THURSDAY, FEBRUARY 10, 1898.

THE BOOK OF THE DEAD.

The Book of the Dead. The Chapters of Coming Forth by Day. The Egyptian Text according to the Theban recension in hieroglyphic edited from numerous papyri, with a translation, vocabulary, &c. By E. A. Wallis Budge, Litt.D., D.Litt., F.S.A., Keeper of the Egyptian and Assyrian Antiquities in the British Museum. In three volumes. Pp. cciv + 354; xl + 517; vii + 386. (London: Kegan Paul, 1898.)

IN the first of the Gifford Lectures for 1896, Prof. Tiele gave an admirable sketch of the method of work which the student of the modern science of religion must pursue if he is to achieve any lasting results. The process is a long one, for he must acquaint himself with the whole field of religion and be master of the material with which he works; and he should, in the Professor's opinion, have taken part himself in exploring and clearing the ground, and have studied at least two religions in the original sources. We fear that for many workers in this comparatively recent field of study the lecturer's words came as a counsel of perfection. But even working by Prof. Tiele's high standard, the range of study is so broad that the student of religion can obtain only a small proportion of his information at first hand, and for the greater part of his material must make use of the labours of others; in the wider field of anthropology, which in one sense includes the science of religion—though Prof. Tiele would not here agree with us—the range of study is still more extensive. For information respecting the culture, customs and beliefs of savage and undeveloped races of the present day, the student must consult the works of travellers, missionaries, and trained collectors and explorers; while for the beliefs of the ancient nations of the world, he necessarily to a great extent depends on the translations made by scholars who have devoted their energies to the interpretation of the sacred books and documents that have come down to us. Prof. Max Müller's "Sacred Books of the East," for example, supply him with ample material in his examination of the beliefs of the ancient Aryan races; though it must be admitted the religious works of many other ancient nations still need trustworthy translations. The want of such a translation of the great religious work of the ancient Egyptians has long been felt, but it is now met by Dr. Wallis Budge's translation of the "Book of the Dead."

The importance of the "Book of the Dead" in its bearings on the religion of the ancient Egyptians cannot be over-estimated. Including as it does their whole system of belief, it is our principal source of information on the subject. It is true that collections of moral precepts, hymns and prayers to the gods, mythological texts and legends, all contribute something to our knowledge; but the collection of compositions, to which the title "Book of the Dead" has been applied, is in itself the embodiment of the Egyptian's creed, and from it alone can any true understanding of his religion be obtained. For many years the work was known only in publications of single papyri of different periods, the most important of which was that published in 1842 by Lepsius, whose numbering of the chapters has been retained by all subsequent editors. It was not until more than thirty years later that any complete edition of the work was contemplated. In 1874, at a meeting of the International Congress of Orientalists, a scheme for such an edition was projected, and M. Naville undertook the work. Confining himself to papyri of the eighteenth to the twentieth dynasties, during which period the finest papyri of the "Book of the Dead" were written, he in 1886 produced a critical edition of the Theban recension of the work, which he published with an introduction but no translation. In the new edition of the work just issued, Dr. Budge has added considerably to M. Naville's text by using some unique papyri—which have been acquired during recent years by the British Museum. In another volume he has published a complete vocabulary to the text, which will prove of great service to Egyptologists. But the volume which marks the greatest advance on previous editions, and with which we are here concerned, is the one in which Dr. Budge gives a complete translation of the text, a work that has long been needed, but which he is the first to have accomplished; the translation is preceded by an introduction, in which he deals with the origin, aim and contents of the "Book of the Dead," and states the conclusions at which he has arrived as the result of many years of study.

The many points suggested by such a work cannot be adequately treated within the limits of a review, and it will be necessary to confine our attention to certain parts of the introduction where Dr. Budge has developed his theories with regard to the "Book of the Dead." One of the most important chapters of the introduction is that devoted to the history of the "Book of the Dead." The four main recensions of the work have long been recognised by scholars, that of the Old and Middle Empires, the Theban version, the version of the twentieth dynasty, and the text of the Saite and Ptolemaic periods. Dr. Budge, however, strikes out a novel line in his sketch in the history of the work, by going back beyond the time of the pyramid-builders of the fifth and sixth dynasties, and seeking in the remains of prehistoric Egypt the causes that led to the subsequent development of the work. In the graves recently excavated at El-'Amrah near Abydos, which possibly belonged not to the Egyptians themselves, but to their predecessors in the land, were found skeletons showing traces indicating that the bodies to which they belonged had been embalmed. This custom of preserving the bodies of their dead, which we thus find in existence at the dawn of Egyptian civilisation, lasted without a break through the whole period of the nation's history down to the fourth century A.D. In what way it gave rise to the "Book of the Dead" is best described in Dr. Budge's own words:—

"As time went on the embalming of the dead was performed in a more elaborate manner, and at the same time the last resting place of the mummified body was chosen more carefully and wrought with greater attention. At a very early period the wealthy discarded the use of holes in rocks and caves as tombs, for in these the bodies were accessible to the attacks of enemies, and wild animals and serpents; and the same objection was,

naturally, made to shallow hollows made in the limestone and covered over with slabs of the same material, and also to the vaulted, crude brick graves which were commonly in use in the early dynasties. The place of these was taken by pyramids built of stone, and by many-chambered tombs hewn in the living rock. Experience, however, soon showed the Egyptian that the most carefully constructed tomb was incapable of preventing damp-rot or dry-rot and decay, and that some other power besides his own must be invoked to prevent the destruction of his body, which, though needing longer time to accomplish, was as effectually performed by these means as by the tooth of the wild animal or serpent, or by the hand of the enemy. At this stage the aid of the professional religious man or priest was called in, and the task of finding means to prevent rot and decay was entrusted to him. There is little doubt that when the body was laid to rest in the tomb, the priest pronounced certain words or formulæ or prayers over it, and it is probable that the recital of these words was accompanied by the performance of certain ceremonies. Whatever these formulæ were they formed the foundation of the 'Book of the Dead' of later Egyptian times."

This is a reasonable theory as to the origin of the work, and we think Dr. Budge is also justified in the further assumption that though these formulæ were first only recited, they were afterwards written down by the priests with a view to preserving them, and that the custom of inscribing portions of them on the walls of the tomb, and of writing them on the coffin and on papyri deposited in the tomb, followed from the subsequent belief that their efficacy was thus insured for the benefit of the deceased. In a series of eighteen plates Dr. Budge has illustrated the changes of form which the "Book of the Dead" underwent in the long course of its development from the time when we find it on the walls of the pyramids at Ṣaḳḳāra, to its final deterioration in compositions of the Roman period. Its culmination in the illuminated papyri of the eighteenth dynasty is illustrated by means of three very beautiful coloured plates representing portions of the famous papyrus of Ani in the British Museum.

Another section of the introduction, which will prove useful to any one who attempts to understand the "Book of the Dead," is that which Dr. Budge devotes to its object and contents. He here classifies the chapters according to their subject-matter, and we thus gain an insight into the underlying unity of the work; for, though its chapters represent beliefs belonging to all ages in the life of the nation, the aim underlying them all is in some way or other to benefit the deceased. "They were intended," says Dr. Budge, "to give him the power to have and to enjoy life everlasting, to give him everything which he required in the life beyond the grave, to ensure his victory over his foes, to procure for him the power of going whithersoever he pleased and when and how he pleased, to preserve the mummy intact, and finally to enable his soul to enter into the bark of Rā or into whatever abode of the blessed had been conceived of by him." We have not space to enter into any adequate discussion of the exact nature of the ancient Egyptian's belief in a resurrection and a judgment, or to consider how far he advanced in his conception of monotheism. He never outgrew his belief in magic, and while undoubtedly advancing in his notions of a spiritual existence, he did not discard the more primitive tenets of an earlier age. It is constantly necessary to bear this fact in mind in reading the "Book of the Dead." By his translation of the work, Dr. Budge has earned the gratitude of all students of the science of religion, for he has thereby placed within their reach a wealth of fresh material. For the benefit of those who are not Egyptologists, we are glad to note that the introduction and translation are issued as an independent work, and sold separately from the volumes containing the hieroglyphic text and vocabulary.

FERNS.

Die Farnkräuter der Erde. By Dr. H. Christ. Pp. viii + 388; with 291 figures. (Jena: Gustav Fischer, 1897.)

SINCE the publication of Baker's "Synopsis Filicum" in 1873 (Dr. Christ makes no mention of John Smith's "History of Ferns," 1877) no complete systematic account of the ferns has appeared, so that there is room for a work which embodies the more modern discoveries in this subdivision of plants. During this interval, Dr. Christ says a number of new species have become known, and, owing to the researches of G. Mettenius into the general structure of this subdivision, additional materials are to hand for the elaboration of a more natural arrangement. He believes that the older authors, including Hooker, too rigidly limited themselves to the consideration of the sorus and indusium for purposes of classification. Influenced by these reflections he has been led to change the arrangement adopted in the "Synopsis Filicum," in several cases, for what he regards as a more natural grouping. His view of the matter is, however, sometimes open to doubt. The position he assigns to the genus Loxsoma may be taken as an example of one of such alterations. He transfers it from the Hymenophyllaceæ to the Polypodiaceæ, apparently because its leaves have several layers of cells and are furnished with stomata. On the other hand, its sorus and indusium resemble those found in the Hymenophyllaceæ. An alteration like this may be defended or assailed according to the personal feeling of each systematist, and its criticism will depend on what morphological value each individual places on the various diagnostic characteristics. But it appears that the structure of the leaves, taken alone, would often be misleading. The leaves of a few of the Hymenophyllaceæ are several layers thick; while in the Osmundaceæ—a group, for the most part, possessed of stout leaves—Leptopteris has delicate and filmy leaves without stomata. The existence of the fossil *Palæopteris hibernica*, which had leaves resembling Loxsoma, but in other respects belonging to the Hymenophyllaceæ, renders the connection of the latter genus to that class of ferns more probable.

Again, Dr. Christ removes *Ceratopteris thalictroides* (a plant which, by the way, is omitted in the index, but described in the text) from the Polypodiaceæ into a separate class, the Parkeriaceæ, without, it might be thought, sufficient reason. The anomalies in the structure of its vegetative organs may well be accounted for by its watery habitat, unique among the filices.

The two species of Matonia are placed in a separate group, as Baker suggested.

It is disappointing to find that no mention is made of the gametophyte in ascertaining the relations of the classes to one another; although its systematic value has been shown in several cases. It is quite possible that the position of doubtful genera, such as Loxsoma, will only be understood when its gametophyte has received complete investigation. The omission, however, may be justified owing to the practical difficulties of obtaining the sexual generation for systematic purposes.

The introduction is short and is chiefly occupied with explaining the scope of the book; and it seems a pity that a writer, with so much knowledge of the ferns, did not give more space in his work to general considerations. At the end, however, Dr. Christ refers to the marked manner in which ferns belonging to different classes resemble one another: thus, Diacalpe—a member of the Aspidiaceæ—has a sorus very like that found in the Cyatheaceæ. In the Polypodiaceæ some genera have the sorus situated at the tip of the veins and projecting beyond the margin of the leaves, in this reminding us of the Hymenophyllaceæ. It is fanciful, if not inaccurate, to see in this position of the sorus a resemblance to the mosses. Other interesting examples are given; but it is unfortunate that the author applies the term "mimicry" to these instances of parallelism in related groups. Such an application of the term must only lead to confusion.

The descriptions of the genera and species are marked by their precision and lucidity, and the numerous illustrations, which were specially prepared for this work, are characteristic drawings, though sometimes roughly executed. The appearance of such a book will be welcomed by systematists interested in the ferns containing, as it does, the more recent results of Baker, Hooker, Kuhn, Luersson, Prantl, &c., and those of Dr. Christ himself.

It might be suggested that if the key of genera, which precedes the detailed diagnoses of genera and species, was furnished with references to the pages on which the diagnoses are to be found, an addition would be made to the usefulness of the book. H. H. D.

SCIENCE IN FICTION.

The War of the Worlds. By H. G. Wells. Pp. 303. (London: William Heinemann, 1898.)

MANY writers of fiction have gathered material from the fairy-land of science, and have used it in the construction of literary fabrics, but none have done it more successfully than Mr. H. G. Wells. It is often easy to understand the cause of failure. The material may be used in such a way that there appears no connection between it and the background upon which it is seen; it may be so prominent that the threads with which it ought to harmonise are thrown into obscurity; or (and this is the worst of all) it may be employed by a writer whose knowledge of natural phenomena is not sufficient to justify his working with scientific colour. Mr. Wells makes none of these mistakes. Upon a groundwork of scientific fact, his vivid imagination and exceptional powers of description enable him to erect a structure which intellectual readers can find pleasure in contemplating.

"The Time Machine"—considered by the majority of scientific readers to be Mr. Wells' best work—showed at once that a writer had arisen who was not only familiar with scientific facts, but who knew them intimately enough to present a view of the future. "The Island of Dr. Moreau," though decried by some critics, is a distinctly powerful work, and the worst that can be said of it is that the pabulum it provides is too strong for the mental digestion of sentimental readers. But in several respects "The War of the Worlds" is even better than either of these contributions to scientific romance, and there are parts of it which are more stimulating to thought than anything that the author has yet written.

The invasion of the earth by inhabitants of Mars is the idea around which the present story is constructed The planet is, as Mr. Percival Lowell puts it, older in age if not in years than the earth; and it is not unreasonable to suppose that if sentient beings exist upon it they would regard our world as a desirable place for occupation after their own globe had gone so far in the secular cooling as to be unable to support life. Mr. Wells brings the Martians to the earth in ten cylinders discharged from the planet and precipitated in Surrey. The immigrants are as much unlike men as it is possible to imagine, and only a writer familiar with the lines of biological development could conceive them. The greater part of their structure was brain, which sent enormous nerves to a pair of large eyes, an auditory organ, and sixteen long tactile tentacles arranged about the mouth; they had none of our complex apparatus of digestion, nor did they require it, for instead of eating they injected into their veins the fresh living blood of other creatures. Their organisms did not sleep any more than the heart of man sleeps; they multiplied by budding; and no bacteria entered into the scheme of their life. When they came to the earth they brought with them a means of producing a ray of intense heat which was used in connection with a heavy vapour to exterminate the inhabitants of London and the neighbourhood.

This bald outline does not, however, convey a good idea of the narrative, which must be read before the ingenuity which the author displays in manipulating scientific material can be appreciated. The manner in which the Martians are disposed of is undoubtedly the best instance of this skill. As the Martians had eliminated micro-organisms from their planet, when they came to the earth their bodies were besieged by our microscopic allies, and they were destroyed by germs to which natural selection has rendered us immune. This is a distinctly clever idea, and it is introduced in a way which will allay the fears of those who may be led by the verisimilitude of the narrative to expect an invasion from Mars. Of course, outside fiction such an event is hardly worth consideration; but that the possibility of it can be convincingly stated, will be conceded after reading Mr. Wells' story. A remarkable case of the fulfilment of fiction is furnished by the history of the satellites of Mars. When Dean Swift wrote "Gulliver's Travels" (published in 1726), he made the astronomers on the island of Laputa not only observe two satellites, but caused one of these to move round the planet in less time than the planet itself takes to rotate on its axis.

As every student of astronomy now knows, the satellites were not discovered until 1877, and one of them actually does revolve round Mars three times while the planet makes a rotation. The coincidence is remarkable; but it is to be hoped, for the sake of the peace of mind of terrestrial inhabitants, that Mr. Wells does not possess the prophetic insight vouchsafed to Swift.

In conclusion, it is worth remark that scientific romances are not without a value in furthering scientific interests; they attract attention to work that is being done in the realm of natural knowledge, and so create sympathy with the aims and observations of men of science. R. A. G.

OUR BOOK SHELF.

Introductory Course in Differential Equations. By D. A. Murray, B.A., Ph.D. Crown 8vo. Pp. xv + 234. (New York and London: Longmans, Green, and Co., 1897.)

Ordinary Differential Equations; with an Introduction to Lie's Theory of the Group of One Parameter. By James Morris Page. Crown 8vo. Pp. 226 + xviii. (London: Macmillan and Co., 1897.)

MR MURRAY'S book is adapted to provide for students that knowledge of the subject of differential equations which they are likely to want in applications of mathematics to physics, and in the general courses in arts and science in "classical" colleges. The author is chiefly occupied with giving expositions of the devices usually employed in the solution of the simple differential equations which such students meet with, and he will be found a safe guide in these matters. He follows the plan, which most recommends itself to teachers, of omitting theoretical considerations, or postponing them until the student has had practice in carrying out the processes with which he must be acquainted before the theory can be understood. But he does not leave the reader altogether in the dark as to the underlying theory and the modern developments. These are considered near the end of the book in a series of notes, which ought to prove very useful to those who wish to know more about the subject than can be learned from the text. In one case, that of the integration of linear equations in series, the author has departed from his general practice of giving an account of the simple and particular rather than of the difficult and general. It seems unfortunate that he did not choose for discussion the forms of the series which satisfy such equations in the neighbourhood of ordinary points. When a second edition is called for he will do well to alter this, and to avoid such expressions as "concentric cylinders" and "consecutive curves." The book is well printed, and is adequately supplied with well-chosen examples, some of them relating to physical subjects; and it ought to prove of service both to those for whom it is primarily intended, and also to British students who have not time to master Forsyth's treatise, but wish to learn rather more about the subject than is to be found in Lamb's "Infinitesimal Calculus."

In several important respects Mr. Page's book differs considerably from most existing text-books on differential equations. It is not sufficiently elementary for students reading the subject for the first time, since it makes no attempt to supply that thorough drilling in the solution of linear equations with constant coefficients and other simple forms, which our Universities insist on as a preliminary test of proficiency. Those, however, who have passed beyond the threshold of the subject, and who wish to study the general machinery underlying the methods they have learnt, will find in Mr. Page's work the first attempt to present to English readers a concise account of some of Prof. Lie's important developments of the theory of transformation groups, by which he has shown that the usual methods are only applicable to such differential equations as admit of known infinitesimal transformations. A great many of the methods here described are due exclusively to Prof. Lie; the examples at the end of each chapter are, however, largely taken from existing text-books. A feature which strikes us as distinctly good, is the treatment together of simultaneous systems and the equivalent linear partial equation.

The two books before us are thus, to a great extent, complementary in scope. Starting with no knowledge of differential equations, a course of study first under Mr. Murray's and then under Mr. Page's guidance will lead the student by easy stages up to an insight into the Theory of Groups.

Nature Study in Elementary Schools; a Manual for Teachers. By Mrs. L. L. W. Wilson. Pp. xix + 262. Woodcuts. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1897.)

