THURSDAY, JANUARY 10, 1895.

THE ORIGINS OF ART.

Die Anfänge der Kunst. By Dr. E. Grosse. 301 pp. 32 figures in the text, and 3 plates. (Freiburg i.B.: Mohr, 1894.)

DR. E. GROSSE, in his book on "The Origins of Art," has struck out a new and very promising line of research. Other authors may have worked to a limited extent at restricted aspects of the subject, or may have theorised to an unlimited extent; but no one has studied the beginnings and evolution of the arts, with such constant reference to what actually occurs, irrespective of what the arm-chair philosopher imagines might have happened.

Dr. Grosse limits its present investigation not only to primitive art, but also to the sociological aspects of the science of art, not because he does not appreciate the other aspects, but because he wished to deal the more thoroughly with this particular problem. His main object appears to be to show, as he expresses it, that "art does not serve only as a pleasant amusement, but for the fulfilling of the most earnest and highest practice of life."

The book contains the following chapters: The aim of the science of art; the method of the science of art; Primitive folk; Art, Decoration, Ornamentation, Representation (sculpture and painting); Dancing, Poetry, Music, and Conclusion. The method adopted is that of comparative ethnography, and our author confines his attention to the lowest and least settled peoples—to the hunter-folk. In order to eliminate as far as possible the secondary factors of race and climate, he studies the condition of each art among the following peoples: Australians, Mincopies (Andamanese), Bushmen, Eskimo, and Fuegans, with occasional references to other peoples.

Each of these chapters is treated in so fresh and suggestive a manner, that one is tempted to quote largely; but a summary of the general conclusions will give a fair idea of the scope of the book. The chapter on dancing is particularly interesting, and the importance of the dance in social evolution is clearly brought out; no one who has witnessed and studied various kinds of savage dances, can fail to feel that they have a significance and value which is entirely lost in the dances of civilised people. "The pleasure of strong and rhythmical movements, the pleasure of imitation, the pleasure of giving vent to the feelings, these factors," writes Dr. Grosse, "give a complete and sufficient explanation of the passion which primitive folk have for dancing." At the same time, he points out that the occasional assembling for social dances induces co-operation among loosely-connected hunter-folk. "It is perhaps along with war the one factor which causes the members of a primitive group to vividly feel their solidarity, and it is at the same time one of the best preparatives for war. It is difficult to over-estimate the value of primitive dances in the culture-development of mankind."

It is found that the artistic creations of the hunter-folk have by no means arisen from purely æsthetic intentions, but they serve at the same time for some practical object, and frequently this latter appears to be the chief motive. Primitive ornaments are not originally and essentially employed for decoration, but as significant marks and symbols. In other cases the æsthetic intention certainly predominates, but, as a rule, it is only in music that it appears as the sole motive.

Although artistic activity, as such, hardly anywhere occurs at the lowest grades of culture, still it is everywhere recognisable, and essentially of the same character which one finds in the higher grades of culture. Only one art, architecture, is wanting among any of the hunter-folk. Herbert Spencer suggested that the three main groups of poetry—lyric, epic, and dramatic—were evolved in the course of the development of the higher culture from an undifferentiated primitive poetry; but these are already to be found in an independent position of their own at the lowest culture grade.

Primitive art forms are constructed according to the same laws as the highest creations of art, the great æsthetic principles of rhythm, symmetry, opposition, gradation and harmony are employed by the Australians and Eskimo as well as by the Athenians and Florentines. The sensations of primitive art are narrower and coarser, their materials are more scanty, their forms are poorer and more clumsy; but in its essential motives, means, and aims, the art of primitive times is one and the same with the art of all times.

Dr. Grosse does not believe that racial character has a decided determining significance in the development of the art of a people at the lowest grade of culture, but that the individuality of the folk, as well as that of individuals, continuously increases with the course of their development. The uniform character of primitive art is due to a uniform cause, and that culture factor is the uniform character of the condition of life of the hunter-folk, irrespective of race or latitude.

