would be about four times as great as at 0° F., or eight times as much as at − 35° F. The comparatively great contractibility in ice observed at considerably reduced temperatures (see the author's former paper "On Observations on Pure Ice and Snow," Roy. Soc. Proc., No. 245, p. 544) may probably account for the great reduction in its plastic properties at low temperatures. This is in accord with the practical cessation of motion in glaciers during the cold of winter. It was also noticed in course of the research that the plasticity of the naturally frozen pond ice was manifestly greater than that of the prepared pure ice; the comparative difference in the behaviour of the pond ice was doubtless owing to a portion of the saline constituents of the water interspersing during congelation between the faces of the individual crystals of ice, thereby tending to reduce the cohesion of the mass as a whole, and increasing its plasticity.

Linnean Society, June 5.—Prof. C. Stewart, President, in the chair.—The President nominated as Vice-Presidents for the year Messrs. W. Carruthers, P. Martin Duncan, J. G. Baker, and F. Crisp.—Mr. H. Little exhibited and made some remarks upon a photograph of a remarkable Aroid, *Amorphophallus titanum*, which had flowered for the first time in this country.—Mr. James Groves exhibited a specimen of an *Orobanche* parasitic upon a *Pelargonium*.—The following papers were then read and discussed:—On a collection of plants made in Madagascar, by Mr. G. F. Scott Elliot.—On Weismann's theory of heredity applied to plants, by Rev. G. Henslow.—Teratological evidence as to heredity of acquired conditions, by Prof. Windle.—On the development of the tetrosporangia in *Rhabdochorton Rothii*, Naegeli, by Mr. Harvey Gibson.—On the position of *Chantransia*, with a description of a new species, by Mr. George Murray and Miss E. Bass.—On the development of the cystocarp in *Callophyllis laciniata*, by Miss A. L. Smith.—On the cystocarps of some genera of Florideæ, by Mr. J. B. Carruthers.

Royal Meteorological Society, June 18.—Mr. Baldwin Latham, President, in the chair.—The following papers were read:—On the difference produced in the mean temperature derived from daily maximum and minimum readings, as depending on the time at which the thermometers are read, by Mr. W. Ellis. In the publications issued by the Greenwich Observatory authorities, the maximum and minimum temperatures are those referring to the civil day from midnight to midnight. At many stations the observers only read their instruments once a day, viz. at 9 a.m., when the reading of the maximum thermometer is entered to the preceding civil day, and the reading of the minimum thermometer to the same civil day. Such stations are called "climatological stations." The author has tabulated the Greenwich maximum and minimum temperatures according to both methods for the years 1886–89, and finds that the climatological maximum and minimum means are in excess of the civil day means.—On the distribution of barometric pressure at the average level of the hill stations in India, and its probable effect on the rainfall of the cold weather, by Mr. W. L. Dallas. The weather over India during January 1890 was very dry, and in marked contrast to that which prevailed during January 1889. The distribution of barometric pressure was, however, much the same in both months. The author has investigated the records at the hill stations, and has prepared charts showing the distribution of barometric pressure from both high and low level stations. From the high level charts it appears that the mean barometric gradient in 1889 was rather more than twice that in 1890, and, considering what is known of air movements, even at moderate elevations above the earth's surface, it may be assumed that these differences in pressure were accompanied with large differences of air motion; and if it is also assumed that the evaporation over the Southern Ocean is in all years fairly comparable in amount, the deficiency of rainfall over India in the winter of 1889–90 can be attributed to diminished lateral translation of vapour owing to sluggish movements in the upper atmosphere.—On the relative prevalence of different winds at the Royal Observatory, Greenwich, 1841–89, by Mr. W. Ellis. The author gives the following as the average number of days of prevalence of different winds for the 49 years 1841–89, as derived from the records of the self-registering Osler anemometer:—

N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
40	45	27	22	35	106	46	22	22

—On some recent variations of wind at Greenwich, by Mr. A. B. MacDowall.—On the action of lightning during the thunderstorms of June 6 and 7, 1889, at Cranleigh, by Captain J. P. Maclear, R.N. The author examined a number of trees which had been struck by lightning during these thunderstorms, and found that those which were struck before the rain fell were shattered, while those which were struck after the rain commenced were simply scored, with the bark blown off. It seems that during rain every tree is conducting electricity, and a disruptive discharge takes place where the conductor becomes insufficient. This depends on the position of the cloud, the amount of foliage on the tree, its condition of moisture, and its connection with running water.