THERE is a notion in this book—a sensible, practicable notion; and this is enough to distinguish Mrs. Wilson's lessons from the common run of school natural histories. Her aim is to stimulate the children to work for themselves; and now and then she succeeds in laying out really interesting work for them, as in the lessons on seedlings and on some common American trees. We recommend the book to the notice of enterprising teachers. In spite of very obvious defects, it may be a guide to better methods than those which prevail at this time. The great fault of the book is the feeble execution of an excellent idea. Many of the lessons do no sort of justice to the objects, and pass over without remark features which ought to arouse the curiosity of the children. We can hardly understand how any teacher could work through the thorn-apple with a class, and then write down so poor a description as that on p. 19. Many of the drawings, particularly those of insects, are too crude and hasty to be produced as examples even of what can be done in school. In the present writer's opinion the mythology and the poetical pieces are overdone. These things may be allowed to come in as extempore illustrations; but when they are laboured, they simply distract the attention and prevent the children from focussing their minds upon the objects.

A word as to the use of printed lessons. On no account should the book be produced in class; that would be to give the solution of the problems in advance. Nor should the teacher reproduce the very lessons given in the book, but devise lessons of his own upon the same lines. In this way the book now before us can be turned to excellent account. L. C. M.

Botanical Microtechnique: a Handbook of Methods of Preparation, Staining, and of Microscopical Investigation of Vegetable Structures. By Dr. A. Zimmermann, Privat-docent in the University at Tübingen. Translated from the German by James Ellis Humphrey, S.D. Pp. xii + 296. (Westminster: Archibald Constable and Co., 1896.)

MODERN advanced work in vegetable, as in animal, histology requires the aid of a refined and often complicated technique in order to render apparent the more difficult details of structure. The zoologist possesses at least one good treatise on methods; but until the appearance, in its English form, at the hands of Dr. Humphrey, of Zimmermann's excellent work, there was no advanced handbook available to a student unacquainted with German. The scope of the book is sufficiently indicated by the title, and under its new form can be confidently recommended to English-speaking students.

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.*]

Bipedal Lizards.

I COMMUNICATED to NATURE, July 22, 1897, the intelligence that I had demonstrated by practical experiments that both the Australian Water Lizard (*Physignathus Leseuri*) and the Muricated Tree Lizard (*Amphibolurus muricatus*) shared with the Australian Frilled Lizard (*Chlamydosaurus kingi*) the singular faculty of running erect on its hind legs only. In that letter I refer to the as yet unconfirmed rumour that the Mexican Iguanoid Lizard (*Corythophanes Hernandeseyi*) also runs bipedally, and express the opinion that, judging from the close correspondence in general structure—more especially as regards the abnormal length of the hinder limbs—that exists between many of the American Iguanidæ and the Australian Agamidæ, it will probably be found that a corresponding bipedal mode of locomotion is shared by many allied members of the first-named family.

As a result of that communication and of a further ventilation of the subject in a paper recently read by me at the Royal Colonial Institute,[1] I have quite recently received an extensive and exceedingly interesting confirmation of my anticipations. Mr. Henry Prestoe, a twenty years' resident in the West Indies, writes me as follows:—"I have been struck by your remarks on the bipedal locomotion of the Frilled Lizard. It has occurred to me you would be glad to learn, if only in confirmation of your views, that with all the lizards—from the large Iguana,

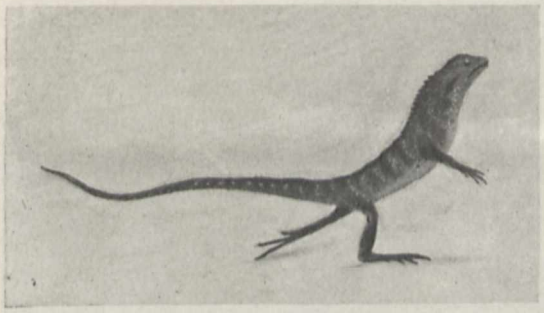

FIG. 1.—Leseur's Water Lizard (*Physignathus Leseuri*), running erect.

which lives in trees chiefly and is about five feet long when full-grown, down to the smallest mite one sees occasionally about the stones, I have ever seen running, the method of hurried locomotion is *bipedal*. The most familiar example is the so-called Diamond Lizard, common in the pastures and pleasure-grounds of Trinidad, 18 to 24 inches long, including the tail. The attitude results, when the progress is over a muddy surface, in footprints exactly like those of a small fowl, going lightly, and accounted in my mind years ago for the occurrence of bird-like footprints much further down in geological strata than birds are known to have existed. The motion of the legs of the Diamond Lizard, when running, is so rapid as to render them for the time invisible. But in the case of the large Iguana the case is different, and it takes an effort to get up into the slanting position which the Diamond and smaller lizards assume at once. Meantime the action or "swing" of the behind feet is that of an ordinary duck—accentuated—remaining grotesque in fact so long as the more or less erect position is kept up."

Mr. Prestoe has informed me of the further interesting fact that there are many figures traced on the rocks about the watershed of the Guianas, certain of which unmistakably represent a lizard, such as the Diamond species, running on two legs. A figure Mr. Prestoe has supplied me with as a fair reproduction of one of the rock scratchings corresponds in a noteworthy manner with the silhouette-like representation of Leseur's Water-lizard obtained by myself when taking an instantaneous photograph of the animal in its most characteristic bipedal attitude.

[1] "Australian Natural History Gleanings." (*Journal of the Royal Colonial Institute*, January 1898.)

This phenomenon of bipedal locomotion, now shown to be common to many lizards that differ not only in their modes of life and widely separated habitats, but also in essential structural features, can scarcely fail to commend itself to the closer attention of the systematic biologist. When, as first reported by me, only a single species, *Chlamydosaurus kingi*, could be accredited with this remarkable mode of locomotion, it was interpreted as

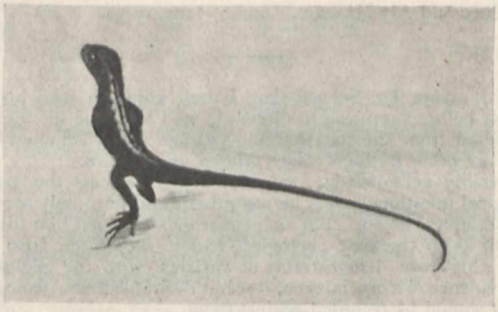

FIG. 2.—Australian Muricated Tree Lizard (*Amphibolurus muricatus*), running erect.

most probably representing a habit that had been independently and recently acquired. Now, however, the demonstrated fact of its widespread occurrence is clearly indicative of its inheritance from a remoter ancestry with whom bipedal locomotion also constituted a common method of progression. The question is, who were they?

Apart from the foregoing considerations, I would suggest that the provision of conditions at our Zoological Gardens under which the many lizards possessing bipedal habits could exercise their singular but hitherto almost completely overlooked athletic accomplishments, would prove a great attraction to both naturalists and to the general public. Several varieties of these bipedal lizards are now on view in the Reptile House. They are at present, however, confined in relatively small cages, and, as I have demonstrated by practical experiments, it is essential for their display of bipedal locomotion that a level floor, with a free run of at least 20 or 30 feet, should be at their disposal.

Instantaneous photographs taken by me—but hitherto unpublished—illustrating characteristic attitudes assumed by *Physignathus Leseuri* and *Amphibolurus muricatus*, when running erect, are herewith reproduced.

W. SAVILLE-KENT.

The Glacial Period and the Irish Fauna.

MR. LAMPLUGH assumes (NATURE, January 13, p. 245) the correctness of the view that during the Glacial Period the basin of the Irish Sea was filled with an ice-sheet, and argues that my "interesting speculations" on the origin of the Irish fauna, in so far as they are based upon assumptions as to the glacial conditions of the Irish Sea, will therefore possibly not meet with much acceptance among geologists. That the Irish Sea, however, was filled with an ice-sheet during the Glacial Period is certainly not universally accepted among geologists. I think also, that it would have been more advantageous to us to hear Mr. Lamplugh's remarks, after having read in full my paper dealing with the origin of the Irish fauna, instead of the short abstract in NATURE. He would then have observed that I particularly avoided basing assumptions as to the origin of the Irish fauna on the glacial conditions of the Irish Sea. It has been rather too much the practice among some geologists of late, not only to assume the correctness of their theories as to the nature of the Glacial Period, but also to base thereon the probable course of events of the migrations of animals and plants. I have attempted, with a view to arriving at a more satisfactory conclusion on the origin of the British fauna, to found my deductions almost entirely on the presence in or absence from the British Islands of continental species. These conclusions are at variance with the views held by the, what we might call, extreme Glacial school of geologists.

In dealing with this subject, it seems to me, there is nothing gained in reiterating the same assumptions over and over again; and it really is immaterial whether the reindeer, the Irish elk, and dozens of other animals can or cannot cross ice. This does

not affect the British fauna as a whole very much. The bulk of the English and Irish animals *must* have travelled to these islands on a land-surface which was not covered by ice, and how they did so and when, is the problem at issue. To attack this problem from a purely zoological point of view will, I think, be of great service to geological science, and will help to clear up many doubtful points as to the nature and cause of the Glacial Period.

R. F. SCHARFF.

Science and Art Museum, Dublin, January 31.

I CAN assure Dr. Scharff that I took pains to read his full memoir before venturing to discuss it, as I think he should have recognised from the fact that the passage which I quoted from it did not occur in the abstract printed in NATURE.

I readily acknowledge my inability to discuss the purely zoological questions which he has raised, and purposely avoided any attempt to do so. But as his methods have led him to conclusions as to the past geological conditions of the Irish Sea basin which are demonstrably at variance with the geological field-evidence in a crucial area, it seems desirable that a geological protest should be recorded against them.

If Dr. Scharff could be persuaded to reconsider his subject from a standpoint which should include both the zoological and the geological evidence, he might yet find some solution which would be satisfactory to the students of both sciences.

G. W. LAMPLUGH.

On Augury from Combat of Shell-fish.

IN a foot-note to my letter on this subject (NATURE, vol. lvi. p. 30, May 13, 1897), I remarked that the *Khchau* (a shell-fish), applied by the Cambodians to the divination of a war, is likely to belong to the family of Paludinidæ, taking into consideration the fact that the Japanese and the Chinese of former days used some species of viviparus (= Paludina) for the same purpose. Lately, while examining M. A. Parvie's article "Excursions dans le Cambodge, &c." in *Cochin-Chiné Française; Excursions et Reconnaissances*, No. 9, p. 479, 1882, I have come across a passage giving confirmation to my view, The author, giving nomenclatures of the Cambodian molluscs, identifies the native *Kechau* (which is doubtless another French form of the spelling *Khchau*) with the Latin "Paludina"; whereas the allied genus Ampullaria has its Cambodian name "Tal."

KUMAGUSU MINAKATA.

January 31.

THE TOTAL ECLIPSE OF THE SUN.

VIZIADURG, *Monday, January* 17.

THE work is so incessant here from sunrise to midnight that I have not time to give anything like an adequate idea of our doings. I may say, however, that we have been here since last Saturday week, and everything is ready for the eclipse. We have now over 120 volunteers. Captain Chisholm-Batten has taken charge of the whole arrangement, and to me, an old eclipser, it is a beautiful thing to see the splendid drill which we have commenced in eclipse form, along all lines, to-day, going on to the sound of the bugle. The observers have been arranged into twenty-one parties as follows :—

Observing Parties.

	Instruments, &c.	Staff.
I.	6-inch prismatic camera	7
II.	9-inch prismatic camera	8
III.	Integrating spectroscope	3
IV.	Discs	18
V.	Sketches of corona, without discs ...	12
VI.	Colours of landscape	6

FIG. 1.—Camp, Saturday, January 8. Putting in concrete pillars.

VII.	Shadow phenomena	8
VIII.	6-inch equatorial, with grating spectroscope	5
IX.	$3\frac{3}{4}$-inch equatorial	3
X.	Hand spectroscopes, with slits	6
XI.	Prisms for observations of ring spectra ...	7
XII.	Timekeepers	3
XIII.	Contact observations	2
XIV.	Polariscope	2
XV.	Observations of temperature	13
XVI.	Observations of stars during totality ...	7
XVII.	Landscape cameras for shadow, &c. ...	7
XVIII.	Observations of shadow bands	3
XIX.	Kinematograph for eclipse	4
XX.	Kinematograph for shadow	2
XXI.	Coronograph	3
	Total	129

Incessant instruction has been going on since the eclipse party joined the *Melpomene* at Colombo; but in this I have had quite a subordinate part to play, for the officers are past masters in many of the subjects which concern

us. Our log of lectures, &c., between January 5 and 17, runs something like this :—

LECTURES, &C., JANUARY 5–17, 1898.

Wednesday, January 5.

General lecture.
Corona drawing.

Thursday, January 6.

Corona drawing, conducted by Mr. Fowler.

Saturday, January 8.

Lecture on spectra (forenoon).
Lecture on spectra (afternoon).
Colours of landscape, by Lieut. Dugmore, R.N.
Corona drawing.

Monday, January 10.

Lecture on spectra, by Lieut. Colbeck, R.N.

Tuesday, January 11.

Lecture on spectra, by Engineer Mountifield, R.N.
Colours of landscape, by Lieut. Dugmore, R.N.
Corona drawing, by Lieut. Dugmore, R N.

Wednesday, January 12.

Sketches of corona, with discs.

Thursday, January 13.

Colours of landscape, by Lieut. Dugmore, R.N.
Sketches of corona, with discs.

Rehearsal of drills for—

6″ prismatic camera—9″ prismatic camera—Description and sketches of corona, with discs—Timekeepers.

Friday, January 14.

Lecture on observations of stars during totality, by Lieut. Blackett, R.N.

Rehearsal of drills for—

6″ prismatic camera—9″ prismatic camera—Integrating telescope—Descriptions and sketches of corona, with discs—6″ equatorial—$3\frac{3}{4}$″ equatorial—Timekeepers—Coronograph—Colours of landscape.

Saturday, January 15.

Drill for—

6″ equatorial (morning), conducted by Prof. Pedler.

Rehearsal of drills for—

6″ prismatic camera—9″ prismatic camera—Integrating telescope—Descriptions and sketches of corona, with discs—6″ equatorial—$3\frac{3}{4}$″ equatorial—Timekeepers—Coronograph—Colours of landscape.

Monday, January 17.

Drill for—

6″ equatorial, conducted by Prof. Pedler.
Instruction on landscape cameras, by Messrs. Fowler and Turner.

Rehearsal at eclipse time of drills for—

6″ prismatic camera—9″ prismatic camera—Integrating telescope—6″ equatorial—Timekeepers—Coronograph.

Rehearsal at 5 p.m. of—

6″ prismatic camera—Integrating telescope—Timekeepers—Description and sketches of corona, with discs—$3\frac{3}{4}$″ equatorial—Coronograph—Colours of landscape—Kinematograph for shadow.

The climate here is delightful, and the weather has been up to the expected standard. To-day we have had a good deal of cloud after eclipse time ; but our hopes are very high in spite of this, for it all disappeared before sundown, and to-night the zodiacal light has testified to the clearness of the air. From the first the arrangements of the Public Works Department have been admirable, and all the work has gone on like clockwork, till at last a large space in the Forts is now covered with structures of matting shielding the instruments, which leave nothing to be desired. Great precautions have also been taken against exposure to the sun, and as a result we are all perfectly well. It is impossible to say enough as to the help which the Captain of the *Melpomene* has given to the whole enterprise ; he has anticipated all requirements down to the minutest detail. As at Kiö a signal station has been established, and everything the ship can lend, down to fire-buckets, is at our disposal in twenty minutes. The Collector of Ratnagiri, Mr. Bomanji, is also encamped here. At present he is our host, and any local assistance necessary is at once rendered ; at first we had great difficulties, as the Bombay authorities imagined everything could be worked from the ship.

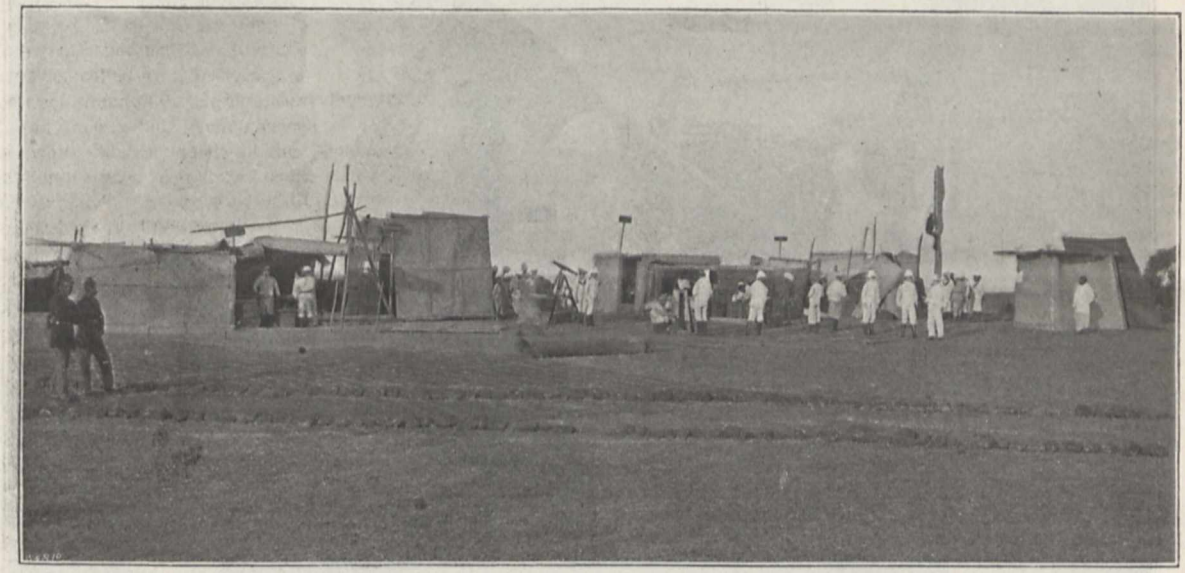

FIG. 2.—Camp, Monday, January 17. All instruments adjusted and drills commenced.

We have no news of the other parties, but Mr. Eliot, C.S.I., F.R.S., is expected to-morrow to take charge of the meteorological observations, and he doubtless will bring observers with him.

I enclose some photographs of the various instruments with their shelters. During the eclipse everything sunward will come down, and arrangements have been made so that everybody will have 40 seconds for a square look at the eclipse. The eclipse clock and timekeepers (we have a relay, one relieving the other at "65 seconds more") are working splendidly.