The particular kind of production of a people depends, above all, on the geographical and meteorological conditions under which they live. The hunter-folk have remained hunter-folk—not, indeed, as the older ethnologists believed, because they were from the very beginning condemned to stand still through a faulty disposition, but because the nature of their native country prohibited progress to a higher form of production. Herder and Taine maintain that climate exerts a direct influence on the spirit of a people and the character of their art; but Dr. Grosse claims to have proved that the influence is indirect—the climate commands the art through the production. It is doubtful whether this can also be proved for the art of the higher folk, since people provided with a richer culture have made themselves in their production independent of the influences of climate. The progress of culture emancipates the folk from a slavery to nature to a mastery over nature, and one may dare to assume that this also finds a corresponding expression in the development of art.

There are no peoples without art, and even the lowest and roughest races devote a great part of their time and energy to art; to art, adds Dr. Grosse (perhaps somewhat unjustly), which is looked down upon by civilised nations from the height of their practical and scientific acquirements, and treated mainly as an amusement; but

from the standpoint of modern science it is incomprehensible that, if such an immense amount of energy was diverted from the conservation and development of the social organism and devoted to æsthetic creation and enjoyment, Natural Selection would not step in, and long ago have rejected those peoples who wasted their energy in so unproductive a manner, in favour of other and more practically endowed folk. The conclusion is therefore arrived at that, from the very beginning, primitive art, besides its immediate æsthetic significance, must also possess a practical advantage for the hunter-folk.

The primitive arts operate in very different ways on primitive life. Ornament demands technique above everything. Ornament and the dance play an important part in the intercourse of both sexes, and through their influence on sexual selection probably serve for the improvement of the race. On the other hand, some of the arts increase the power of the social group in its resistance to hostile attacks; for example, certain decoration is employed to frighten opponents; poetry, dancing and music stimulate and encourage the warriors. The most important and beneficent effect which art exercises on the life of the folk consists in the consolidation and broadening of the social relationship. Not all arts effect this to an equal degree. While dancing and poetry seem predestined to this through their innate peculiarity, music is, from the same cause, almost quite excluded from it. But the effect of the two former varies according to the stage of culture of the people; for example, dancing loses its influence as soon as the social groups become too large for them to be united in one dance; and, on the other hand, poetry has to thank the printing-press for its incomparable power. Among the hunter-folk, dancing is the most important social influence; for the Greeks, sculpture embodied the social ideal in the most effective form; in the middle ages, architecture united souls and bodies in the halls of their gigantic domes; in the Renaissance, painting employed a language which is understood by all the cultured peoples of Europe; and in recent times, the reconciling voice of poetry rings amid the clash of arms and the conflict of classes and peoples.

As science enriches and elevates our intellectual life, so art enriches and elevates our emotional life. Art and science are the two most powerful means for the education of the human race. No pastime therefore, but an indispensable social function is art, one of the most effective weapons in the struggle for existence, and consequently it must develop itself always more richly and powerfully through the struggle for existence. Art is a social function, and every social function must serve for the conservation and development of the social organism. But it is wrong to demand of art that it should be moral, or, more correctly, moralising, for then one demands that art shall no longer be art. Art serves social interests best when it serves artistic interests.

From the foregoing account it will be seen that this book deals largely with the sociological aspects of æsthetics; and it is not only a study of primitive art in the widest sense of the term, but it is also a study of some of the factors of social evolution. It is certainly a book which should be translated into English, in order that it may obtain a wider circle of readers.

ALFRED C. HADDON.

FORBES'S HANDBOOK OF MONKEYS.

A Handbook to the Primates. (Allen's Naturalists' Library.) By H. O. Forbes. 8vo. 2 vols. illustrated. (London: W. H. Allen and Co., Limited, 1894.)