Geological Society, June 4.—Dr. A. Geikie, F.R.S., President, in the chair.—The President referred to the sad loss which the Society had sustained through the death of Mr. Dallas, and read the following resolution, which had been passed by the Council and ordered to be entered upon its minutes:—"The Council desires to record on its minutes an expression of its deep regret at the death of the Assistant-Secretary, Mr. Dallas, which took place on the 29th ultimo, and of its sense of the loss inflicted on the Council and Society by the removal of one who, for the long period of twenty-two years, had done them invaluable service, and who, by his courtesy, kindliness, and helpfulness had endeared himself as a personal friend to the Fellows." It was moved by Dr. Evans, seconded by Dr. Hinde, and carried unanimously, that the resolution passed by the Council be communicated to Mrs. Dallas on behalf of the Society also.—The following communications were read:—As to certain "changes of level" along the shores on the western side of Italy, by R. Mackley Browne.—North Italian Bryozoa, by A. W. Waters.—Notes on the discovery, mode of occurrence, and distribution of the nickel-iron alloy "Awaruite," and the rocks of the district on the West Coast of the South Island of New Zealand in which it is found, by Prof. G. H. F. Ulrich. In an introduction, the author describes the original discovery, determination, and naming of the mineral in 1885 by Mr. W. Skey, and clears up a misunderstanding by which he himself had been credited with the discovery; he furthermore gives a historical sketch of the further investigations and publications referring to the mineral. The geology of the Awaruite-bearing district is described. The rocks consist of peridotites and serpentines, breaking through metamorphic schists with occasional massive intrusions of acid rock. The petrographical characters of the peridotites of the hill-complex, including the Olivine and Red Hill Ranges, and serpentines are considered in detail, and the mode of occurrence of the Awaruite in them and in the sands derived from their denudation is discussed. The author submits a sketch-map of the localities where the mineral has been discovered in sand, including not only George River, but also Silver Creek, Red Hill, and other localities, and quotes Mr. Paulin's belief that it occurs diffused

through the whole extent of peridotite and serpentine rocks, and inferentially in the drifts derived therefrom. The President noted the interest attaching to the gradual development of our knowledge of native iron of terrestrial origin. Prof. Judd was glad to have the present opportunity of removing a misconception that had arisen concerning this mineral. In bringing the matter before the Society on a previous occasion he dwelt upon the facts of special geological interest, and Mr. Skey's name was not mentioned in the few lines placed on record in the Proceedings. No attempt, however, had been made by Prof. Ulrich to claim the discovery of this mineral, though he appeared to have been the first to record its peculiar occurrence in the ultrabasic rocks. In the South Island was the well-known chromite-bearing olivine rocks of the Dun Mountain, but the rock now described was in a distant part of the same island. An interesting series of serpentines derived from peridotites has been sent over by the author, and these specimens contain the "Awaruite." A number of garnets and chlorites, with chrysotile, talc, and magnetite, have been found in the Red Hills. He was not aware that any "Awaruite" had been discovered in the peridotite; but this was probably due to the softer nature of the serpentine, where it could be more easily detected. He had recently heard that one of the serpentines of Norway had yielded a similar alloy.

EDINBURGH.