The new dropping-shutters, $16 \times 6\frac{1}{2}$, promise excellently; ten photographs of the spectrum can be taken in 10 seconds. A boat will be moored at the spot which we calculate the shadow will reach 5 seconds before totality, when the exposures begin; but we are not entirely dependent upon this, for the cusp will be watched, and again it has been calculated that this will extend through an arc of 45° at the same time (5 seconds) before totality. The arc will be watched to extinction in a $3\frac{3}{4}$-inch telescope, and this will enable the general signal "go" to be given.

Prof. Pedler has been here some days, and has got his 6-inch equatorial with grating spectroscope drill into perfect order. He begins 7 minutes before totality to repeat my Egyptian observations and studies certain special lines in the spectrum of the corona during totality. He has a comparison arc spectrum of iron, carbon, &c., photographed in the instrument before we came out.

NORMAN LOCKYER.

FIG. 3.—9-inch Prismatic Camera, showing arrangement and kind of shelter used.

"A TRIP TO CANADA."

AMONG the more interesting and instructive results of the recent visit of the British Association to Canada, is the issue of a pamphlet entitled "A Trip to Canada" by a clergyman, who was one of the party.

The motives with which the journey was undertaken are given with a naïveté which commands respect. "The Jubilee of 1897," we are told, "naturally suggests the idea of a little foreign travel on one's own account. It is one thing to read about the Colonies; it is another to see them with one's own eyes. Where shall we go? There is a large choice. In these days there is a variety of Cook-like associations, which bid for one's patronage. This summer I was glad to take what came to hand. The British Association held its meeting last August in Toronto."

This is, indeed, a delightful picture. When the century was in the lusty hey-day of its youth and middle age, prelates and professors "gave and received hard knocks." Now, as the years roll on, science waits, hat in hand, on the country rector. His breakfast table is piled with the circulars of a "variety of Cook-like associations." As he cracks his egg he thinks of accompanying the geologists to Moscow and the Caucasus. A slice of cold ham recalls the Arctic Circle, the midnight sun and Thos. Cook. Then his vagrant fancy swerves to Grindelwald and Dr. Perowne. But with the first spoonful of marmalade he feels that the British Association and Toronto have secured the prize. He decides to patronise universal science and the British Empire.

The reasons for this decision were not less stupendous than the decision itself. Civilisation has travelled from east to west. "Let us," says the author, in a moment of pious aspiration, "let us follow in the track of Providence."

The idea of taking a "Cook-like" tour in "the track of Providence" strikes us as novel, and would, perhaps, have been thought to be profane had it emanated from Thos. Cook and Son themselves. Originating, as it does, with a clergyman, we can only bow the head and wonder at the varied manifestations of the religious instinct.

The alternative plans had been carefully considered, and the following sentences indicate the kind of information which had been collected. "The British Empire is composed of possessions in many parts of the globe. We hold India by military occupation; its 300 millions of people are put under our rule. Australia, New Zealand and Tasmania are in the Antipodes; Borneo, Singapore and the West Indies are in the tropics. Africa has various climes and races and interests. . . . Canada comes first among our possessions from a tourist point of view."

After this display of recondite knowledge, it will hardly be believed that one of the author's motives for taking a trip across the Dominion was that it improves one's geography; but this fact, reinforced by the arguments as to the "track of Providence" and the "tourist point of view" settled the matter, and to Canada our author went.

The journey once undertaken was as remarkable in its experiences as in its inception. "For the two first days [of the voyage]," says the traveller, "you feel more or less in a strange land." The feelings of the first two days are often so peculiar, that it is difficult to find words to describe them; but to feel "in a strange land" when you are really at sea is, we believe, a unique experience.

Arrived at the other side, "Quebec in electric light, as we gazed upon it, reminded me of Valetta between its two harbours, or even of Venice standing in its waters. It is commonly said to resemble Gibraltar." As we have always understood that there is a hill or cliff of some sort both at Gibraltar and Quebec, but that Venice is as flat as a pancake, we confess to being puzzled by this passage.

The first effect of Niagara on the traveller was exactly the opposite of that it ordinarily produces. "Niagara," he says, "makes one forget Lord Kelvin." The Horse Shoe Falls, we are told, "is a thing to see not once or twice, but to imbibe and sleep upon." The first of these phrases reminds us of the experiences of the young lady at Venice. "We have been out on the Grand Canal," she wrote, "drinking it all in. Life never felt so full before." We are not aware that there is any competitor for the originality of the idea of sleeping on the Horse Shoe Falls.

At Toronto our author's favourite subjects were geography and anthropology, but he "threw in a little geology and zoology." Prof. George Dawson will be sorry to hear that his address was dull; but Prof. Miall will be gratified by the following summary of his teaching: "He said you should not collect specimens and put them in bottles, but study their living habits."

We cannot follow the trip across the continent in detail.

Sometimes the author becomes didactic. "The old road [in the valley of the Frazer] is now disused, and the iron road has taken its place. . . . The two roads are a natural parable. The old road is like the way of the world, along which weary travellers toil and often lose hope. In the railway the voyageur (*sic*) travels safely and with rapidity. The cares of travel sit lightly upon him. He sleeps peacefully at night, and he enjoys the prospect by day. He looks on his journey's end with pleasure. He thanks . . ." But we refrain from giving the quotation which the author adds to this quaint specimen of moral reflection. The sleek tourist, carted about without any effort of his own except that of pulling his purse from his pocket, has never before, we suppose, been taken as the type of the "seekers after truth." The pioneer, hewing his way through the wilderness, careless if his road be rough or smooth is, we take it, much nearer to the conception which John Bunyan had formed of those who through the Slough of Despond, the Valley of the Shadow of Death, and the River itself, press forward to their goal.

One quotation more and we have done. We all remember the difficulty with which Martin Chuzzlewit escaped from the peremptory demand of Colonel Diver, "Let me ask you, sir, how do you like my country?"

Our author would have been equal to the occasion. "One is asked one's opinion about the country. That it is a great country is plain to all. A country of the size of Europe is not a small country. At present it is thinly populated. The Canadians think much of their country and everything in it. An enthusiastic young lady, whose home is in Ottawa, and who is on her way to a finishing school in London, said 'Don't you think the electric cars in Ottawa are better than anywhere else?' Of course they are, one cannot but reply, quite *bonâ-fide*. Would not she brighten an electric car, wherever she was?"

This is masterly. The judicial logic of the opening and the skilful retreat behind the young lady would have baffled Colonel Diver himself.

But enough of this. The note of the British Association is that it strives to bring the scientific expert into contact with the amateur, who is often a man from whom, on some special point, the expert may have much to learn. It is possible that some of those who are thus brought nominally within the scientific fold, care more for the cheap excursions and the "tourist point of view" than for the advancement of science. This is perhaps inevitable. At all events the Association has not chosen to attempt to sift the chaff from the grain, and the Canadians were willing to extend their generous hospitality not only to the group of well-known scientific workers who crossed the Atlantic, but to others whose only introduction was their Association ticket. As a member of the Association our author was everywhere kindly received, was carried across the continent half-price, and even enjoyed the pleasure (which he duly notes) of riding in electric trams for nothing. It might have been expected that he would have been grateful for the privileges which were extended to him in his presumed character of one anxious for the advancement of science. We have looked carefully through the pamphlet and find scarcely a single expression which gives evidence of any such sentiment. On the contrary he seems to think that the benefit was mutual. His last words are: "A trip to Canada is a pleasant experience. May I say that it gives pleasure to those whom one goes to see, as well as to the individual who makes the trip."

His scientific companions fare no better than his hosts. They are gracefully described as crossing the Atlantic "to disgorge their erudition well flavoured with salt." There is a contemptuous reference to "the smaller fry." A body which Sir John Evans, Lord Kelvin and Lord Lister were not ashamed to lead, is called "Cook-like." The author's whole attitude is that of a man who has paid his money, and has had no more than his rights.

We should not have dealt with this pamphlet at such length had it not been accompanied by a printed request for subscriptions for an object which many men of science would be glad to help. In his desire to benefit this object the author may give his work a wide circulation in this country and in Canada. We think it right, therefore, to draw attention to what otherwise might have been left unnoticed, in order to protest that this pamphlet must not be taken to represent the attitude of average members of the British Association.

None of them desired to imbibe Niagara, or are likely to forget Lord Kelvin. Amongst them there was the deepest feeling of gratitude for the hospitality they received; hospitality which the most distinguished acknowledged was more kindly and more lavish than they had any right either to expect or to desire.

THE HABITS OF ICE-SEALS.

THERE are four species of earless, or true seals inhabiting the boreal part of the North Atlantic and Arctic Oceans which may well be designated ice-seals, since they dwell for a considerable portion of the year either on the solid pack-ice or on ice-floes. These species are the Greenland or harp-seal (*Phoca grænlandica*), often termed, on account of the conspicuous black markings on the yellowish-white ground-colour of the back, the saddle-back; the ringed seal (*P. hispida*); the large bearded seal, or square-flipper (*P. barbata*); and the crested, or hooded seal (*Cystophora cristata*), the males of which carry the peculiar dilatable sac on the nose from which the species derives its names. The first three of these are closely allied forms, but it is not a little remarkable that whenever the young of the first and second are born in a uniform yellowish-white coat, those of the third make their appearance in the world in a dark pélage; the white coat being not improbably shed *in utero*. It is commonly believed that the young of the fourth species are also white-coated, as are certainly those of the more southern grey seal (*Halichærus grypus*). If a white coat serves as a protection to the new-born "pup" on the ice, it is difficult to see why this type of coloration should have been departed from in the case of one species. But the whole subject is one of great difficulty, as the white-coated young of the grey seal may often be seen in the Hebrides reposing on black rocks. All the four species in question agree in the circumstance that the young are produced during their sojourn on the ice; but in other respects very considerable differences are displayed in regard to habits.

In the first place, the Greenland and the crested seal are essentially migratory animals, the former associating in immense herds and the latter in smaller parties, whereas the bearded seal, which is considerably the largest of the three, only makes a slight movement to the south when compelled by the increase of the winter pack-ice, and is a comparatively solitary creature. But these are by no means the only points of difference in this respect. The Greenland seal visits the country from which it takes its name twice annually, namely in the autumn and the spring; and breeds chiefly on the coasts of Jan-Mayen and Newfoundland, the young being produced in the latter district at the beginning of March, but in the former some weeks later. That some of these seals which migrate from Greenland travel westwards to Jan-Mayen is most probable, but where the remainder pass their time while away from their native land, is not yet ascertained with certainty. The southern migration of these seals on the Atlantic coast of America, which commences when the frost sets in, is described as a wonderful sight; at first small advance parties pass down, and these are followed by the main body, which includes thousands of individuals, and takes about a couple of days in passing a given point. Although during their migration hugging the coasts, the Greenland seals during the breeding-season frequent the heavy floe-ice, at least in East Greenland, which is not liable to break up, and therefore affords them a safe habitation. As they have no difficulty in obtaining access to the water, in this district, at any rate, they do not make breathing-holes; and it has been commonly supposed that this is their invariable habit, but in a little pamphlet recently issued by Commander Robinson,[1] entitled "Ice-riding Pinnipeds," it is stated that when on solid thin ice such holes are made. In disposition this seal is mild and gentle; and it is a well-ascertained fact that the young are born in the white coat, the British Museum possessing a stuffed example in this state. From its numerical abundance it is commercially one of the most valuable of the true seals.

As regards the bearded seal, this, as already mentioned, is a comparatively rare and solitary species, fond of reposing on floating ice in the open sea, and moving southwards only when compelled by the extension of the pack-ice. It is apparently one of the species which does not make a breathing-hole, as it does not frequent large extents of ice; and it may generally be recognised at a distance by its habit of performing a somersault when diving into the water. In the pamphlet already referred to the suggestion is made that a certain number of the young of this species are infected by the migratory instinct of the young Greenland seals, and wander south with them. In addition to the testimony of sealers, a specimen in the Natural History Museum conclusively proves that the young "square-flipper" is born in the dark coat.

The ringed seal, which is common to the North Atlantic and Pacific, is a non-migratory species, whose favourite haunts are retired fjords and bays, in which it remains during the time they are tightly packed with ice. When, however, the ice breaks up, the "floe-rats," as they are called by the sealers, retire to the ice-floes, upon which the young are born in March and April. This species always form an "atluk," or breathing-hole in the ice, which is in the form of an oblique passage, through which the surface of the ice can easily be reached from below. The hole appears to be made while the ice is forming; but accurate accounts of the *modus operandi* are still required. In the above-mentioned pamphlet it is stated that the animal works on the ice with its front claws, revolving round this pivot with its body; but it is somewhat difficult to realise how such a method can be effectual, and, *primâ facie*, it would seem more probable that the passage is made while the ice is sufficiently thin to break with the weight of the seal, and kept open by constant use. The breathing-hole affords an easy method of capturing the seals which use it, and the great reduction in the number of these seals is largely due to this method of hunting.

As it differs much in external form from other ice-seals, so the crested seal has several peculiarities in habits. Unlike the others, it is a bad-tempered animal, living, except when driven to associate more closely by an unusual scarcity of ice, in small parties scattered over a wide extent of ice, always preferring the outside of the pack, or drift ice to the neighbourhood of land, and seldom frequenting either the coasts or isolated rocks. On the American side they are chiefly to be met with near the eastern edge of the main ice-pack, where there are numerous patches of open water, and consequently abundant room for fishing. Ordinarily small parties of from three to five individuals are scattered over the broken rough ice, at distances of from thirty to fifty yards apart. The easy access to water thus afforded obviates in general the necessity of making breathing-holes. They are stated to resemble fur-seals in being polygamous; and the males certainly engage in combats for the possession of the females, during which they utter loud cries which may be heard for miles. In winter these seals travel south, but they do not make the two annual journeys characteristic of the saddle-backs in Greenland. In European seas the crested seal has become comparatively rare, although on the American

[1] I am informed by the author that, owing to certain errors, all available copies of this work have been cancelled.

side, where its favourite haunts are Labrador and Newfoundland, it is still so abundant that many thousands are at times taken by a single vessel. March is the breeding-time, and at this season the young are produced on the ice far away from land. All previous writers with which we are acquainted state that the young are born in the white coat, which is not exchanged for the grey till the lapse of about twelve months. But Commander Robinson is positive that this is incorrect, and that the grey coat is assumed previous to birth. Unfortunately there are no specimens in the British Museum available for deciding this disputed point; but it is earnestly to be hoped that such may be supplied before long. In the meantime it may be suggested that the discrepancy has arisen from the young of one species having been mistaken for that of another, although it is at the same time difficult to see how this can have been the case with a seal so peculiar in appearance, and dwelling so much apart as does the present.

The above are but a few of the leading features in the habits of the northern ice-seals, to describe which in detail would require a small volume. Among the points which require special elucidation are what becomes of the great bulk of the harp-seals between their visits to Greenland in May and September, the mode in which seals make their breathing-holes, and the colour of the newly-born crested seal. R. L.

MAGNETIC AND PENDULUM OBSERVATIONS.[1]

IT may be remembered that Lieutenant Peary, before starting on his sixth expedition to Greenland in 1896, offered transport on his steamer to two parties of scientific men, and that the opportunity was very properly accepted. The parties—which were under the direction respectively of Prof. A. E. Burton, of the Massachusetts Institute of Technology, and Prof. R. S. Tarr, of Cornell University—consisted each of six members, and were entirely independent in organisation and equipment of the main body of the expedition. The researches of the Boston party consist of observations in terrestrial physics, including glacier phenomena, and studies of Eskimo life, and their reports are now coming to hand. The report of Mr. G. R. Putnam, of the United States Coast and Geodetic Survey, who undertook the magnetic and pendulum observations, is now before us.

Early in July Mr. Putnam left Boston with a complete outfit of magnetic, pendulum, and astronomical instruments, and arrived at Halifax, Nova Scotia, two days later. Here he found time to make magnetic determinations at the Naval Dockyard, at which station the declination observations cover a period of nearly three centuries. Reaching Sydney, Cape Breton, the starting point of the expedition proper, six days elapsed before the departure of the *Hope*, Lieutenant Peary's steamer, and in this time all the instruments were set up and used. The voyage along the Labrador coast was only interrupted by a few hours' stop at Turnavik, where magnetic observations were made. Passing up the Hudson Straits, Mr. Putnam spent two days at Ashe Inlet, but here a gale on the second night unfortunately interfered with the full success of his work. The *Hope* then turned eastward, and on August 1 the coast of Greenland was sighted. Magnetic observations only were made at Godhavn, and Umanak was reached a day or two after. Here Mr. Putnam's party landed and settled down for a month, while the *Hope* continued her northern voyage. The required observations having been completed, the whole party indulged in exploring trips, but on these excursions they could not well take the magnetic instruments. On the return of Lieutenant Peary, the homeward journey began. After the magnetic observations at Godhavn had been repeated, the ship anchored at Niantilik, in Cumberland Sound, where observations were again attempted, but here the value of the pendulum observations was lessened, because unfavourable weather did not allow the necessary time-observations. Sydney was again reached September 26, and here a few observations were taken, prior to the instruments being shipped to Washington, where they were tested and found to be unaffected by their long journey of 5000 miles.

The magnetic outfit, comprising a dip circle of the ordinary Kew pattern and a magnetometer, was lent by the Coast and Geodetic Survey. In the case of the latter instrument, the magnet consisted of a hollow octagonal prism of steel, held in a stirrup with a long arm to which the two silk fibres were attached. By this arrangement the magnet remained sensibly horizontal at ordinary latitudes, but a copper balancing ring was sometimes used at the most northerly stations. The formula used for computing the moment of inertia of this ring (p. 74) is incorrect, and the term $\frac{1}{3}(x_2^2+x_2x_1+x_1^2)$ should be replaced by $\frac{1}{4}(x_2+x_1)^2$, although the numerical correction happens to be insensible. For determining the azimuth by the sun, the magnet box is removed from the base and circle, and the latter is then used with a separate theodolite.

Mr. Putnam's results in this part of his work are both valuable and interesting. Further evidence has been obtained of the violence of magnetic disturbances in polar regions, although far greater disturbances have been recorded. Thus the range in a day observed at Niantilik exceeded $4\frac{1}{2}$ degrees, a change of over 3 degrees being noticed in twenty minutes. A comparison with the contemporary record at Washington reveals, it is true, that an unusual magnetic storm visited this city, but its severity as measured by the range of declination was fifteen times less than that at the northern station. With the exception of Niantilik, earlier information is available with regard to all the stations visited by Mr. Putnam; and although only Halifax and Godhavn possess satisfactory records extending over the last three-quarters of a century, the general tendency in the change of the magnetic elements seems to be clearly indicated. At present it appears that at all these points "the westerly declination is diminishing, the northerly dip is diminishing, the horizontal force is increasing, and the total force is diminishing."