OF the series of which the present work forms a part, five volumes have now made their appearance, namely, one on Marsupials and Monotremes, one on British Birds, a third on Butterflies, and the two now under consideration; while a sixth, on British Mammals, is now in the press. In the three volumes previously issued, it was found practicable to make use of the original plates (with the addition of a few new ones) from the old "Jardine's Naturalists' Library"; but those in the volume in that series devoted to monkeys were such grotesque caricatures, that both editor and publisher were soon convinced that their reissue was impracticable. Consequently, the plates (twenty-nine in number, in addition to several maps) in Mr. Forbes's volumes have all been prepared from entirely new sketches from the pencil of Mr. Keulemans. Whether the lithographers have been quite as successful with some of these as they might have been, we think is doubtful; the colours in some instances being decidedly too bright, while in others the execution is too coarse, and not sufficiently detailed. As a whole, however, they are very creditable, while some, such as the portrait of the Aye-aye, forming the frontispiece to the first volume, are admirable specimens of artistic work.

In a series of volumes like those under consideration, it can scarcely be expected that their respective authors should undertake a detailed study of the skins and skulls of each species they describe, as if they were writing a museum catalogue. Nevertheless, we believe that Mr. Forbes has done this in a large number of cases, and has consequently been able to make some important identifications. He had a specially difficult task before him, for several reasons. In the first place, there is no British Museum catalogue of Primates since the small one published as far back as 1870 by Dr. Gray, which is now, of course, totally out of date; and, secondly, the collection of monkey-skins and skulls in the National Collection is far from being anything near as complete as is desirable. So that, even if the author went through the whole series in the groups most requiring revision, it is improbable that his conclusions would in all cases be unassailable. It may be added that the British Museum collection of monkey-skins consists largely of menagerie-specimens, without properly authenticated localities, or without specified localities at all; the reason of this being the well-known dislike of English naturalists and collectors to shoot monkeys.

As against these drawbacks, Mr. Forbes had some compensating advantages, notably the recent description, by Dr. Forsyth Major, of several new forms of Lemuroids, both recent and fossil. Consequently, his volumes contain descriptions of several forms which are not to be met with in any other collective work on the subject. Not the least interesting among these is the gigantic extinct Lemuroid (*Megaladapis*) of Madagascar, which it is possible may have been still living when that wonderful island was first visited by Europeans.

Mr. Forbes follows the classification now generally

adopted by English zoologists, including the Lemuroids in the Primates, and commencing his description with the latter, from which he ascends to the higher forms. As the volumes only bear the title "Monkeys" on their covers, it will perhaps be a surprise to many of our readers (as it was to ourselves) to find Man included in the second volume. Although we were aware that many zoologists regarded Man merely as a highly-advanced monkey, yet we believe this to be the first occasion in which he has been termed a "monkey" pure and simply. We trust it may be the last.

We do not propose to criticise any of the author's views as to the limits of species or varieties, or enter into any di cussion on the thorny path of synonymy and the identification of imperfectly defined species. And we accordingly content ourselves with saying that his descriptions are, for the most part, accurate and well-written, and that these are enlivened, when occasion requires, with interesting notes on the habits of some of the better-known species. We cannot, however, refrain from entering a protest against the "double-barrelled" system of nomenclature (as exemplified in *Tarsius tarsius*) the author sees fit to employ—to our mind the most inelegant and absurd result of a slavish adherence to priority.

An important feature of the work is the inclusion of all the known forms of fossil Primates. It would, however, have been better had the author consulted a text-book of geology, as we should not then have been told that while Lemuroids are met with in the Quercy Phosphorites and the Hordwell beds of Hampshire, yet (vol. i. p. 111) "in strata of *Oligocene*[1] and older Miocene age no Lemuroid remains have come to light in Europe." We have likewise some doubt as to the alleged Ungulate affinities of the Tertiary Lemuroids referred to on the page last cited; and, indeed, it seems to us incredible that an animal whose position is admittedly in the Primates, can at the same time be allied to such widely different groups as the Ungulates and the Insectivores, although this is stated by the author to be the case. One other criticism, and we have done. On p. 217 of the second volume it is stated that to the genus *Simia* "has been referred a molar tooth found in the Pliocene strata of the Sivalik hills in India. It is considered to belong to an Orang-Utan, *Simia satyrus*." We have the best reasons for believing that the specimen in question is a canine tooth, and likewise that the palæontologist who made the generic determination would be surprised to learn that he had identified it with a living species.