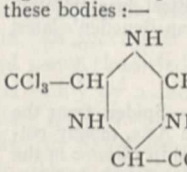
Royal Society, June 2.—Sir Douglas Maclagan, Vice-President, in the chair.—Prof. Crum Brown read a paper on the relation of optical activity to the character of the radicals united to the asymmetric carbon atom. He stated that—if we denote the optically active compound by the symbol C(ABΓΔ)—where C denotes the carbon atom, and A, B, Γ, Δ denote the radicals arranged in order of a hitherto undetermined quantity, K—any replacement of one of the radicals by a new one which changes the order as regards K alters the sense of the optical activity. Suppose, for instance, that as seen from A the values of K for B, Γ, Δ are in ascending order. If we substitute for Γ an atom whose K is greater than that of Δ, the order will now be B, Δ, Γ', which is left-handed if that of B, Γ, Δ was right-handed. Thus (assuming that increase of *mass* is accompanied by increase of K), he finds that in a number of such compounds the alteration indicated produces a substance in which the direction of rotation of the plane of polarization of light is reversed. —Dr. H. R. Mill read a paper on the mean level of the surface of the solid earth, in which he showed that, from Dr. John Murray's calculations, the general level of the lithosphere was at a depth of 1400 fathoms beneath mean sea-level. More recent explorations show that the oceanic depths are deeper and more extensive than was formerly supposed, so that the mean sphere-level—the surface of a shell which cuts the slope between the elevated and depressed region of the earth's surface in such a manner as to leave a volume of elevated material above it exactly equal to the volume of the depressed region beneath it —appears to lie close to a depth of 1700 fathoms. The contour line of 1700 fathoms of ocean depth divides the earth's surface into two equal areas—one of depression, the other of elevation. This remarkable coincidence shows that the portions of the elevated half of the lithosphere projecting above mean sphere-level would just suffice to fill the hollow beneath mean sphere-level of the depressed half. Dr. Mill also pointed out that round the edge of the great three-armed northern elevated mass the slope to the depressed area was so steep that the outlines of the 1000 and 2000 fathom contours follow the coast-line very closely; but the Antarctic elevation rises from the bed of the depression with an extremely gentle slope.—Mr. J. Crockett communicated an account of Weierstrass's contributions to the calculus of variations.—Mr. John Anderson gave accounts of the recent Louisville tornado, and showed a barometric record made in its neighbourhood. The barometer fell suddenly to the extent of about one-tenth of an inch, and again instantly rose as the tornado passed.

PARIS.

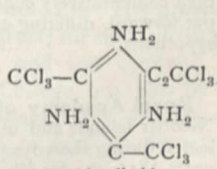
Academy of Sciences, June 16.—M. Hermite in the chair. —On the ordnance survey of France, by M. Maurice Lévy. In commenting upon the work undertaken by the Geodetical Commission, M. Lévy notes that two kinds of documents will be published—one to contain an account of the methods of calculation and corrections which have been employed, as well as the description of the instruments used; the other to be a graphical *répertoire* of the levels determined—and in presenting an account of the first series of operations, some explanation of the work is given.—Theory of the permanent movement produced near the widened opening of a fine tube; application to the second series of Poiseuille's experiments, by M. J. Boussinesq.—Calculation of the successive temperatures in an indefinite homogeneous and athermanous medium which is in contact with a source of heat, by the same author.—On the various isomeric inosites and their heat of transformation, by M. Berthelot. The author finds that in dextrorotatory inosite, dehydrated and having the formula $C_6H_{12}O_6$, dissolved in 300 c.c. of water at 17°·9, the heat absorbed by 1 molecule is − 2·05 calories. Lævorotatory inosite similarly treated gives − 2·03 calories. On mixing the two liquids no rise or fall of temperature was observed. It is therefore concluded that two symmetrical inosites do not show any signs of combination when in solution. Four grammes of neutral inosite were dissolved in 300 c.c. of water at 18°. The rate of solution was slower than that of the active inosites, and the heat developed was − 3·87 calories. This heat of solution is negative and greater than that of either of the active inosites. The three corresponding tartaric acids give the same results.—Variation of the elasticity of glass and of crystal with temperature, by M. E. H. Amagat. It appears from the experiments that the variation increases with the temperature; it is a little greater for glass between 100° and 200° than between 100° and 0°, and considerably greater in the case of crystal; and it seems probable that the variation would increase more and more in value with still higher temperatures.—On a new property of luminous waves, by M. Gouy.—Characteristic equation of hydrogen, by M. Ch. Antoine.—On the variation of temperature with altitude in cyclones and anticyclones, by M. Marc Dechevrens. From a series of observations the law is formulated that "at sea-level and in air, at an altitude less than 1000 or 1200 metres, the temperature in a vortex varies inversely as the pressure, whilst in air at greater altitudes it varies directly as the pressure. In the latter case the temperature has a minimum along the axis of the cyclone and a maximum on the perimeter of the depression; a maximum also occurs along the axis of an anticyclone."—On the combinations and reactions of the gases ammonia and phosphoretted hydrogen with the halogen compounds of arsenic, by M. Besson. The compounds $AsBr_3.3NH_3$; $AsCl_3.4NH_3$; $AsI_3.4NH_3$; and $2AsF_3.5NH_3$ are described, and the products of their decomposition indicated.—On a new method of forming crystalline oxychlorides of the metals; researches on the oxychlorides of copper, by M. G. Rousseau. Among other bodies of the same type, the author has succeeded in obtaining crystallized *atacamite* by his method.—On the combination of phosphorus pentafluoride with nitrogen tetroxide, by M. Émile Tassel. The body formed, $N_2O_4.PF_5$ reacts with water in accordance with the equation—