The apparatus used for determining the relative force of gravity, comprised a set of three half-second pendulums, one sidereal and two mean time chronometers, and a meridian telescope. The pendulums were swung in an air-tight case, in which the pressure was reduced to about 6 cm. by means of an air-pump. All the chronometers were provided with electrical break circuit attachments, and were thus capable of the instantaneous raising of a shutter by an electrical mechanism and the momentary illumination of a slit every second or two seconds. By this means the reflections of a flash in two mirrors, one attached to the fixed knife edge, and the other to the head of the pendulum, could be observed in a telescope. The period of the pendulum was then deduced from the observed coincidences. At the southern stations coincidences were observed with sidereal seconds, but nearer the pole, with mean time seconds, on account of the decrease in the period of the pendulum. Whenever the plan could be carried out each pendulum was swung for a period of eight hours, both in reversed and direct positions, and star observations were made at the beginning and end of the forty-eight hours. The following table summarises the principal results (p. 103):—

[1] "The Scientific Work of the Boston Party on the Sixth Peary Expedition to Greenland. Report A."

Station.	Latitude N.	Longitude W. of Greenwich.	g_1, reduced to sea level.	g_0, theoretical value.	$g_1 - g_0$.
	° ′	° ′	cm.	cm.	cm.
Washington ...	38 53	77 1	980·101	980·087	+ 0·014
Sydney (Cape Breton) ...	46 9	60 12	980·722	980·732	− 0·010
Ashe Inlet ...	62 33	70 35	982·109	982·104	+ 0·005
Umanak ...	70 40	52 8	982·594	982·632	− 0·038
Niantilik ...	64 53	66 20	982·275	982·271	+ 0·004

The theoretical value is that given by the assumed formula,

$$g_0 = 978{\cdot}066\,(1 + 0{\cdot}005243 \sin^2 \text{latitude}),$$

and g_1 is obtained by using Bouguer's formula.

It would not be easy to over-estimate the value of these accurate determinations of gravity, for they help to fill a very serious gap in the series of observations which have been made in various parts of the world. Prof. Helmert's recent report to the International Geodetic Association has shown that no pendulum observations had been obtained in the region visited by Mr. Putnam, and it is in the polar regions that data as to the variations of gravity are of the greatest importance and, therefore, most urgently required. Mr. Putnam concludes his report with some historical notes on the development of apparatus and the progress of research, which are very interesting. It is hardly correct, however, to say that the law $t = \pi\sqrt{\frac{l}{g}}$ applies even to the ideal simple pendulum (p. 110). These notes contain a good account of the controversy which has arisen about the appropriateness of the second term in Bouguer's formula for the reduction of g to sea level: $dg = \frac{2g\mathrm{H}}{r}\left(1 - \frac{3\delta}{4\Delta}\right)$, where δ is density of matter lying above sea level, and Δ is the mean density of the earth. The value of pendulum observations as affording indications of surface density is insisted upon, and a practical application of the method is suggested. It is to be hoped that Mr. Putnam will see his project realised, by which the relative proportions of ice and rock in the great Greenland elevation may be determined by pendulum experiments.

RAINFALL OF THE UNITED STATES.

UNDER this title the Weather Bureau of the Department of Agriculture has published a bulletin containing a discussion of the observations obtained from the longest and most trustworthy rainfall registers in the United States, accompanied by annual, seasonal, and other charts. In addition to the usual tables of the mean monthly and annual precipitation, arranged according to geographical distribution, an important departure has been made by separately discussing the rainfall of the crop-growing season; for, as the author remarks, however valuable a knowledge of the water supply throughout the year may be, information as to the amount of rainfall available for agricultural purposes is possibly of greater consequence.

Another departure from the ordinary treatment of the subject is the discussion of the monthly distribution by districts and types according to natural boundaries. The conditions favourable for rainfall are chiefly (1) nearness to the ocean, (2) proximity to the track of storms, and (3) the position of mountain ranges. The rainfall of the North Pacific coast is quoted as an example of the combined effect of all three conditions, the distinguishing characteristic of this type being a wet season from October to March, and a practically rainless summer, except in Northern California and parts of Oregon and Washington. About half of the yearly fall occurs between December and February. The rainfall is discussed under twelve such types; we are unable to refer specially to each of these, but the chart of mean annual precipitation shows that there is a narrow belt on the north-west coast, extending from Cape Flattery on the north to midway of the Oregon coast on the south, and some distance inland, where the annual amount exceeds 50 and at some points 100 inches. Eastward and southward the annual fall diminishes, reaching a minimum on the lowlands and valleys between the Coast Range on the west and the Sierra Nevada and the Cascade Ranges on the east, where the amount in some cases does not exceed 10 inches, but in years of plentiful rainfall as much as 20 inches may fall in the best-watered parts. At Terrace (Utah), a station on the Central Pacific Railroad, the mean annual fall is only 4·3 inches, and in the driest year was as low as 0·7 inch. To the eastward of the Rocky Mountains the annual fall is from 10 to 18 inches, and increases slowly to 60 inches on the Florida and Gulf coasts, and from 40 to 50 inches in the Eastern States. There is, however, a gradual decline both from the Atlantic coast westward and from the Gulf coast northward. In considering the various rainfall values in this discussion allowance must he made for the position of the gauges which are generally exposed on roofs, owing to the stations being mostly in towns. It is well known that the amount caught in the gauge decreases with altitude above the ground, and it is estimated that the loss from this cause in the values quoted by the Weather Bureau is from 5 to 10 per cent. of the total annual fall. With regard to the important subject of excessive rainfall, down to the year 1888 only one self-recording gauge was in use at the Signal Service stations; five others were added in 1889, and the publication in the *Monthly Weather Review* of the maximum falls in five and ten minutes, and also in one hour, were begun. In August 1890 a cloud-burst passed over Palmetto (Nevada), when a gauge that was not exposed to the full intensity of the storm caught 8·8 inches of water in an hour, and in August 1891, 11½ inches were measured within an hour at Campo (California). The great majority of excessive rains are said to occur east of longitude 105° W., and principally in the summer months, in connection with afternoon thunderstorms; they occasionally take place in the track of West India hurricanes, and are more abundant on the Gulf and South Atlantic coasts than at inland places. The maximum rates of rainfall per hour, estimated from periods of five minutes, at the Weather Bureau Stations which possess self-registering gauges, were 9 inches at Bismarck (N. Dakota); 8·4 inches at St. Paul (Wisconsin), and 8·2 inches at New Orleans.

This valuable memoir has been prepared by Mr. A. J. Henry, under the direction of Prof. Willis L. Moore, the Chief of the Weather Bureau.

NOTES.

THE German Emperor, as King of Prussia, has conferred upon Dr. John Murray, Director of the Scottish Marine Station, and formerly of the *Challenger* expedition, the rare distinction of knighthood in the Order *Pour le Mérite* founded by Frederick the Great. This is generally allowed to be the highest honour which a man of science can receive, and is limited to thirty German and twenty-five foreign knights. Lord Kelvin, Lord Lister, and Sir G. G. Stokes are the only other British men of science now alive who have received the Order. Dr. Murray has also been elected a Foreign Member of the Imperial Russian Academy of Sciences.

THE Committee appointed by the American Society of Naturalists to inquire into the practicability and feasibility of the exploration of the Antarctic continent, report that an expenditure of from forty thousand to fifty thousand dollars would suffice for an independent scientific expedition. The Committee suggests that if this fund could not be raised by

public subscription, a number of scientific societies and institutions of general learning, should contribute the amount required, each sending representatives to the expedition in proportion to the sums subscribed.

WE are glad to hear that the Zoological Society of London has contributed 100*l.* towards the expenses of the International Congress of Zoology; and we hope to hear that other natural history societies have followed this excellent example.

SIR DYCE DUCKWORTH has been appointed to deliver the Harveian Oration before the Royal College of Physicians of London for 1898. Dr. G. V. Poore has been nominated Milroy Lecturer for 1899.

THE Council of the Institution of Civil Engineers have resolved that the "Engineering Conference," inaugurated in 1897, is to be biennial, and that, accordingly, the next meeting will be held in London in the spring of 1899.

A LARGE and representative Royal Commission has been appointed to advise as to the best means by which the products of British industry, agriculture, and the fine arts may be procured and sent to the International Exhibition to be held at Paris in the year 1900. Among the Commissioners, which include the Prince of Wales and the Duke of York, are the following representatives of science and the arts, in alphabetical order:—Sir F. A. Abel, Sir George Birdwood, Major-General Sir Owen Tudor Burne, Sir G. H. Chubb, Major-General Sir John Donnelly, Lord Kelvin, Sir James Kitson, Sir Trevor Lawrence, Lord Lister, Sir John Lubbock, Sir Clements Markham, Mr. W. H. Preece, Mr. E. Windsor Richards, Earl Spencer, Mr. W. T. Thiselton-Dyer, Sir E. Maunde Thompson, and Sir W. H. White.

M. FRANCHET has been elected President of the Botanical Society of France for the current year; MM. Zeiller, Boudier, Clos, and Roze Vice-Presidents.

PROF. O. MATTIROLO, of Bologna, has been appointed Professor of Botany and Director of the Museum and Botanical Garden at Florence; Prof. F. Morini, of Messina, takes his place at Bologna.

ON December 18, 1897, a hall was opened at Bologna for the reception of the herbaria, preparations, and sections of the botanist Aldrovandi. It has been erected at the cost of the city and province.

THE part of *Malpighia* comprising fascs. 9 and 10 for the year 1897, edited by Prof. O. Penzig, contains a view of the very handsome monument erected to the memory of Malpighi at Crevalcore.

THE post of Government botanist to Victoria, vacant by the death of Baron Ferdinand v. Müller, has been conferred on Mr. J. G. Luchman.

THE death is announced of Dr. Waldemar v. Schroeder, professor of pharmacology in the University of Heidelberg, and author of a number of treatises on physiological chemistry.

WE learn from *Science* that the Bruce gold medal of the Astronomical Society of the Pacific has been awarded to Prof. Simon Newcomb, for his distinguished services to astronomy.

THE American Academy of Arts and Sciences has elected M. Elias Metschnikoff, of Paris, Foreign Honorary Member in the Section of Zoology and Physiology.

THE twenty-sixth general meeting of the Federated Institution of Mining Engineers will be held at Newcastle-upon-Tyne on February 22 and 23.

AT the annual general meeting of the Royal Horticultural Society, held on Tuesday, the Council announced that they had appointed the Rev. George Henslow to be professor of botany to the Society, and that Prof. Henslow had kindly undertaken to give addresses at a number of the 1898 meetings, drawing attention to interesting points connected with some of the plants, &c., exhibited. The Council believe that these "demonstrations" will be greatly appreciated by the Fellows of the Society.

AT the general monthly meeting of the members of the Royal Institution, on Monday, the special thanks of the members were returned to Mrs. Tyndall for her liberal donation of 1000*l.*, presented in the name of the late Prof. Tyndall, for the promotion of science Thanks were also returned to Sir Frederick Abel, Sir Andrew Noble and Prof. Dewar for donations to the fund for the promotion of experimental research at low temperatures. It was announced that the centenary of the Royal Institution would be celebrated next year.

THE meeting of the Manufacturers' Association of America at New York, on January 25-27, was the most notable gathering of the masters of industry ever held in America, or probably in the world. It was estimated that the 966 persons who attended the closing banquet represented industries which produce 9,000,000,000 dollars of manufactures annually. In the meetings of the Association prior to the banquet the subject of the metric system was presented by the committee, together with a resolution strongly favouring it; which resolution met with support from many of the most influential members of the Association, but was opposed by the chairman of the committee on the grounds of the expense of making new gauges and tools in changing from the present standard. The final result was that the resolution was not carried.

FURTHER particulars of Prof. O. C. Marsh's valuable gift to Yale University (see p. 322) are given in the *Yale Alumni Weekly*. From a scientific point of view, the value of the collections now presented to Yale is beyond price, each one containing many specimens that can never be duplicated, and are already of historical interest in the annals of science. Among the prominent features of one of these collections, that of extinct Vertebrates, may be mentioned (1) the series of fossils illustrating the genealogy of the horse, as made out by Prof. Marsh, and accepted by Huxley, who used it as the basis of his New York lectures; (2) the birds with teeth, nearly two hundred individuals, described in Prof. Marsh's well-known monograph "Odontornithes"; (3) the gigantic Dinocerata, several hundreds in number, Eocene mammals described in his monograph on this group; (4) the Brontotheridæ, huge Miocene mammals, some two hundred in number; (5) Pterodactyles, or flying dragons, over six hundred in number; (6) the Mosasaurs, or Cretaceous sea-serpents, represented by more than fifteen hundred individuals; (7) a large number of Dinosaurian reptiles, some of gigantic size. Besides these are various other groups of mammals, birds, and reptiles, most of them including unique specimens.

IN referring to the priceless collections which have now become the property of Yale University, by Prof. Marsh's generosity, the *Alumni Weekly* remarks that Prof. Marsh is a Yale graduate of the Class of 1860. He is a nephew of the late George Peabody, and thus he secured the donation that gave Yale the present Peabody Museum, as well as a reserve building fund that then seemed adequate for future additions. After obtaining this great gift for Yale, Prof. Marsh served his *alma mater* faithfully, without salary, for thirty years, as professor of palæontology, refusing all offers to go elsewhere. Besides bringing together with untiring zeal these vast scientific

collections now presented to the University, Prof. Marsh has found time to describe many of the important specimens new to science, and make them known to the world in more than two hundred and fifty publications.

WE have been requested to announce that it is proposed to raise, by international subscription, a memorial fund to the late Prof. Edmund Drechsel, the well-known physiological chemist, whose recent death at Naples, on September 22, 1897, has been a great loss to science. Prof. Drechsel has left a widow and two young sons in very poor circumstances. It is hoped that sufficient money will be raised to contribute materially to the support and education of these boys, as well as to provide a modest memorial to Drechsel in the place where he is buried. Any contribution to this object may be sent direct to Prof. Kronecker, Physiologisches Institut, Bern; or to Mr. Ernest H. Starling, 8 Park-square, London, N.W., who will forward any subscriptions received to Prof. Kronecker. This appeal has been circulated among the members of the Physiological Society; but Drechsel was even more a chemist than a physiologist, and many English chemists, as well as other scientific men, may be glad to contribute in some way to the memorial which is being raised on behalf of his widow and children.

WITH reference to the recrudescence of epidemic influenza the *British Medical Journal* says:—Influenza has further increased in London during the past week, and medical practitioners in all parts of the town are finding their hands very full. The epidemic seems to be very prevalent also in some of the home counties, especially in Kent and Surrey, and it prevails also in Devonshire and Cornwall. The epidemic now prevalent, in some districts at least, differs in its character from those from which we have suffered in previous years. It has long been recognised that the disease may present at least three distinct types, according to whether it attacks most severely the respiratory, the nervous, or the digestive systems. In the earlier epidemics in recent years the majority of cases belonged to the first type, and many deaths were caused by bronchitis and pneumonia. Later, the prevalent type was the nervous, and men were left in a condition of mental and physical depression which for many months greatly limited their activities, and in too many cases helped to fill the asylums. The present epidemic is remarkable for the very large proportion of cases which show symptoms of profound disturbance of the digestive system.

IT is surprising that in a subject like mathematics, where any student may easily rediscover known theorems for himself, so few journals exist devoted to the interchange of notes and queries. We are glad to see that *L'Intermédiaire des Mathématiciens*, which exactly fulfils this object, has now entered on its fifth year of publication. The editors, Dr. C. A. Laisant and M. Émile Lemoine, justly take pride to themselves in recording that the recent Mathematical Congress in Zürich owed its origination partly to correspondence in their columns.

A NOTE by Commander C. H. Davis in *Terrestrial Magnetism*, calls attention to the serious effects of electric car disturbances at the magnetic observatory of the United States Naval Observatory, which is situated on Georgetown Heights, in the suburbs of Washington. The disturbances seem to have most affected the vertical force, but the horizontal force and declination were also disturbed. Experiments conducted at the magnetic observatory of Toronto, which is still in a worse predicament than this observatory, show that magnetic instruments must be removed to a distance of at least two miles before the disturbances of an electric railway cease to be apparent. Observations at Toronto have been discontinued. As Commander Davis remarks, it thus appears that the use of powerful electric currents for commercial purposes has destroyed the usefulness of the only two magnetic observatories on the North American continent.

THE *Aeronautical Journal*, which now enters on its second year of publication, bids fair to be a current record of all experiments on aeronautical matters as well as of devices, both practicable and impracticable, for navigating the air. Among the features of the current number are an account of Mr. Chanute's American experiments, and a translation of a paper, by Captain Moedebeck, on the German aluminium balloon which was experimented with on November 3 of last year, but was wrecked through becoming unmanageable. That never failing subject of controversy, the "soaring bird," is again brought forward, this time in a lengthy disquisition by Mr. G. L. O. Davidson. Mr. P. Spencer describes Mr. Pollock's balloon trip of October 12, 1897, across the Channel; and Mr. A. Lawrence Rotch, of the Blue Hill Observatory, contributes a note on "The Highest Kite Ascent." A glance at the list of patents applied for, and actually granted, will show that the "dark ages" of science have not yet entirely disappeared, so far as aeronautics is concerned.

A SMALL pamphlet, entitled "Natural Colour Photographs," has been received from the Natural Colour Photography Company, Ltd., Dublin; and though Prof. Joly's name is not mentioned in it, the process described is evidently the one we owe to his ingenuity. This process, it will be remembered, consists in using two screens: one—the "taking" screen—lined in orange, yellowish-green and blue; and the other—the "viewing" screen—lined in red, green and violet. The pamphlet just received is taken up with directions for using these screens, the former of which is employed to obtain the negative, while the latter—when superimposed upon the positive finally obtained—reproduces the colours of the original object, which appears as a transparent photographic image in the natural colours. Many photographers will be glad to know where to procure these screens, and how to obtain the best results with them.