An especial feature of Mr. Forbes's work is the attention paid to the geographical distribution of the various species and groups of monkeys and lemurs; this part of the subject being elaborately treated in a series of tables at the end of the second volume, supplemented by eight coloured maps. The details here given will be extremely valuable to all future students of distributional zoology.

The series of which these volumes form a portion, ought certainly to have an extensive patronage from those who are interested in natural history from a popular point of view; while at least some of the volumes—and Mr. Forbes's among the number—will be almost indispensable to professed students of zoology. R. L.

[1] The italics are our own.

BIRDS OF THE WAVE AND WOODLAND.

Birds of the Wave and Woodland. By Phil Robinson, author of "Noah's Ark," &c. Illustrated by Charles Whymper and others. (London: Isbister and Co., 1894.)

MR. ROBINSON is probably the most popular living representative of a school of writers on natural history, dating its origin from the publication, fifty or sixty years ago, of Mr. Broderip's delightful "Zoological Recreations."

Taking birds and beasts as texts for pleasantly discursive essays, in which field-notes, poetry, and folk-lore rub shoulders with the latest conclusions arrived at by the learned in laboratories and dissecting-rooms, he and his fellows bridge the gap which separates the writings of such disciples of Gilbert White as the late Richard Jefferies, and "a Son of the Marshes," from purely scientific works.

Anything which Mr. Robinson has to say of the animal creation in fur or feather is sure to be pleasant reading; never more so than when he has at his elbow as adviser on such mysteries as "the miracle of migration" the young lady who wrote the preface to "Noah's Ark." A book with his name on the back, and pictures by Mr. Whymper between the covers, is certain to find purchasers and readers to enjoy it. It is a typical Christmas book, prettily got up, printed on good paper, "leaded" with seasonable generosity, beautifully illustrated, and edited, perhaps rather hurriedly, to be in time for the Christmas market. We notice, for instance, that an excellent sketch of partridges in a stubble field figures in the list of illustrations as "grouse." Again, he tells us (p. 93) that "once upon a time rooks were called crows," and that "as the latter had very evil reputations the former suffered for it." He goes on to give a piece of his mind to "the obstinate people in the world who will not understand that it makes any difference whether they use a right name or a wrong one." On his very next page is a capital picture of a couple of scaly-beaked rooks gossiping by the nest in a rookery at bed-time, with the legend beneath, "*Crows* at Sundown."

The description of the thrush carrying its snails day after day to the same stone for execution, and there "building up in its own way a little shell midden, like those which prehistoric man has left us of oyster-shells and clams to puzzle over," is in his best style. But we cannot help thinking that the cases must be rather exceptional in which the bird, "when driven by stress of weather to the sea-shore, treats the hard-shelled whelks just as it treated the garden snails"?

The pictures seem to us, almost without exception, excellent, and are so important a part of the book that "Birds of the Wave and Woodland," by Charles Whymper and others, illustrated by the pen of Phil Robinson, would have been a scarcely less appropriate title than that which appears on the front page.

The influence of South Kensington is apparent in most of the pictures, and the only serious doubt which suggests itself on putting down a very pleasant book, is whether it might not have been better, somewhere or other, to have acknowledged that many (ten at least) of the best

are copies, in some instances almost photographically exact, of cases in the Natural History Museum?

Mr. Robinson has kept his best wine for the last. He has seldom, if ever, written anything more fresh and charming than the description, in his concluding pages, of the voles and water-hens of the osier bed in which in boyish days he dodged his hated enemy the keeper, slipping once, as he tells us, when suddenly surprised, into the water, and sitting there "like a coot with only head above the surface, and that half hidden by reeds!" The boy is father to the man, and we can pay the writer no higher compliment than to say he has proved himself worthy of his parentage. T. D. P.

OUR BOOK SHELF.

Studies on the Ectoparasitic Trematodes of Japan. By Seitaro Goto, *Rigakushi.* (Published by the Imperial University, Tōkyō, Japan, 1894.)