$$3(N_2O_4, PF_5) + 14H_2O = 2NO + 4HNO_3 + 3H_3PO_4 + 15HF,$$

thus differing essentially from the corresponding compound containing chlorine.—Heat of formation of uric acid and the alkaline urates, by M. C. Matignon.—Chloralimide and its isomeride; a reversible isomeric transformation, by MM. Béhal and Choay. A mixture of chloralimide (B.P. 169°) and isochloralimide (B.P. 103°–104°) is obtained by the action of heat upon chloralammonia; the method of separation and purification of each of these bodies is described. Both bodies possess the same molecular weight, Raoult's method with benzine for solvent yielding the figures—for chloralimide 430, for isochloralimide 434–435. Each body may be transformed by suitable means, given in detail, into its isomeride. The following formulæ are proposed by the authors as representations of these bodies:—



Chloralimide.



Isochloralimide.

—On an adulteration of linseed oil, by M. A. Aignan.—On the ear gland (*Paludina vivipara*) and the nephridian gland (*Murex brandaris*), by M. L. Cuénot.—Researches on multiple buds, by Mr. William Russell. The conclusion is drawn that "multiple buds, one springing from another and being vascularly

connected therewith, ought to be considered as normal ramifications."—On the influence exercised by the time of cutting upon the production and development of shoots from the stocks in underwood, by M. E. Bartet.—Influence of the peritoneal transfusion of the blood of the dog upon the evolution of tuberculosis in the rabbit, by MM. J. Héricourt and Ch. Richet.—On the antiseptic and antipeptic doses of various substances, by M. Andrea Ferranini.

BERLIN.

Physiological Society, June 6.—Prof. du Bois-Reymond, President, in the chair.—Dr. Hagemann gave an account of his experiments on proteid metabolism during pregnancy and lactation; they were conducted upon two dogs supplied with a constant nitrogenous diet. During the first half of the period of pregnancy more nitrogen was excreted than was taken with the food, so that the nitrogen requisite for the growth of the fœtus must have been derived from the tissue-proteids of the mother. After this period the nitrogenous excretion sank to a condition of equilibrium in the middle of pregnancy, and then fell further until the birth of the offspring. Immediately after parturition there was a very marked increase in the excretion of nitrogen, followed by a sudden fall which led to the output being, during four weeks' lactation, less than the in-take.—Prof. Zuntz made a further communication respecting the intestinal fistulæ which he described at the previous meeting of the Society. As regards the absorption of fats and fatty acids, he found that even the finest and most uniform emulsions were not absorbed either alone or with the addition of bile. When saponified, a marked absorption of the soaps took place, but to a much less extent than in normal animals; neither was it increased by the addition of glycerine. The results obtained were, on the whole, negative. The speaker put forward the view that the absorption of fat in the intestine is dependent upon some at present unknown function of the pancreas.

AMSTERDAM.