AT the meeting of the Academy of Sciences at Vienna, on January 20, Dr. J. Hann communicated a treatise on the theory of the daily oscillation of the barometer. The chief object of the discussion is the investigation of that portion of the regular oscillation of the barometric pressure which occurs once in an entire day. This period is most subject to disturbances of locality and time because all meteorological phenomena have a whole-day period. With the view of eliminating all disturbing influences as much as possible, the author deals with the hourly observations made at sea, and on islands far from continents. Near the equator the extremes of the whole-day period occur near 5h. 30m. a.m. (the maximum) and 5h. 30m. p.m. (the minimum), which are not very different from the average conditions on land, the epochs being retarded with increase of latitude. The amplitude of the whole-day oscillation at the equator is nearly a third of that of the double daily variation. The amplitudes of the daily wave have two principal maxima at the time of the equinoxes, and a principal minimum in June and July, at the time of aphelion; while in December and January, at the time of perihelion, the amplitude is much greater. The author also investigates, for a number of stations, the modifications to which the normal whole-day wave of barometic pressure is subject, owing to the daily periodic transfer of masses of air from land to sea, and the reverse, as well as at mountain stations.

THE Hong Kong Observatory seems to have been originally founded for the purpose of issuing storm warnings and protecting commerce against the destructive typhoons which visit

those parts. Looked at from that point of view the Observatory seems to have fulfilled its original object. The Report for 1896, just received, gives a full account of the work carried on, and particularly analyses the relative success that has attended the weather and storm predictions issued. Adopting the general method of taking the sum of total and partial successes as a measure of success, and similarly with the failures, we learn that 97 per cent. of the weather forecasts have been justified. With regard to the success in predicting the approach of a typhoon, the percentage is nearly as good, if we leave out of account a peculiar storm, prevalent in the winter, called a "Norther," and of which it is impossible to publish any forecast till information is available from the interior of China and the northern ports. For instance, there appears to be no telegraphic communication between the Observatory and either Hankow or Cheefoo, so that all information from a particular direction is wanting, which, if it could be obtained, would add materially to the safety of the shipping and commerce. But notwithstanding these disadvantageous circumstances, the percentage of success is 75 for all gales, and leaving out those for whose successful prediction northern information is necessary, the percentage is as high as 83. Among the original inquiries prosecuted at the Observatory is one on anemometer records at various altitudes. Two Robinson anemometers of identical construction are mounted at 150 feet and 1834 feet above mean sea-level. The lower is at the Observatory on the Chinese mainland, the higher on the island of Hong Kong. The result is to show the ratio between the force of the wind at the two stations for each hour of the day throughout the year. In the summer, when the wind is generally southerly, the proportionate velocity is greater than in winter, when the wind is easterly. Similarly at midnight, and the morning hours, the difference of velocity is greater than at noon, and the hours immediately after.

THE *Pharmaceutical Journal* is doing its best to encourage the use of the metric system by pharmacists in their daily business. Recent legislation has made the use of the system legal in British commerce, but, as our contemporary points out, the mischief of a permissive system is that what is permitted is often, as a matter of convenience, ignored; and there is little doubt that the mere permission to use metric weights and measures in trade will prove futile in encouraging the general adoption of the system. The suggestion is offered, therefore, that pharmacists should neglect no opportunity of familiarising themselves, and those with whom they come in contact in the course of their business, with the more rational weights and measures that are now legal, the more especially as they appear destined, sooner or later, to supplant the older weights and measures entirely. With the view of encouraging and assisting the reform indicated, it is proposed in future to give all quantities in the pages of the *Pharmaceutical Journal* in accordance with the metric system, and the change will be effected in its entirety at as earlier a period as may prove convenient. After the new Pharmacopœia is published, there will be no excuse for British pharmacists to plead unfamiliarity with the metric system.

AMONG the more valuable incidental results of the Canadian meeting of the British Association must be reckoned the advances in our knowledge of the surface life of the North Atlantic, made by members of the Association during their outward and homeward voyages. We have referred in earlier numbers to the collections of plankton made by Prof. Herdman along the Canadian transatlantic route, and by Mr. Garstang along the Canadian and American routes. Prof. Herdman's account of his work is the first to appear, and has been published as a memoir in the *Transactions* of the Liverpool Biological Society (vol. xii.), under the joint authorship of Prof. Herdman, Mr. J. C. Thompson, and Mr. Andrew Scott. The memoir reveals a remarkably wide distribution for the majority of the forms enumerated. Four new species of Copepoda are described, three of them from the St. Lawrence and one from Puget Sound on the Pacific Coast. The discovery of these forms by English visitors should encourage Canadian naturalists to take up this promising field of research for themselves.

IN order to obtain positive data as to the results of the serum treatment of diphtheria in Russia, the two St. Petersburg societies, of Children's Physicians and of Russian Physicians, nominated a special committee which studied all that had hitherto been printed in Russia on the subject, and entered into correspondence with the doctors who had used serum in their practice. An elaborate report of the committee was read, on December 24 last, by Dr. Rauchfuss before a meeting of the Society of Russian Physicians. In 44,631 registered diphtheria cases in which serum was used, the mortality was only 14·6 per cent., while in 6507 cases where no serum was used, the mortality was more than double, *i.e.* 34 per cent. By a careful analysis of data taken from 51 provinces of Russia, Dr. Rauchfuss shows that in each province separately the serum treatment had the effect of at once notably reducing the mortality, even in the midst of severe epidemics. He does not deny that medical help is now applied for in a number of lighter cases, in which no doctor would have been called for a few years ago; but the marked difference between the mortality in the cases which were treated with serum and those which were not, cannot be explained in this way, while the confidence of the population, including the peasants, in the new treatment is also a testimony in favour of it. Eleven laboratories situated in different parts of Russia are now preparing diphtheria serum.

IT is now recognised that properly-organised and equipped museums are valuable factors in education, and render good service in directing and stimulating scientific work. Unfortunately, owing to general lack of means, and a staff the members of which have not received sufficient training, provincial museums are often of no service to education or to science. In *Natural Science* (December 1897), Mr. Herbert Bolton refers to these museums, and points out that hardly any two can be said to work upon a common plan, whilst most develop and exist rather as the sport of circumstances than as the outcome of definite purpose and design. What is badly wanted is the creation of an annual museums' grant by Government in aid of provincial museums of University Colleges, and of large cities possessing good collections and a trained staff, the sum allotted to each being determined by considerations similar to those which guide the application of the present University Colleges' grant. Upon the strength of such a grant the Government could charge each museum with a definite scope of work and the attainment and retention of a certain standard of excellence. It is also suggested that other museums might be subsidised through the agency of Council Councils, upon certificates of efficiency and progress received annually from an accredited visitor, who might be an official of the Government or of one of the first-class museums, Mr. Bolton's scheme of classification of museums, and of the work these institutions might do, should assist in directing attention to an important subject.

M. J. DENIKER (*Bulletins de la Société d'Anthropologie de Paris*, 1897, fascicules 3 and 4), in a paper of considerable length, briefly mentions the characteristics of the inhabitants of the various districts of Europe. If three variants (cephalic index, measurement of stature, and colour of skin and hair) be each classified under three headings, twenty-seven combinations may result: as a matter of fact only six occur in considerable numbers, while four more in lesser numbers. The conclusion

that only six primary races (excluding Turks, &c.) inhabit Europe, with four secondary, the latter in smaller numbers and probably due to mixtures of the primary. These races he characterises and names:

(1) Blond, dolichocephalic, very tall ..	North-western race.
(2) Blond, sub-dolichocephalic, short	Eastern race.
(3) Brown, very dolichocephalic, very short	Ibero insular.
(4) Brown, very brachycephalic, short	Western race.
(5) Brown, sub-dolichocephalic, tall..	Atlanto-Mediterranean.
(6) Brown, brachycephalic, tall ...	Adriatic.

The four secondary races:

(α) Blond, mesocephalic, tall ...	Eastern Prussia.
(β) Blond, mesocephalic, very short...	Sweden.
(γ) Medium, sub-dolichocephalic, tall	Ireland, Belgium.
(δ) Auburn, sub-brachycephalic, medium	Holland to Bavaria.

THE first number of a new volume of *The Naturalist*, that old-established and admirable little monthly journal of natural history for the north of England, marks the disappearance of its former slate-grey wrapper and the substitution of a pink one, together with sundry improvements in type and setting, and the introduction of paper better adapted for illustrations. Altogether the editors are to be congratulated on the changes they have brought about.

WE have received from Messrs. Carl Zeiss, of Jena, a catalogue of microscopes and one of photographic objectives. The former does not describe any new kind of instrument, but in the latter an interesting feature is the new "Planar" lens. It is claimed that, with this, objective enlargements can be obtained of microscopic sections up to 100 diameters, so that it should prove extremely useful to botanists and others whose preparations demand the use of a lens having a large field and great covering power.

THE additions to the Zoological Society's Gardens during the past week include a Dingo (*Canis dingo*, ♂) from Australia, presented by Mr. D. R. McDowall; a Long-legged Buzzard (*Buteo ferox*), a Kestrel (*Tinnunculus alaudarius*), captured in the Red Sea, presented by Mr. J. Kilpatrick; a Golden-naped Amazon (*Chrysotis auripalliata*) from Central America, presented by Mr. Gambier Bolton; two Red Ground Doves (*Geotrygon montana*) from South America, presented by Lady Blake; a Dinker Bok (*Cephalophus grimmi*) from West Africa, presented by Mr. L. H. Nott; a Salvadore's Cassowary (*Casuarius salvadori*) from New Guinea, a Salvin's Amazon (*Chrysotis salvini*), a Blue and Yellow Macaw (*Ara ararauna*), a Red and Yellow Macaw (*Ara chloroptera*) from South America, deposited; two Black Larks (*Melanocorypha peltoniensis*) from Siberia, purchased; two Axis Deer (*Cervus axis*, ♀ ♀), a Pink-headed Duck (*Rhodonessa caryophyllacea*, ♂), an Indian Crow (*Corvus splendens*), four Spotted Turtle Doves (*Turtur suratensis*), two Brown-headed Gulls (*Larus brunneicephalus*) from India, received in exchange.

OUR ASTRONOMICAL COLUMN.

PLANETARY RELATIONS.—In *Comptes rendus*, of January 17, M. Émile Anceaux gives a note on the four great planets, and some new deductions relating to them. The four great planets—Jupiter, Saturn, Uranus, and Neptune—possess between them more than 99/100 of the known planetary mass; whilst Jupiter and Saturn alone have a total mass greater than 9/10 of this. It seems natural, then, to consider the system of these four planets as a world apart and independent of the other planets relatively small, and separated by a band of telescopic planets smaller still. The author considered, therefore, whether, by reason of their importance, the masses of the four great planets would not have some influence upon their distribution with respect to their distances from the sun. Some of the most interesting deductions are as follows:—

The masses of Jupiter and Saturn are inversely proportional to the squares of the major axes of their orbits.

The mass of Jupiter is to the sum of the masses of Uranus and Neptune as the inverse square of the major axis of Jupiter's orbit is to the sum of the inverse squares of the major axes of Uranus and Neptune.

The mass of Jupiter is to the sum of the masses of the four planets as the inverse square of Jupiter's major axis is to the sum of the inverse squares of the major axis of the four planets.

The mean moments of inertia of Jupiter and Saturn referred to the sun are equal to each other.

The mean acceleration of the solar attraction on Jupiter is to the sum of the mean accelerations produced upon Uranus and Neptune as the mass of Jupiter is to the sum of the masses of Uranus and Neptune.

The reason of this harmony may be in the conditions of stability of the system, or in the circumstances which prevailed at the formation of the planets. If this last cause be possible, the study of these relations would not fail to throw some light upon the cosmogony of the solar system.

U PEGASI AND SHORT-PERIOD VARIABLES.—The telescopic variable known as U Pegasi, which was discovered by Chandler in 1894, has for a long time been thought to have the shortest period of all variable stars, but observations made at the Harvard College Observatory go to prove that this is not the case.

Prof. Pickering, in *Circular* No. 23, from the above Observatory, gives the results of the observations made by Mr. O. C. Wendell with the polarising photometer, and states that the discrepancies between various observers, as to the period of the star, made it desirable to determine the true form of the light curve photometrically.

Mr. Wendell began his observations on December 28 of last year, using, as comparison, the star + 15°·4916, mag. 8·90, which is only 15′ distant. From 2784 settings of the photometer he constructed a light curve, from which it soon became evident that alternate rather than successive minima were alike; the magnitudes at principal and secondary minima being 9·90 and 9·75 respectively. The light curve thus drawn, closely resembles in form that of β Lyræ, having nearly equal maxima, with magnitudes of about 9·30, and a period of 8h. 59m. 41s., the secondary minimum occurring nearly midway between the two primaries.

This period, it will be seen, is considerably different from that of 5h. 32m. 15s., as given by Mr. Chandler; but Prof. Pickering points out that, taking either value, the phases recur at nearly the same times every three days. If we neglect the difference between the primary and secondary minima, reduce the half-period to fractions of a day, and multiply it by 16, we obtain the product 2·99824d., or very nearly three days. If we multiply the period 5h. 32m. 15s. by 13, we obtain 2·99948d., or very nearly the same quantity. Accepting this new result, it appears that U Pegasi is no longer the variable star having the shortest period known. This position appears to be held by the variable ω Centauri 19, discovered by Prof. Bailey, who finds its period to be 7h. 11m. Although U Pegasi can no longer be regarded as an example of that peculiar class of short-period variables, having a single maximum in which the decrease is more rapid than the increase, this class is still represented not only by S. Antliæ, but by ω Centauri 24, which Prof. Bailey finds to decrease twice as rapidly as it increases, while ω Centauri 45 increases at least five times as fast as it diminishes.

WINNECKE'S COMET, *a* 1898.—The ephemeris of this comet is continued in the *Astronomical Journal* (No. 425) from February 7 to March 31, but for the purpose of observation it will suffice to give positions as far as the end of February; for after then the comet will be too near the sun to be conveniently observed.

Ephemeris for Greenwich Midnight.

1898.	App. α	App. δ	log Δ
	h. m. s.	° ′ ″	
Feb. 7·5 ...	17 54 3·34 ...	−12 1 18·5 ...	0·1457
9·5 ...	18 4 0·23 ...	21 40·1	
11·5 ...	14 2·88 ...	40 49·7 ...	0·1400
13·5 ...	24 12·71 ...	−12 58 42·2	
15·5 ...	34 28·36 ...	−13 15 12·5 ...	0·1356
17·5 ...	44 49·18 ...	30 15·4	
19·5 ...	18 55 14·35 ...	43 47·1 ...	0·1326
21·5 ...	19 5 43·16 ...	−13 55 43·1	
23·5 ...	16 14·76 ...	−14 6 0·8 ...	0·1310
25·5 ...	26 48·40 ...	14 36·4	
27·5 ...	19 37 23·22 ...	−14 21 28·2 ...	0·1307

ASTRONOMICAL ANNUAL FOR 1898.—We have just received a copy of the sixty-fifth *Annual* of the Belgian Royal Observatory for 1898. The volume is similar in character to the many astronomical annuals published on the continent, giving in calendar form the most important astronomical events of the present year, and in addition geographical data referring chiefly to Belgium. Besides these there is a detailed description of the Royal Observatory at Uccle, together with the instruments and the observations made at the observatory in 1897.

SPECTRUM RESEARCHES OF η AQUILÆ.—Prof. A. Belopolsky has recently completed a new series of photographs in connection with the spectrum of η Aquilæ; and his paper on "Researches on the Spectrum of the Variable Star η Aquilæ" appears in the *Astrophysical Journal*, December 1897. In all, twelve photographs were taken corresponding to the different phases of brightness, and by an "iron comparison" on each photograph, it has been possible to determine the velocity of the system wlth respect to the sun.

The spectrum of η Aquilæ is remarkably like that of the variable star δ Cephei, belonging to a group of which γ Cygni is the type; therefore some of the principal iron lines contained in its spectrum have been utilised in making the measures.

From these measures, the author finds the motion of the system $= -1{\cdot}85$ geographical miles, and from the curve of velocities in the line of sight he concludes "that the times of minimum brightness and the times for which the velocity in the line of sight is zero do not coincide. For this reason the changes in the brightness of the star cannot be explained as the result of eclipses, and some other explanation must be sought." It is very remarkable that Prof. Belopolsky found this was also the case with the variable star δ Cephei.

A SIXTH edition of Mr. Thynne Lynn's handy little book on "Remarkable Comets" has just been published by Mr. Edward Stanford. The information in the book is completely up to date, even the observed return of Winnecke's comet, first seen on the present visit on January 2, being recorded. Encke's comet (period $3\frac{1}{3}$ years) may be expected shortly, and in the summer, Wolf's comet (period $6\frac{3}{4}$ years) should pay us a visit.

THE REFRACTION OF ELECTRIC WAVES.[1]

TWO years ago, Prof. Bose, in a communication to the Asiatic Society of Bengal, described some new devices for dealing with electric waves, which did much to bridge over the gulf between electric waves and light waves. One of these was the employment of nemalite, a fibrous variety of brucite, which has the valuable property of absorbing electric waves vibrating in a certain plane, and transmitting all waves at right angles to that plane. It thus could be made to do for electric radiation what a plate of tourmaline does for light, except that the directions of absorption and transmission are reversed. Nemalite is therefore a very convenient polariser and analyser of electric waves. Tourmaline also acts in the same manner (with planes reversed), but not to any extent comparable with the efficiency of nemalite. The apparatus was subsequently exhibited and worked before the Liverpool meeting of the British Association.

In the present papers, Prof. Bose describes some experiments on the refractive index of glass for electrical waves, carried out for the purpose of testing Maxwell's relation $K = \mu^2$, which maintains that the specific inductive capacity for any substance equals the square of its refractive index.

This relation, originally a purely theoretical deduction from an unproved theory, has been gradually verified as our experimental resources gained in power to grapple with the various difficulties involved in the measurements. In the first place, the specific inductive capacity is not a fixed number, but varies with the nature of the electric charge, whether stationary or alternating, and, if the latter, with the frequency of the alternations. Strictly speaking, Maxwell's relation only applies to the refractive index for waves of infinite length, and determinations of the optical refractive index, *i.e.* the index for electromagnetic waves of about 1/50,000th of an inch, do not bear upon the question. It is only the long invisible electromagnetic waves which can be properly used to test the relation.

TESTING MAXWELL'S RELATION.

The specific inductive capacity of glass has been assigned various values ranging from 2·7 to 9·8. The optical refractive index μ is about 1·5. Prof. Bose determined μ for electric vibrations of a frequency of about 10^{10} vibrations per second. The apparatus used is shown in the diagram.