THIS memoir extends to 275 pages, and is illustrated by twenty-seven plates. The species on which these studies were made, were for the most part collected by the author himself, from various parts of the Japanese coast, between the years 1889 and 1892. For the present he omits the Gyrodactylidæ, as his investigations of the anatomy of this group are not yet completed. After a brief introduction, in which the method of preparation is described, the details of the anatomy of the several systems, as met with among the species of the ten genera found in Japan, are given; this is followed by some notes on the habitat, powers of locomotion, food and colouration of the several forms, and then we have the systematic portion. By far the greater number of the species were found attached to the gills of fishes, but several live in their oral cavity, and some even on the outer surface of their bodies. In one remarkable instance, that of *Tristomum biparasiticum*, the worm was found always attached to the carapace of a copepod, itself parasitic on the gills of *Thynnus albacora*. The "looping" movements observed by Haswell have been often witnessed by Goto, sometimes they are performed so rapidly in succession as almost to escape observation; lateral movements in some instances were noticed. Whilst the greater number feed on the mucous slime of their hosts, some were undoubtedly blood-suckers. In the systematic description, attention is drawn to the important specific characters to be found in the "hooks" which are often present, near the posterior end of the body. Thirty species belonging to the following ten genera are fully described: Microcotyle, Axine, Octocotyle, Diclidophora, Hexacotyle, Onchocotyle, Calicotyle, Monocotyle, Epibdella, and Tristomum. While none of the genera are new, some of them have emended diagnoses, and the information about the various species included in each is brought wonderfully up to date. Of the thirty species, all are described as new; one, *Diclidophora smaris*, was found in the mouth cavity of *Smaris vulgaris*, taken in the Bay of Naples; all the rest are from Japan. Owing to the often very imperfect descriptions given by previous describers of species, it is possible that some of those described by Goto may on further investigation rank as synonyms, but most of them are strikingly distinctive forms. *Octocotyle*, Diesing, and *Diclidophora*, Diesing, have been combined by many in the genus *Octobothrium*, F. S. Leuckart; but the author gives good reasons why Diesing's genera should be retained, characterising the former genus anew. The author's drawings have been beautifully lithographed; the plates have been all executed at Japan, and will bear comparison with any similar work done in Europe. A very complete bibliography of the literature cited is appended. We venture to suggest, that it is a duty of all biologists to send copies of their published writings to the Library of the Imperial University of Japan, where they will be used and appreciated.

Woman's Share in Primitive Culture. By O. T. Mason, A.M., Ph.D. Pp. 286. (London and New York: Macmillan and Co., 1895.)

ANTHROPOLOGY—the science of man—has been sadly neglected in the past, but there are signs that it will be more extensively studied in the future. We believe it was a president of the Anthropological Institute who pointed out, a short time ago, that while such societies as the Zoological, Geological, Linnean, and others were in a flourishing condition, the Institute which has for its object the study of man had only a membership of three or four hundred. This strange state of things is difficult to account for, though probably it is due to some extent to the absence of ethnological material to work upon in the British Isles. It is very well known that, in the United States, the Bureau of Ethnology publishes most elaborate reports upon anthropological topics; but the opportunities for such study in America are far greater than they are here. Prof. Mason is one of the foremost workers in the field of ethnology understood in its widest sense, and he is particularly qualified to trace the story of the part played by woman in the culture of the world. The volume in which he does this is the first of an anthropological series intended for the intelligent reader, but instructive enough to satisfy the student. The author describes the work of woman in all the peaceful arts of life, and shows that the past achievements have had much to do with the life history of civilisation. The book is very well illustrated, and is a desirable acquisition to the library of every one interested in woman's work. A large share of attention is given to women of American races; but, as the author is curator of the Department of Ethnology in the U.S. National Museum, this might have been expected.

A Text-book of Sound. By E. Catchpool, B.Sc. Pp. 203. (London: W. B. Clive, 1894.)