Royal Academy of Sciences, May 31.—Mr. Max Weber pointed out the characters of a true adult hermaphroditic finch (*Fringilla cœlebs*), caught in the neighbourhood of Amsterdam. The right side of the bird has the plumage of the adult male, the left that of the adult female. The striking difference in the colouring of the plumage on the two sides corresponds to an internal co-existence of ovary and testis: the latter is, on the male-coloured (right), the former on the female-coloured (left) side. Both sexual glands, compared, also microscopically, with the testis and ovary of normal finches, are anatomically wholly normal, and able to produce male and female sexual elements. The case seems to be an illustration of the dependence of sexual colouring upon the nature of the sexual gland.—Mr. van Bemmelen stated that Mr. Molengraaff had sent him a white substance found in the high moor of Drenthe (Netherlands), denominated by the moor-diggers as *White Klien*. It consists of 87 per cent. carbonate of oxydulated iron, 6 per cent. carbonate of lime, and 8 per cent. vegetable matter.—Prof. Hubrecht gave a description of the early developmental stages in the shrew. In the two-layered blastocyst the mesoblast makes its appearance: (*a*) from the hypoblast under the anterior portion of the epiblastic shield; (*b*) from the primitive streak and its anterior prolongation; (*c*) from an annular zone of hypoblast below, but just outside the border of the epiblastic shield. The mesoblast from these three sources very soon fuses into one continuous plate. There appears to be considerable agreement between the facts as presented by the shrew and those which Bonnet has described for the sheep. The gastrulation process in the Mammalia was then comparatively considered, and a theoretical interpretation put forward, differing considerably from E. van Beneden's latest hypothesis.

STOCKHOLM.

Royal Academy of Sciences, June 11.—Spiders from the Nicobar Islands and other parts of Southern Asia, mostly collected during the voyage of the Danish war-ship *Galatea* in the years 1845–47, described by Prof. T. Thorell.—On the remains of a fish preserved since the year 1289 in the cathedral of Wisby, and often mentioned in the old chronicles as a remarkable curiosity, by Prof. F. A. Smitt.—Étude des conditions météorologiques à l'aide de cartes synoptiques représentant la densité de l'air, par Dr. N. Ekholm.—On an expedition which has just started for Spitzbergen, by Baron A. E. Nordenskiöld. This expedition consists of some young Swedish naturalists who propose to make geological and zoological researches.—On the fungi of Omberg and its neighbourhood in Ostrogothia, by Herr L. Romell.—On the different kinds of vegetation on the surface of the peat bogs of Southern Sweden, by Herr G. Andersson.—Dendrological studies made in several Swedish provinces, by Herr F. Laurell.—On the vegetation of Norrbotten, by Dr. A. Lundström.—Botanical rambles in the south-west of Jemtland in the summer of 1889, and description of some Hieracia and Carices found, by Dr. M. Elfstrand.—On the oxidation of the phenyl-methyl-triazol-carbon acid, i., by Dr. J. A. Bladin.—On some ammoniacal platina combinations, by Dr. O. Carlgren.—Critical remarks on the history of the vegetation of Greenland, by Prof. A. G. Nathorst.—Studies on the Turbellaria and Nemertinæ of the northern countries, by Dr. D. Bergendal.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Catalogue of Stars observed at the U.S. Naval Observatory during the Years 1845-77, 3rd edition: Prof. M. Yarnall and Prof. E. Frisby (Washington).—Father Perry, F.R.S.: A. L. Cortie (Catholic Truth Society).—Travels in Africa during the Years 1875-78: Dr. W. Junker, translated by A. H. Keane (Chapman and Hall).—Nitrogen: its Uses and Sources in Agriculture: C. M. Aikman (Glasgow, Wright).—A Handy Guide to the Birds in the Bootle Museum: J. J. Ogle (Bootle).—Record of Experiments in the Production of Sugar from Sorghum in 1889: H. W. Wiley (Washington).—A Revised Account of the Experiments made with the Bashforth Chronograph to find the Resistance of the Air to the Motion of Projectiles: F. Bashforth (Cambridge University Press).—Selected Subjects in Connection with the Surgery of Infancy and Childhood: E. Owen (Baillière).—The Triumph of Philosophy: J. Gillespie (Dumfries).—A Hand-book of Descriptive and Practical Astronomy; III. The Starry Heavens, 4th edition: G. F. Chambers (Oxford, Clarendon Press).—Die Pflanzen und Thiere in den Dunklen Räumen der Rotterdamer Wasserleitung: H. de Vries (Jena, Fischer).—Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbelthiere: Dr. O. Hertwig (Jena, Fischer).—Oxford and Modern Medicine: Sir H. W. Acland (Frowde).—The Quarterly Journal of Microscopical Science, June (Churchill).

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