It closely resembles an optical apparatus. The radiator, consisting of two platinum beads with a platinum sphere between them, and fed by an induction coil, is enclosed in the square box. The rays pass through the diaphragm P to the semi-cylinder C of the glass to be investigated. This semi-cylinder is turned until the rays are totally reflected by the back surface. They are detected by the receiver R, containing metallic filings, whose resistance is reduced by the impact of the waves. The shielding of the receiver from strong radiations is a matter of some difficulty. Prof. Bose says:—

"Another troublesome source of uncertainty is due to the action of the tube which encloses the receiver. When a slanting ray strikes the inner edge of the tube, it is reflected and thrown

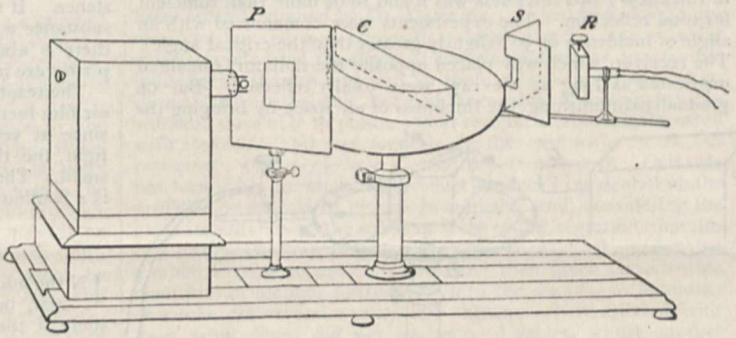

FIG. 1.—The electric refractometer: P, the plate with a diaphragm; C, the semi-cylinder of glass; S, the shield (only one shown in the diagram); R, the receiver.

on to the delicate receiver. Unfortunately it is difficult to find a substance which is as absorbent for electric radiation as lamp-black is for light. Lamp-black in the case of electric radiation produces copious reflection. I have tried layers of metallic filings, powdered graphite, and other substances, but they all fail to produce complete absorption. The only thing which proved tolerably efficient for this purpose was a piece of thick blotting paper or cloth soaked in an electrolyte. A cardboard tube with an inner layer of soaked blotting paper is impervious to electric radiation, and the internal reflection, though not completely removed, is materially reduced. No reliance can, however, be placed on this expedient, when a very sensitive receiver is used.

"After repeated trials with different forms of receiving tubes, I found a form, to be described below, to obviate many of the difficulties. Instead of a continuous receiving tube, I made two doubly inclined shields, and placed them one behind the other, on the radial arm which carries the receiver. The first shield has a tolerably large aperture, the aperture of the second being somewhat smaller. The size of the aperture is determined by the wave-length of radiation used for the experiment. It will be seen from this arrangement, that the rays which are in the direction of the radial arm, can effectively reach the receiver, the slanting rays being successively reflected by the two shields. With this expedient, a great improvement was effected in obtaining a definite reading.

"When the deviated rays are convergent, the receiver is simply placed behind the shields, at the focus of the rays. But when the rays are parallel, the use of an objective (placed behind the first shield) gives very satisfactory results. As objectives I used ordinary glass lenses; knowing the index from my experiments, I was able to calculate the focal distance for the electric

[1] Abstract of two papers communicated to the Royal Society by Prof. Jagadis Chunder Bose, M.A., D.Sc., Calcutta: "On the Determination of the Indices of Refraction of various Substances for the Electric Ray," and "On the Influence of the Thickness of Air-Space on Total Reflection of Electric Radiation."

ray. This is of course very different from the focal distance for the luminous rays. I at first used a lens of 6 cm. electric focal distance, but this did not improve matters sufficiently. I then used one with a longer focus, *i.e.* 13 cm., and this gave satisfactory results."

The value obtained for μ was 2·04, while the optical refractive index for the D line was 1·53. According to Maxwell's relation, the specific inductive capacity K should therefore be $4·16 = \mu^2$, a value well within the extremes of 2·7 and 9·8 mentioned above. It is interesting to note that the refractive power of glass is higher for these electro-magnetic waves than for light, and that ordinary lenses must therefore converge these waves to a shorter focus. Hence the small dimensions of Bose's apparatus.

Total Reflection of Electric Waves.

These and some of the earlier experiments were repeated with two semi-cylinders separated by an air-space, and the thickness of air necessary to produce total reflection was determined. In optics, a very thin film of air suffices. In the case of electro-magnetic waves as produced in the laboratory, the thickness is found to reckon by several millimetres.

Two semi-cylinders of glass, with a radius of 12·5 cm., were placed on the spectrometer circle. The plane faces were separated by a parallel air-space. The radiator was placed at the principal focus of one of the semi-cylinders; the rays emerged into the air-space as a parallel beam, and were focussed by the second semi-cylinder on the receiver placed opposite the radiator.

The two semi-cylinders were separated by an air-space 2 cm. in thickness; this thickness was found to be more than sufficient for total reflection. The experiments were commenced with an angle of incidence of 30° (slightly greater than the critical angle). The receiver, which was placed opposite the radiator, remained unaffected as long as the rays were totally reflected. But on gradually diminishing the thickness of air-space by bringing the

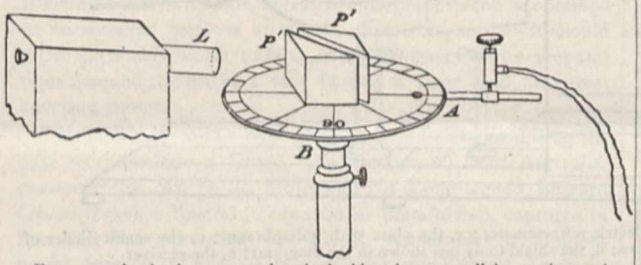

FIG. 2.—L is the lens to render the incident beam parallel; P, P', are the right-angled isosceles prisms; A and B are the two positions of the receiver. The receiver-tube is not shown in the diagram.

second semi-cylinder nearer the first (always maintaining the plane surfaces of the semi-cylinders parallel), a critical thickness was reached when a small portion of the radiation began to be transmitted, the air-space just failing to produce total reflection. The *beginning* of transmission could easily be detected and the critical thickness of air determined with tolerable accuracy. The slight discrepancy in the different determinations was due to the unavoidable variation of the sensitiveness of the receiver. When the thickness of air was reduced to 14 mm. the receiver began occasionally to be affected, though rather feebly. But when the thickness was reduced to 13 mm. there was no uncertainty; a measurable, though small, portion of the radiation was now found to be always transmitted.

With an angle of incidence of 60° the minimum thickness for total reflection was found to be between 7·6 mm. and 7·2 mm. The minimum effective thickness is thus seen to undergo a diminution with the increase of the angle of incidence.

The author also determined the influence of wave-length, using three different radiators.

The following method of experimenting was adopted as offering some special advantages. If a cube of glass be interposed between the radiator and the receiver placed opposite to each other, the radiation striking one face perpendicularly would be transmitted across the opposite face without deviation and cause a response in the receiver. If the cube be now cut across a diagonal, two right-angled isosceles prisms will be obtained. If these two prisms were now separated slightly, keeping the two hypothenuses parallel, the incident radiation would be divided into two portions, of which one portion is transmitted, while the other portion is reflected by the air film in a direction at right angles to that of the incident ray, the angle of incidence at the air-space being always 45°. The transmitted and the reflected portions would be complementary to each other. When the receiver is placed opposite to the radiator, in the A position, the action on the receiver will be due to the transmitted portion; but when the receiver is placed at 90°, or in the B position, the action on the receiver will be due to the reflected portion. The advantage of this method is that the two observations for transmission and reflection can be successively taken in a very short time, during which the sensitiveness of the receiver is not likely to undergo any great change. In practice three readings are taken in succession, the first and the third being taken, say, for transmission and the second for reflection.

When the prisms are separated by a thickness of air-space greater than the minimum thickness for total reflection, the rays are wholly reflected, there being no response of the receiver in position A, but strong action in position B. As the thickness is gradually decreased below the critical thickness, the rays begin to be transmitted. The transmitted portion goes on increasing with the diminution of the thickness of air-space, there being a corresponding diminution of the reflected component of the radiation. When the thickness of the air-space is reduced to about 0·3 mm., no reflected portion can be detected even when the receiver is made extremely sensitive. The reflected component is thus practically reduced to zero, the radiation being now entirely transmitted; the two prisms, in spite of the breach due to the air-space, are electro-optically continuous. This is the case only when the two prisms are made of the same substance. If the second prism be made of sulphur, or of any other substance which has either a lower or a higher refractive index, there is always found a reflected portion even when the two prisms are in contact.

The results obtained show that the effective thickness of the air-film increases with the wave-length. This was to be expected, since at very small wave-lengths, such as those of ordinary light, the thickness required for total reflection becomes very small. The brilliant reflection in the crack of a pane of glass is a familiar example.

PALÆOLITHIC MAN.[1]

IN the address of last year the evidence for the existence of man in the Tertiary period was reviewed, and although some of the evidence was very cogent, yet in no case did it amount to a proof, such as is necessarily demanded before so great an antiquity can be accepted for the human race. On the other hand, the presence of man in Quaternary times has long since been proved by the presence of many undoubted flint implements, in cave and river deposits of Pleistocene age and in relation with the bones of the mammoth and other extinct mammalia.

But other questions have now to be answered. What were the physical and intellectual peculiarities of the men who made the palæolithic implements? Have any parts of his skeleton yet been found?

Human bones and skeletons, more or less imperfect, supposed to be of Pleistocene age, have often been recorded both in this country and also on the continent of Europe; but a close investigation has, in most cases, proved them to be of much more recent origin, or has shown that there were very grave doubts as to their authenticity.

Much has been done to eliminate the doubtful records by such writers as Prof. Boyd Dawkins, M. Gabriel de Mortillet, and MM. Fraipont and Lohest; and consequently it is only necessary, at the present time, to consider the more important of these discoveries, and especially those which have been made within the last ten or fifteen years.

The famous Canstadt skull, described by Jaeger in 1835, is of uncertain origin, for when the mammalian remains, with which it was supposed to have been associated, were first described in the year 1700, no mention was made of this skull, and it is therefore by no means certain that it was associated with these extinct mammals. A new interest is awakened in this and some other of the earlier and unauthenticated remains of man by the discovery, within the last twelve years, of very similar skulls which are accepted as of palæolithic age. The skull discovered by M. Faudel in 1865, at Eguisheim on the Lower Rhine, is not unlike that from Canstadt, and is generally believed to be of

[1] Abstract of Presidential Address to the Geologists' Association, delivered at the Annual Meeting, February 4, by Mr. E. T. Newton, F.R.S.

Pleistocene origin, while that from Engis, described by Schmerling in 1833, is evidently much more recent. The origin of the well-known Neanderthal calvaria has always been doubtful, but its extraordinary heavy brows and low forehead gave it an interest at the time of its discovery, which is not lessened now that very similar skulls have been found under better authenticated conditions.

The Moulin Quignon jaw, which created so much discussion for a few years after its its discovery in 1863, has long since been put aside as lacking authenticity. But the jaw found by M. Dupont in the Naulette cave is accepted as that of a human being that lived with the mammoth. The human bones from the caves of Aurinac, Cromagnon, Frontal, Mentone, and some others were shown by Prof. Boyd Dawkins to be of neolithic age. The skeleton found at a depth of thirty-two feet at Tilbury Docks in 1883 was thought by Sir R. Owen to be of palæolithic age, but Mr. T. V. Holmes has shown that those gravels are of comparatively modern origin, and could not be older than neolithic.

A fresh impetus was given to the study of palæolithic man by the memoir of MM. Fraipont and Lohest, who in 1887 gave an account of two remarkable skeletons found at Spy, in the province of Namur, Belgium. These skeletons are accepted as of the same age as the extinct mammals, with the bones of which they were found associated. The skulls are of a low type, and one of them especially makes a very close approach to that from the Neanderthal, not only in the general form, but also in the great development of the brow ridges and the lowness of the forehead.

A single tooth from Pont Newydd cave, St. Asaph ; a piece of a skull from the brick-earth of Bury St. Edmunds, and parts of a skeleton from the high terrace-gravel of Galley Hill, Northfleet, are believed to be the only well-authenticated instances of palæolithic human remains yet found in Britain ; and it is only the skeleton last named that is sufficiently well-preserved to give any idea of the form of the skull or limb-bones. The Galley Hill skull is very long and narrow, the brow ridges are strongly developed and the forehead is low, but not so depressed as in the Neanderthal calvaria. Although it may not be correct to include the Java Pithecanthropus in the genus Homo, yet as it holds an intermediate position between the lowest type of human skull, —the Neanderthal—and that of certain apes, it cannot be neglected when considering the early progenitors of man and its position in the geological series at the beginning of the Pleistocene, if not in the Pliocene, is precisely the place where such an ancestor would be expected to appear.

Although the greater number of the human remains supposed to be of palæolithic age are now known to be of more recent origin or are not well substantiated, yet there are a few which may be accepted as in all probability representatives of the men who made the palæolithic implements. In the latter category may be placed the skeletons from Spy and that from Galley Hill, as well as the jaw from Naulette and the piece of skull from Bury St. Edmunds. The Eguisheim skull and a few other remains found on the continent of Europe should perhaps be included with these. The famous calvaria from Neanderthal and Canstadt are among the remains of uncertain origin, but, on account of their resemblance to the Spy skulls, are supposed to be of the same age, and to belong to the same race.

If we accept the Spy, and other skeletons, as the remains of the men who made the palæolithic implements, what do they tell us of the mental and physical condition of those early progenitors of mankind ? As a gauge of intellectual capacity, we have to confess that their skulls tell us far less than do the relics of their handiwork.

Prof. Huxley's dictum regarding the Spy men was that "the anatomical characters of their skeletons bear out conclusions which are not flattering to the appearance of the owners." They were short and powerful, but must have walked with a bend at the knees. Their skulls were depressed, with strong brow ridges and lower jaws of brutal depth. The Neanderthal skull has been said by the same authority to be the most apelike of human crania yet discovered. At the same time it is highly probable that these palæolithic men were not less intelligent than some of the savage races living at the present day, for their brain capacity seems to have been as great as that of average Hottentots and Polynesians ; and with an equal volume of brain we may presume there was an equal intellectual power. Moreover, men of no mean intellectual capacity are known to have possessed skulls of the Neanderthal type.

It may be doubted whether we are right in regarding the Neanderthal type of skull as typical of the palæolithic race, for other skulls referable to this period are less marked in character, and appear to indicate a greater range of form within the race than has usually been supposed. At present we have too few examples to allow of any definite deductions being made ; but what we do know, points to the palæolithic race having had long skulls (dolichocephalic), in which particular they approach the neolithic race ; but differ from them in the greater development of their brow ridges, in their lower and more receding foreheads, and in their shorter stature.

That palæolithic man possessed considerable mechanical skill, is shown by the well-fashioned flint implements that have been found ; and the striking outlines of animals and men incised by him on pieces of ivory and bone, as well as the clever carvings in similar material, is evidence of no little artistic ability. And further, if we bear in mind how little of his work has been preserved to us, and how much that was perishable must have entirely disappeared, we shall be inclined to credit our palæolithic ancestors with a somewhat higher social status than we have usually supposed them to have enjoyed.

ALCOHOL IN RELATION TO MICROBIAL DISEASES.

THE effect of alcohol on the artificial production of immunity in animals in regard to rabies, tetanus, and anthrax has been recently studied by Dr. Deléarde. It has been frequently observed that persons addicted to alcohol suffer, as a rule, far more severely from the effects of microbial infections than normal individuals, and not long ago, in 1896, Abbot, of Philadelphia, showed that pathogenic bacteria, incapable of killing healthy animals, were able to produce fatal results in animals intoxicated with alcohol. This was found to be the case with the *B. coli communis*, the *staphylococcus*, and the *streptococcus*. Deléarde has turned his attention to the effect produced by alcohol on the artificial prevention of disease in animals ; and, considering the great importance of the subject, it is to be regretted that his conclusions are drawn from so few experiments. It appears that a rabbit vaccinated against rabies, and then given considerable quantities of alcohol (introduced into the œsophagus by means of a tube) for several weeks, and subsequently inoculated with fresh rabid virus, did not succumb to rabies, whilst another rabbit treated similarly, only omitting the doses of alcohol, died of rabies. In this case the alcohol had apparently preserved the animal's immunity to rabies. On the other hand, a rabbit dosed with alcohol during the course of the anti-rabic inoculation, obtained absolutely no immunity from rabies ; whilst a rabbit, first of all intoxicated and then vaccinated, acquired immunity to rabies as long as the supply of alcohol was stopped as soon as the vaccinations were commenced. In the case of tetanus, however, if the anti-tetanic inoculations were succeeded by the administration of alcohol, the animal lost all its artificially acquired immunity to the disease, and invariably succumbed to tetanus infection ; again, if treated with alcohol during the vaccinations, it only acquired immunity to tetanus with difficulty, and if first of all intoxicated and then vaccinated, the animal obtained immunity as long as the supply of alcohol ceased when the vaccinations began. As regards anthrax, it is almost impossible, it appears, to protect animals from this disease if they are treated with alcohol during the vaccination period. On the other hand, animals first intoxicated and then vaccinated can acquire immunity providing, as in the other cases mentioned above, the alcohol is stopped as soon as the vaccinations are commenced, but they suffer considerably more during the process than animals which have received no alcohol. The experimental results obtained with rabies bear out the observations which have been made with regard to intemperate persons and the anti-rabic treatment in various Pasteur Institutes, and a very striking instance of the ineffectuality of the treatment in such a case was recorded only this year. An habitual drunkard was bitten by a mad dog, as was also a child by the same dog ; both underwent precisely the same anti-rabic treatment. The man during the whole time continued to drink to excess, and subsequently died of rabies, whilst the child remained perfectly well. In the case of the administration of antitoxins it would appear, therefore, highly desirable that at least during the vaccinations alcohol should be prohibited.

STRIDULATION IN SOME AFRICAN SPIDERS.[1]

THE spiders which form the subject-matter of this paper, are probably best known by the comprehensive title "Mygale." They are also sometimes called crab-spiders, presumably from the great size to which most of the species attain; sometimes bird-eating spiders, from their alleged propensity for capturing and devouring small birds, a propensity which suggested to Lamarck the generic term *Avicularia*, still in use for one of the South American genera. But during the last fifty years our knowledge of this group has increased by leaps and bounds; the genus has expanded into a family, represented by numbers of genera which are rapidly becoming more and more accurately defined and classified.

Apart from their large size and usually heavy build, these spiders, referred to a family variously termed *Mygalidæ*, *Theraphosidæ* and *Aviculariidæ*, may be recognised from the vast majority of other spiders by possessing two pairs of lung-sacs, and by the circumstance that the mandibles or jaws project horizontally forwards; while the fang closes almost longitudinally backwards.

So far as habits are concerned, it may be added that none of the species spread nets for the capture of prey. Most of them live on the ground beneath stones, or in deep burrows which they excavate in the soil, and line with a layer of tough silk to prevent the infall of loose particles of earth or sand. At nightfall the spiders may be seen watching at the entrance of their burrows for passing insects, and during the breeding season the females are to be found at its further extremity mounting guard over their egg-cocoon. Other species again live in trees, and spin a silken domicile either between forked branches or in the hollow trunk, or in large leaves rolled up for the purpose. There is no doubt that their food consists almost wholly of insects of various kinds. Nevertheless cases are on record of the destruction of small reptiles, mammals, and birds by these monstrous spiders.

The discovery of stridulatory organs in the members of this family dates back to the year 1876, when Prof. Wood-Mason came across one in an Assamese species now known as *Musagetes stridulans*. Since that year organs like that which he described have been found, not merely in the solitary species as he and most of his successors appear to have thought would be the case, but in a great number of genera ranging from India to Queensland.

In some of the African *Theraphosidæ* Mr. Pocock has had the good fortune to discover two stridulating organs, which are not only quite different from each other, but also quite different from those possessed by the genera inhabiting Tropical Asia. One of these organs occurs in the genus *Harpactira*, the common "Mygale" of Cape Colony. It occupies the same position as the analogous organs existing in the Oriental species, being situated between the mandible and the maxilla. The other, on the contrary, found in *Phoneyusa* and its allies, is placed between the maxilla and the basal segment of the first leg.

What is to be said respecting the function of these organs, and what evidence, it may be asked, can be adduced in support of the view that they subserve stridulation? To this question the answer must be that so far as the African species are concerned there is no direct evidence based upon observation of the living animal to show what part they play in the spider's economy. But that their true and probably sole function is the emission of sound, is so strongly supported as to reach practical certainty from what is known of the function of the analogous organ detected by Wood-Mason in the Assamese genus *Musagetes*.

Observations have shown that the function of the instrument in spiders of this genus is to emit sound, so it may be concluded that organs constructed upon the same principle, and occupying the same or similar positions, will in all probability be found to perform the same office; and no further basis need be sought for the belief that the African spiders, *Harpactira* and *Phoneyusa*, and their allies, can stridulate as well as their Oriental relations.

What now is the use to the spider of the sounds that these organs give forth? It has been suggested that, like the call of the cicada and the chirrup of the cricket, they have a sexual significance, and serve to inform one sex of the whereabouts of the other. This belief, however, has no foundation in fact; for, in the first place, there is not a particle of evidence that these spiders possess an auditory sense; and, in the second place, these stridulatory organs are equally well developed in the males and females, and are not, like the sexual stridulating organs known in other groups, confined to the male, or at all events better developed in that sex than in the female. Moreover, they appear in the young at an early age, and become functionally perfected long before the attainment of sexual maturity. So the supposition that they act as a sexual signal may be regarded as unsupported by evidence.

As a matter of fact, the true key to their function is supplied by the behaviour of the living spiders. From observations by Mr. Peal and Mr. E. W. Pickard-Cambridge, it appears that the spiders emit the sound when on their defence and acting under the stimulus of fear or anger, in exactly the same way as the rattlesnake makes use of its rattle. Mr. Pocock points out that the only explanation that has been suggested touching the function of the snake's rattle is that it serves as an advertisement of the whereabouts of the poisonous reptile, so that it may be avoided by enemies which might otherwise inadvertently injure it. Similarly poisonous and noxious insects are decked with warning colours, so that they may be readily recognised and not slain in mistake for harmless or edible species. If this be the true explanation of the so-called warning coloration of the insects in question, and of the whirring noise made by the rattlesnake, there seems to be no reason to doubt that the same significance is to be attached to the stridulation emitted by the peculiar organs recently discovered in the great African spiders.

[1] Abridged from an article by Mr. R. I. Pocock in the *Zoologist*, January 15.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Professor of Mineralogy has been granted the sum of 50*l.* a year for five years, from January 1, to assist in the purchase of specimens and apparatus for his department.

Sir Archibald Geikie, F.R.S., will deliver the Romanes Lecture at the Sheldonian Theatre on Wednesday, June 1. His subject will be "Types of Scenery, and their Influence on Literature."

The Junior Scientific Club held its first meeting for this term on Wednesday, February 2. Mr. A. W. Brown exhibited and described some life specimens of *Aphrodite* and two specimens of the unsegmented Cestode, *Amphilina*. Mr. G. W. S. Farmer read a paper on "Training." Mr. A. E. Boycott (Oriel) is President this term.

CAMBRIDGE.—The Special Board for Biology have re-elected Dr. Arthur Willey to the Balfour Studentship for one year. The same Board have nominated Mr. K. R. Menon to occupy the University's table at the Naples Zoological Station.

Mr. W. W. Skeat, District Magistrate of Larut, Perak, has offered to the Ethnological Museum a collection of exceptional interest and scope, illustrative of the fast-disappearing indigenous crafts of Selangor and its neighbourhood.

Dr. G. Elliot Smith, advanced student of St. John's College, has been approved for the Certificate of Research. His original dissertations relate to the origin of the Corpus Callosum and to cerebral anatomy.

Mr. H. E. Durham, M.A., M.B., has been appointed one of the representatives of the University at the Madrid Congress of Hygiene, to be held in April next.

Sir E. Frankland has been appointed an Elector to the chair of Chemistry, Sir W. Turner an Elector to the chair of Anatomy, Prof. D. Oliver to the chair of Botany, Sir A. Geikie to the Woodwardian Professorship, Dr. Hugo Müller to the Jacksonian Professorship, Mr. L. Fletcher to the chair of Mineralogy, Lord Walsingham to the chair of Zoology, Lord Kelvin to the Cavendish Professorship, Sir W. H. White to the chair of Mechanism, Prof. Schäfer to the chair of Physiology, Lord Lister to the chair of Surgery, and Dr. J. F. Payne to the chair of Pathology.

IN the last paragraph of the Speech from the Throne, read at the opening of the new Session of Parliament, on Tuesday, it was announced that measures for the constitution of a teaching University for London, and for dealing in part with the subject of secondary education, would be brought forward "in case the time at your disposal should permit you to proceed with them." As several other measures are in the same case, the outlook is not

very hopeful for either of the educational measures referred to, and unless the Government seriously pushes them forward another Session will pass without the much-needed legislation. The measures are urgently pressing for consideration, and they ought not to be permitted again to lapse, as they have done before.

THE *Lancet* announces that the Senate of Glasgow University have appointed Prof. Michael Foster to be Gifford Lecturer in the Glasgow University for the sessions 1898-99 and 1899-1900, in succession to Prof. Bruce, whose term of office expires with the current session.

THE students of Finsbury Technical College will hold their annual conversazione at the College on February 18. Prof. S. P. Thompson has promised to lecture on "Wireless Telegraphy." Mr. Ives will give an exhibition of colour photography, and glow-lamp making will be demonstrated by Mr. Robertson.

AN illustrated article on technical education in the United States, together with some other statistics relating to the occupations of students who have passed through certain representative American institutions, appears in the January *Record of Technical and Secondary Education*. Among other articles we notice one on technical instruction given to fishermen in Aberdeenshire and Essex.

THE following item of information from the tenth annual report (1897) of the Clerkenwell Public Library, London, is worth recording:—"Scientific works are very largely circulated. Biology, including evolution and methods of scientific research, is a very popular subject, the sixty-eight works which the library contains on this topic having been issued over 2800 times within recent years. In this subject two copies of Darwin's 'Descent of Man' have been issued nearly 200 times, a record which is exceeded only by the most popular novels."

DR. W. B. BENHAM, M.A., New College, Oxford, has been elected to the chair of Biology in the University of Otago, and will leave England at the end of March. Dr. Benham has for the past seven years held the post of "Aldrichian Demonstrator in Comparative Anatomy" at Oxford, and as such has acted as assistant to Prof. Lankester, to whom he was previously assistant in University College, London. For ten years Dr. Benham has been Lecturer in Animal Biology at Bedford College for Women, London; and was appointed Examiner in Zoology in the University of London last year. His original researches are embodied in some thirty papers: these are mainly concerned with the anatomy and classification of the Oligochæte Annelids; he has also contributed the article "Polychæta" to the Cambridge Natural History, and published an account of the Brain of the Chimpanzee "Sally," the Blood of *Magelina*, the Anatomy of *Phoronis*, &c.

AT the annual congress of the South-eastern Union of Scientific Societies, held at Tunbridge Wells last May, Mr. S. Atwood, of New Brompton Natural History Society, drew attention to the difficulty of securing rooms for meetings in some of the smaller towns, even where suitable rooms belonging to Technical Institutes existed, which the Societies would be willing to hire. On the proposition of Mr. Pankhurst, of Brighton, the following resolution was passed unanimously:—"That it be an instruction to the Council of this Union to consider the question of how far buildings erected under or used for the purposes of the Technical Institution Acts may be made available for the use of local scientific societies." Since then the Council have had the matter under consideration, and have communicated with Colonel Holland, of the Kent County Council, who has replied to the effect that the Technical Education Committee have no control over Technical Institutes, and the local authority must be applied to for the permission desired. Colonel Holland adds: "If that authority wishes to help, it can do so without any permission from the Technical Education Committee." It appears, therefore, that no legal obstacle exists to the use of rooms belonging to or used for the purposes of technical instruction when such rooms are not needed for their special objects.

IN a paper on the teaching of science in secondary schools, read on January 12, in Birmingham, before the Friends Guild of Teachers, Dr. Bevan Lean deprecated children beginning systematic work in science or entering the laboratory before the age of thirteen or fourteen, and urged that before boys (and girls) were allowed to learn chemistry or physics they should possess at least a sound knowledge of arithmetic. It was emphasised that the teaching of science in schools should not be in any sense commercial, nor should its aim be the mere awakening of interest or even the gain of knowledge: it was valuable solely as a means of mental culture, because through it could best be stimulated the power of accurately ascertaining facts and drawing correct inferences. It was urged that this educational value could best be obtained through chemistry, because chemistry admitted of quantitative experiment within the time of a short class and of an infinite variety of experiment; and, moreover, it so frequently touched matters and operations that were familiar to children in every-day life. The scientific method of investigating nature must be illustrated, and that necessitated placing the children in the attitude of discoverers, so that they could proceed from the known to the unknown, and not from the simple to the complex. Experience showed, too, that the problems on which great investigators were engaged 100 years ago were suitable for the modern schoolboy. This did not mean that we could build up the whole of our science for ourselves. The time for books and lectures would come, but at school it was far more important that boys and girls should be placed in direct contact with facts in the attitude of inquirers. It was a necessary corollary that the teacher ought to have a knowledge of the history of his science, and that it would be a great advantage if he had himself carried on original research: at the least, he ought to have an inveterate habit of inquiry.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, January.—On the commutator groups, by Dr. G. A. Miller. This is a collection of eleven theorems, some of which are proved in the present paper. For proofs of the remaining theorems reference is made to the writings of Frobenius and Dedekind. Dr. G. A. Miller has also a paper, read before the Society at its December meeting, entitled "On the limit of transitivity of the multiply transitive substitution groups that do not contain the alternating group." This is a paper which contains three theorems and four lemmas bearing upon results recently given by Jordan and Bochert in *Liouville's Journal* and the *Mathematische Annalen* respectively.—Geometry of some differential expressions in hexaspherical coordinates, by Dr. V. Snyder, read at the Toronto meeting, is an appendix to the author's dissertation "Ueber die linearen Complexe der Lie'schen Kugel geometrie" (Göttingen, 1895). It gives an outline of differential geometry, and shows the application of it to the quadratic complex. Some results are, among the ∞^3 spheres which touch a given surface, there are ∞^2 which also cut a fixed sphere at a constant angle. These spheres either envelope another surface or are arranged in ∞^1 pencils, touching the surface along the curve of intersection with the sphere, which is then a line of curvature of the given surface (*cf.* Darboux, "Théorie des surfaces," vol. i. p. 257, who does not mention the exceptional case). The locus of the point-sphere in a spherical complex of degree n is a surface of degree $2n$, and contains the circle at infinity as an n-fold line. The surface of singularities of a quadratic spherical complex is a cyclide. The Dupin cyclide is the only surface that can be the complete envelope of a non-reducible special quadratic spherical complex. Numerous references are given to writers on the subject.—Dr. E. O. Lovett gives a useful abstract of some lectures by Sophus Lie, viz. "Vorlesungen über Differentialgleichungen mit bekannten infinitesimalen Transformationen" (edited by Dr. G. Scheffers, Leipsic, 1891).—Dr. Charlotte A. Scott, in a short note, commends a translation of Prof. Klein's "Vorträge über ausgewählte Fragen der Elementargeometrie," by Messrs. W. W. Beman and D. E. Smith.—The "Notes" and "New Publications" give their usual useful information.

Bulletins of the St. Petersburg Society of Naturalists, 1897 (xviii.), Nos. 2 and 3, February and March.—No. 2.—Geological excursion in North Russia, by Amalitzkiy.—Age of clay slates on the Upper Ulba, Altai, by von Petz.—Excursion to Crimea (botany), by Levandosvkiy.—On the part played by iron on the motions and the degeneration of cells when they are submitted to the bactericidal action of the immunised serum, by Sakharoff.—On fertilisation in *Juglans regia* and *J. nigra*, by Navashin.

No. 3.—On the relations between the Upper Tertiary in Russia, Rumania, and Austro-Hungary, by Andrusoff.—Journey to East Persia (geo-botany), by Korovyakoff.—All these communications are fully summed up in French or German.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 20.—"The Homogeneity of Helium." By William Ramsay, Ph.D., LL.D., Sc.D., F.R.S., and Morris W. Travers, B.Sc.

About a year ago, a paper by Dr. Norman Collie and one of the authors (W. R.) was published, bearing the title "The Homogeneity of Helium and of Argon." In that paper (NATURE, 1896, p. 546) various reasons were adduced to show why an attempt to determine whether or no argon and helium are homogeneous was worth making. The results of the experiments at that time indicated that while it did not appear possible to separate argon into two portions of different densities, the case was different with helium. Samples were obtained after repeated diffusion which possessed respectively diffusion rates corresponding to the densities 2·133 and 1·874. It was there pointed out that these densities are not correct (although their ratio is probably not wrong), owing to the curious fact that the rate of diffusion of helium is too rapid for its density, *i.e.* it does not follow Graham's law of the inverse square root of the densities. These samples of gas also differed in refractivity, and the difference was approximately proportional to the difference in density.

Towards the end of the paper, the conjecture was hazarded that it was not beyond the bounds of possibility that the systematic diffusion of what we are accustomed to regard as a homogeneous gas, for example, nitrogen, might conceivably sift light molecules from heavy molecules. It is true that the fineness of the lines of the spectrum would offer an argument in favour of the uniformity of molecular weight; but still it is never advisable to assume any physical theory without submitting it to rigorous proof. And it was thought possible that the fractional diffusion to which helium had been subjected might have had the result of effecting such a separation; a separation, not of chemical species, but of molecular magnitude. The other and more ordinary explanation of the splitting of helium into fractions of different density is that helium must be regarded as a mixture of two gases, one lighter than the other.

Since the publication of the paper mentioned, Dr. A. Hagenbach has confirmed the possibility of separating helium into portions of two densities by diffusion; and the differences in density were practically the same as those observed in the laboratory of University College, London.

These experiments were made with somewhat over 200 c.c. of gas; but it was decided to make experiments of a similar kind, on a much larger quantity of helium.

An apparatus was therefore constructed, similar in principle to the one previously employed, but on a much larger scale.

The Fractional Diffusion of Air.

In order to test the working of the apparatus, a set of diffusions was carried out with air. After four rounds, comprising twenty-four diffusions, the light portion contained 17·37 per cent. of oxygen and the heavy portion 22·03. A fairly rapid separation was thus being effected considering the closeness of the densities of nitrogen and oxygen.

The Fractional Diffusion of Nitrogen.

A similar set of experiments was carried out with nitrogen, prepared by the action of solutions of ammonium chloride on sodium nitrite, in presence of copper sulphate. The gas was dried and passed over red-hot iron prepared by reduction of ferric oxide in order to remove any oxygen or to decompose any oxides of nitrogen which might be present. After thirty rounds, involving 180 operations, the "light" portion of the nitrogen, after purification by circulation over copper oxide, had not altered in density. It must therefore be concluded that nitrogen is homogeneous as regards the relative density of its individual molecules.

The Fractional Diffusion of Helium.

The first sample of helium employed was prepared from samarskite and clèveite. After seventeen rounds, involving 102 operations, the diffusion rates of the lighter and heavier portions were measured.

A fresh quantity of gas from clèveite was similarly treated.

The light gas from the first set of diffusions was then mixed with the light gas from the second set of diffusions and the mixture was re-diffused fifteen times, involving ninety operations. The density of the lightest portion of this helium was determined by weighing and found to be 1·988. The helium had, therefore, not been made sensibly lighter by re-diffusion. The mean of the two determinations may be taken as the true density of pure helium; it is 1·98. The refractivity of this sample measured against hydrogen and multiplied by the ratio between hydrogen and air, viz. 0·4564, gives 0·1238. This specimen of light helium of density 1·988 was placed in one of the refractivity tubes, and the lightest helium of the former preparation (density = 1·979) in the other. They had the same refractivity (1000 to 1004). The contents of No. 1, obtained from the mixture of light gases, had the density 2·030, showing that only a little heavier material had been withdrawn.

The lighter fractions of helium were then sealed up in glass reservoirs and stored. The heavier portions were placed in the diffusion apparatus and submitted to methodical diffusion.

After fifteen rounds (ninety operations) the heaviest fraction had density 2·275, the lightest 2·08. The refractivity of the heaviest gas was next determined and found to be 0·1327. This gas examined in a Plücker's tube showed brilliantly pure helium lines, but along with these the reds and green groups of argon. Calculating from the density of this gas it should contain 1·63 per cent. of argon according to the equation $1·961x+20y=2·275$. Calculating from the refractivity the percentage of argon should be 1·05, from the equation $1·245x+0·9596y=13·33$. A mixture of 99 per cent. of the purest helium and 1 per cent. of argon was made, and it showed the argon spectrum with about the same or with somewhat less intensity than the heaviest gas. Finally, the heavy gas was diffused to the last dregs, so that only about 0·5 c.c. remained undiffused; and this small residue, transferred to a Plücker tube, showed the argon spectrum with only a trace of the spectrum of helium. The yellow line and the bright green line were visible, but feeble. This spectrum was compared with that of a mixture of argon with a trace of helium, and nearly the same appearance was to be seen. With the jar in parallel and a spark gap interposed the blue spectrum of argon was equally distinct in both tubes; and, more important still, *there was no trace of any unknown line.* It appears, therefore, that helium contains no unknown gas, nor is it possible to separate it by diffusion into any two kinds of gas; all that can be said is that most minerals which evolve helium on heating also evolve argon in small quantity. This accounts for the difference in density observed in different samples of helium; and in one instance, viz. malacone, the amount of argon evolved on heating the mineral, though small, was much in excess of the helium, so far as could be judged by the spectrum.

We are disappointed in the result of this long research, because we had thought it not improbable that an element of density 10 and atomic weight 20 might prove to be the cause of the fact that different samples of helium possess different densities, according to the mineral from which they are extracted, and also of the separation of helium into portions of different densities by diffusion. We still regard it as by no means improbable that further research will lead to the discovery of the "missing" element.

Addendum.—Since this paper was written, Profs. Runge and Paschen, in a communication to the British Association in August of last year, have withdrawn their contention that helium is a mixture, or, perhaps more correctly stated, they now ascribe to helium the same complexity as that of oxygen, the spectrum of which may also be arranged in two series, each consisting of three sets of lines. As oxygen has not yet proved to be complex, the surmise that helium is complex therefore falls to the ground.

Chemical Society, January 20.—Prof. Dewar, President, in the chair.—A ballot for the election of Foreign Members was held and Profs. S. Arrhenius, P. Curtius, A. P. N. Franchimont, W. Körner, W. Markownikoff, N. A. Menschutkin, H. Moissan, W. Ostwald, F. M. Raoult, I. Remsen, W. Spring, L. J. Troost, P. Waage and J. D. van der Waals were subsequently declared duly elected.—The following papers were read:—The preparation of pure iodine, by B. Lean and W. H. Whatmough. Pure iodine is conveniently prepared by heating cuprous iodide in a stream of dry air at 220–240°; it melts at 112·5–114°.—Derivatives of bromtolylhydrazine, by J. T. Hewitt and F. G. Pope.—Researches on the terpenes. (1) On the oxidation of fenchene, by J. A. Gardner and G. B. Cockburn. On oxidising fenchene with dilute nitric acid, cis-camphopyric acid and its anhydride are formed. Turpentine hydrochloride, when oxidised with nitric acid, yields camphoric and camphopyric acids.—The action of alkalis on amides, by J. B. Cohen and C. E. Brittain. The authors have succeeded in pre-

paring a series of compounds, which probably have the constitution $NNaR.C.Me(OH)_2$, by the action of caustic alkalis on amides.—The formation of monomethylaniline from dimethylaniline, by J. B. Cohen and H. T. Calvert. Phenylnitrocarbinol acts violently upon dimethylaniline with formation of nitrosomethylaniline, benzylic alcohol and benzaldehyde and evolution of nitrogen.—Note on the aluminium-mercury couple, by J. B. Cohen and H. T. Calvert. A small quantity of chlorine is retained by aluminium, probably as oxychloride, when it is amalgamated with mercuric chloride.—Action of chloroform and alkaline hydroxides on the nitrobenzoic acids, by W. J. Elliott.

Geological Society, January 19.—Dr. Henry Hicks, F.R.S., President, in the chair.—On some gravels of the Bagshot district, by Horace W. Monckton. The author referred to his papers on gravels south of the Thames, published in the *Quart. Journ. Geol. Soc.* for 1892 (p. 29) and 1893 (p. 308), and gave some additional details. He suggested that the occurrence of stones which had been very little rolled or waterworn in gravels at certain localities, afforded evidence of the presence of ice in the water by which those gravels were deposited; and that the position of some sarsens which he described was due to the same agency. He gave details and exhibited photographs of a number of sarsens which he had seen *in situ*. In the discussion which followed the reading of the paper, the hypothesis advanced by the author was criticised unfavourably by several speakers, but others supported it.—On the occurrence of chloritoid in Kincardineshire, by George Barrow. The rock containing the chloritoid was first found *in situ* at the entrance to the little gully at the head of Friar Glen Burn, near Drumtochty Castle. It has since been observed at many places along a belt of country extending from the coast north of Stonehaven nearly as far as the North Esk. The rock is easily recognised by the presence of numerous white spots, which are always present and are larger than the chloritoid. The chloritoid and the spots vary in size, being largest when the rock is most crystalline (a schist), and smallest when it is least crystalline (a slate). The mineral appears as minute glistening scales in the schist, but in the slate it can be recognised only with the aid of the microscope. The optical characters were described, and shown to be identical with those of the mineral from the Ile de Groix, and with those of the ottrelite from Ottré and Serpont. An account of the methods adopted to obtain a pure sample was given. Several analyses were made, and it was proved that as the purification increased, the analyses approximated more and more closely to the analysis of the mineral from the Isle de Groix. The final result was as follows:—SiO_2 26·00, Al_2O_3 40·05, FeO 19 50, Fe_2O_3 5·05, MgO 2·88, loss on ignition 6·00; total, 99·48.—The annual general meeting of the Society will be held on Friday, February 18, at 3 p.m.

Linnean Society, January 20.—Dr. St. George Mivart, F.R.S., Vice-President, in the chair.—Mr. J. E. Harting exhibited a series of photographs of the grey seal (*Halichærus grypus*) at various ages, taken from life by Mr. Henry Evans, of Jura, on the Haskeir Rock, Outer Hebrides, to which place the animal resorts every autumn for breeding purposes. Some of the photographs showed the young thickly clothed with white hair, which is retained for several weeks after birth, but is gradually shed before the animal enters the water. Details of measurement and weight were given, and occasion was taken to review the status of the grey seal as a British species, and to indicate its known breeding stations in the British Islands.—Mr. W. J. H. McCorquodale exhibited a skull of a hartebeeste which was one among some fifty skulls of various ruminants he had recently received, all having their horns infested by the larvæ of *Tinea vastella*, upon the chrysalids of which he offered some remarks. The collection was from Nigeria, and was made by his brother the late Lieut. R. H. McCorquodale, 3rd Dragoon Guards, while doing duty as a special service officer in W. Africa. He further recorded the capture by his brother, in 1896, of a giraffe from the regions of the Benue River, north of Calabar, remarking that the specimen was the only one known from this region of Africa, and that its skull was now deposited in our national collection.—Mr. W. E. de Winton, who was present as a visitor, made some remarks on the geographical distribution of the giraffe in Africa, and traced the limits of the range of the northern and southern species as far as had been ascertained.—Dr. W. G. Ridewood read a paper on the larval hyobranchial skeleton of the anurous batrachians, in which were recorded observations made on twenty-one species belonging to nineteen genera.—Mr. R. H. Burne read a paper on the *porus genitalis* of the *Myxinidæ*, in which he concluded that the urogenital sinus present in the lampreys is in the *Myxinidæ* unrepresented, and that the ureters and genital pore open into an integumentary cloaca.

PARIS.

Academy of Sciences, January 31.—M. Wolf in the chair.—Note accompanying the presentation of the notice on the scientific work of H. Fizeau, by M. A. Cornu.—On the approximate development of the disturbance function, by M. H. Poincaré.—On the meteorological observatories of the Atlantic Ocean, by S.A.S. Albert, Prince of Monaco. Two centres of observation, at San Miguel and Flores, have been established in the Azores, and the results are regularly telegraphed to certain continental observatories. The observations from these two stations gives some fifty hours' warning to European ports of approaching depressions.—Remarks by M. Mascart on the preceding paper.—M. Cremona was elected a Correspondent in the Section of Geometry in the place of the late M. Brioschi.—Martial function of the liver in the Vertebrates and Invertebrates, by M. Dastre. The hepatic organ whenever present is always distinguished from the other tissues by the increased amount of iron it contains. Thus in the Crustacea the liver is rich in iron, containing four times as much as muscle, the blood and ovary containing practically none. In Molluscs (cephalopods) the hepato-pancreas contains, weight for weight, twenty-five times as much iron as any of the other tissues; in Lamellibranchs the ratio is about five to one, and the same for Gasteropods. The presence of this iron is independent of the metal in the blood, thus where copper is present in the blood as hæmocyanine, iron only is present in the hepatic tissue.—Observations of the periodical comet of Arrest, made at the Observatory of Rio de Janeiro with the 25 c.m. equatorial, by M. L. Cruls.—On some photographs of nebulæ obtained at the Observatory of Meudon, by M. A. Rabourdin.—Remarks on the preceding communication, and on the correct method of getting comparable images of the nebulæ, by M. J. Janssen. A telescope was specially designed for this work, of 1 metre aperture and 3 metres focal length. Owing to its very short focal distance this instrument is very valuable for observing and photographing very faintly luminous objects, especially nebulæ.—On the development of analytical functions for real values of the variables, by M. Painlevé.—On the systems of partial differential equations, analogous to systems of equations of the first order, by M. Jules Beudon.—On the relations between the infinitesimal elements of two homographic or correlative figures, by M. A. Demoulin.—On surfaces applicable to a surface of revolution, by M. A. Pellet.—On the decomposition of Θ-functions into factors, by M. G. Humbert.—On the most general monographic method resulting from the relative position of two superposed planes, by M. Maurice d'Ocagne.—On the permanent changes of form and breaking of metals, by M. G. A. Faurie. Test pieces of metals, submitted to longitudinal stress under certain conditions, develop nodal points at equal distances apart. These effects are not produced by bending or torsion.—On the flexion of thick bars, by M. Ribière.—Experimental study of the lustre of projectors of light, by MM. A. Blondel and J. Rey.—Study of some radiations by interferential spectroscopy, by MM. A. Perot and Ch. Fabry. By means of the interference apparatus described in previous papers, it is now shown that the green thallium ray is composed of one bright ray and of two others, more faint, situated towards the red. The bright green ray of mercury is also triple, two of these three lines being separated by only $\frac{1}{100}$th of the interval between the sodium lines. Some of the cadmium lines were also split up.—On the measurement of high temperatures by the interference method, by M. Daniel Berthelot. The method is based upon the fact that if the density of a gas is diminished to the same extent on the one hand by a rise of temperature, or on the other by a diminution of pressure, the index of refraction has the same value in both cases. The constant temperature required in these experiments was obtained by means of an electric furnace, composed of two spirals of platinum wire, jacketed with asbestos, by which any temperature up to 1000° C. could be steadily maintained.—On the composition of air at different places, and on the density of gases, by M. A. Leduc. After discussing the errors inherent to the methods of Dumas and Regnault, figures are given for the composition by weight of air taken at various places and under varying conditions of wind. The author notes that in comparing the densities of various gases with oxygen the figures obtained by himself and Lord Rayleigh agree very exactly, but that compared with air

there is a constant difference of about ·0001, and hence concludes that the air of London contains 0·1 per cent. less oxygen than that of Paris.—New researches relating to the influence of the X-rays upon the explosive distance of the electric spark, by M. S. Guggenheimer.—On the Hertz resonator, by M. Albert Turpain.—On the decomposition of sulphite and hyposulphite of strontium by heat, and the production of phosphorescent strontium sulphide, by N. J. R. Mourelo.—Contribution to the study of oxydase in grapes. Its utility in the preparation of wine, by MM. A. Bouffard and L. Semichon. By the application of oxydase, white wines may be prepared from red grapes.—Phyllocyanic acid and the phyllocyanates, by M. A. Guillemare.—On the destructive action of a blood serum upon the red corpuscles of another species of animal. Inmunisation against this action, by MM. L. Camus and E. Gley.—Tyrosin, a chemical vaccine against snake poison, by M. C. Phisalix. This is the first known case where the cell sap of a plant confers immunising properties against snake poison.—The neurology of the encephalon in fishes, by M. Catois.—On the morphological limits of the rings of the integument, by M. Charles Janet.—On the fresh-water fauna of the Canary Isles, by M. Jules Richard. Among the species observed the following were the most remarkable: *D. similis*, var. *Alluadi*, and *Canthocamptus palustris*.—On the area of dispersion of the malacological fauna at great depths in the Atlantic, by M. Arnould Locard.—On the germination of the spores of the truffle, and the production of teleutospores, by M. A. de Gramont de Lesparre. The stages of germination are shown in nine diagrams.—On the age of the quaternary gravels of Villefranche (Rhône), by M. Gaillard.—On a new method for determining the position of foreign bodies by radiography, by M. H. Morize.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 10.

ROYAL SOCIETY, at 4.30.—Contributions to the Theory of Alternating Currents: W. G. Rhodes.—The Development and Morphology of the Vascular System in Mammals. I. The Posterior End of the Aorta and the Iliac Arteries: Prof. A. H. Young and Dr. A. Robinson.—Further Observations upon the Comparative Chemistry of the Suprarenal Capsules: B. Moore and Swale Vincent.—The Effects of Extirpation of the Suprarenal Bodies of the Eel (*Anguilla anguilla*): Swale Vincent.

MATHEMATICAL SOCIETY, at 8.—The Transformations which leave the Length of Arcs on any Surface Unaltered: J. E. Campbell.—On Aurifeuillians: Lieut.-Colonel Cunningham, R.E.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Report of the Council.—Discussion upon Mr. Philip Dawson's Paper on Mechanical Features of Electric Traction.

FRIDAY, FEBRUARY 11.

ROYAL INSTITUTION, at 9.—The Metals used by the Great Nations of Antiquity: Dr. J. H. Gladstone, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Annual General Meeting.

PHYSICAL SOCIETY, at 5.—Annual General Meeting.—Address by the President.—Also Paper: On Electromagnetic Induction in Plane, Cylindrical, and Spherical Current Sheets, and its Representation by Moving Trails of Images: Prof. G. H. Bryan, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Protection of Power Transmissions from Lightning: John T. Morris.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—First Report to the Gas-Engine Research Committee: Description of Apparatus and Methods, and Preliminary Results: Prof. Frederic W. Burstall.—Steam Laundry Machinery: Sidney Tebbutt.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of Two New Species of *Clausilia* from the Province of Che-Kiang, China: E. R. Sykes.—List of the Species of *Cataulus* found in Ceylon, with Descriptions of some New Land Shells from that Island: E. R. Sykes.—Notes on the Genus *Coxiella*: E. A. Smith.—Note on *Cypræa caput-anguis*, Philippi, with the Description of a New Variety of *C. caput-serpentis*: Mrs. A. F. Kenyon.

MONDAY, FEBRUARY 14.

SOCIETY OF ARTS, at 8.—The Principles of Design in Form: Hugh Stannus.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Recent Journey in Western Australia: Hon. David W. Carnegie.

IMPERIAL INSTITUTE, at 8.30.—Sierra Leone: Lieut. J. P. Mackesy, R.E.

TUESDAY, FEBRUARY 15.

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

ZOOLOGICAL SOCIETY, at 8.30.—On the Osteology of the Steganopodes: W. P. Pycraft.—On the Skeleton of the Regenerated Limbs of the Midwife-Toad (*Alytes obstetricans*): Dr. W. G. Ridewood.—Description of a New Sea-Snake from Borneo: G. A. Boulenger, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Stability of Channels through Sandy Estuaries: P. M. Crosthwaite.

ROYAL STATISTICAL SOCIETY, at 5.—Democratic Statistics of the United Kingdom: their Want of Correlation and other Defects: Edwin Cannan.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Process Reproduction from an Editor's Point of View: Wallace L. Crowdy.

ROYAL VICTORIA HALL, at 8.30.—Brains: Hugh de Haviland.

WEDNESDAY, FEBRUARY 16.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1897: Edward Mawley.—Monthly and Annual Rainfall in the British Empire, 1877 to 1896: John Hopkinson.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Essay on Micro-crystallography, with Lantern Illustrations: T. C. White.—Exhibition of Miscellaneous Lantern Slides: J. E. Barnard.

ENTOMOLOGICAL SOCIETY, at 8.—On the Genus *Erebia*: H. J. Elwes and Dr. T. A. Chapman.

THURSDAY FEBRUARY 17.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Depletion of the Endosperm of the *Hordeum vulgare* during Germination: H. T. Brown, F.R.S., and F. Escombe.—On the Connection between the Electrical Properties and the Chemical Composition of Different Kinds of Glass: Prof. A. Gray, F.R.S., and Prof. J. J. Dobbie.—Contributions to the Mathematical Theory of Evolution. On the Inheritance of the Cephalic Index: Cicely Fawcett and Prof. K. Pearson, F.R.S.

ROYAL INSTITUTION, at 3.—Some Italian Pictures at the National Gallery: Dr. Jean Paul Richter.

SOCIETY OF ARTS (Imperial Institute), at 4.30.—The Plague in Bombay: Dr. Herbert Mills Birdwood.

LINNEAN SOCIETY, at 8.—On the Genus Arenaria: F. N. Williams.—On the Brain in the Edentata, including Chlamydophorus: Dr. Elliot Smith.

CHEMICAL SOCIETY, at 8.—Some Lecture Experiments: J. Tudor Cundall.—Observations on the Influence of the Silent Discharge of Electricity on Atmospheric Air: W. A. Shenstone and W. T. Evans.

FRIDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 9.—A Yorkshire Moor: Prof. L. C. Miall, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Relationship of Variations of the Ground-Water Level to the Incidence and Seasonal Distribution of Malarial Fevers in India: Surgeon-Captain Leonard Rogers.

SATURDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 3.—The Structure of Instrumental Music (with Musical Illustrations): William H. Hadow.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Religio Medici: Sir T. Browne, edited by Dr. D. L. Roberts (Smith, Elder).—Chambers's Algebra for Schools: W. Thomson (Chambers).—A Flower-Hunter in Queensland and New Zealand: Mrs. Rowan (Murray).—Elementary Botany; P. Groom (Bell).—Quarterly Current Charts for the Pacific Ocean (Meteorological Office).—Elementary Physics: J. G. Kerr (Blackie).

PAMPHLETS.—Remarkable Comets: W. T. Lynn, 6th edition (Stanford).—Quantitative Exercises for Beginners in Chemistry: A. H. Mitchell, 2 parts (Reading, National Publishing Association).—A Catalogue of Recent Cephalopoda, Supplement 1887–96: W. E. Hoyle (Edinburgh).—Mythos und Naturwissenschaft, &c.: G. W. A. Kahlbaum (Leipzig, Barth).—Eleventh Annual Report of the Liverpool Marine Biology Committee, &c. (Liverpool).

SERIALS.—Chambers's Journal, February (Chambers).—Natural Science, February (Dent).—Fortnightly Review, February (Chapman).—Scribner's Magazine, February (S. Low).—Journal of Botany, February (West).

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