AS an elementary text-book dealing with the physical processes which cause the sensation of sound, we think this deserves praise. It will certainly give the student the knowledge required before the more elaborate treatises can be read with profit. The author writes as a well-informed teacher, and that is equivalent to saying that he writes clearly and accurately. There are numerous books on acoustics, but few cover exactly the same ground as this, or are more suitable introductions to a serious study of the subject.

Ottica. By Prof. Eugenio Geleich. Pp. 576. (Milano: Ulrico Hoepli, 1895.)

THIS well-constructed manual will compare favourably with the best elementary text-books of optics. It is attractively designed, handy in size, and scientifically arranged. First the phenomena and theory of refraction, reflection, and dispersion are described; optical instruments form the subject of the second part of the book; interference and dispersion the third part, and optical phenomena of the earth's atmosphere, the fourth part; various interesting notes, and a comprehensive bibliography, conclude the volume. The optics of astronomical instruments are treated much more fully than is usually the case in elementary text-books.

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.*]

On the Liquefaction of Gases—A Claim for Priority.

EVER since the year 1883, I have been almost uninterruptedly engaged in the examination of the behaviour of the so-called permanent gases at very low temperatures. During the first few months I performed my experiments together with the late Prof. Wróblewski; afterwards, during a series of years, I was alone; and more lately, I went through several investigations with Prof. Witkowski. The results of my researches I published in the Polish, French, and German languages, whilst they were going on; in the *Reports* of the Cracow Academy, of the Vienna Academy, in *Wiedemann's Annalen*, and in the *Comptes rendus*. My researches are thus well known to the scientific world, and I may add, without boasting, that they have been acknowledged by learned men of different nationalities; they were also known to Prof. Dewar, who repeated them several times, and always confirmed my results—those, for instance, on the absorption spectrum and the bluish colour of liquid oxygen, and on the liquefaction of ozone.

Prof. Dewar at first duly acknowledged those of my experiments which he repeated, but afterwards he changed his behaviour, and in the lectures which he gave in the Royal Institution, and during which he liquefied large quantities of oxygen and air, he never again mentioned that his experiments were merely repetitions of mine, performed and published several years before. This is, perhaps, the reason why the English public, which attended those lectures, grew convinced that the liquefaction of oxygen, and other so-called permanent gases, has been achieved for the first time by Prof. Dewar; and it may be that the Rumford medal awarded by the Royal Society to Prof. Dewar, for the labours which I was the first both to perform and to publish, is due to those very lectures. That my labours should thus have been passed over in silence, is all the more astonishing, because as soon as the description of my apparatus, serving to liquefy large quantities of oxygen and air, was published in 1890, I sent him a reprint of it from the *Bulletin International de l'Académie de Cracovie*. A brief report of the apparatus is also contained in the *Beiblätter* of Wiedemann (vol. xv. p. 29), under the title, "K. Olszewski: Uber das Giessen des flüssigen Sauerstoffs."

There is here no space for me to enumerate all my investigations as regards the liquefaction and solidification of the gases in question; but I intend shortly to publish in the English language a more complete summary of my works, by which the English public will be enabled to see that only a small part of the researches which were performed by Prof. Dewar ought to be attributed to him. For the present, I will only state that all the so-called permanent gases (hydrogen alone excepted) were liquefied in quantity for the first time by me, and that I determined their critical points and boiling points; that nitrogen, carbon monoxide, nitric oxide, and methane were also solidified, and their freezing points determined. By means of solid nitrogen I obtained *the lowest temperature* that ever has been both obtained and measured, viz. −225°. Many other gases and liquids were frozen, and their freezing points determined for the first time by me. I must finally remark that I also gave public lectures on the subject in Cracow; the first in 1890, during which I obtained, in the presence of over a hundred students, 100 c.cm. of liquid oxygen; the second in July 1891, during the Congress of Polish Naturalists and Physicians, and then I obtained 200 c.cm. of liquid oxygen in the presence of a good many naturalists, and showed its bluish colour and its absorption spectrum. The only reason that I have never hitherto employed a larger quantity of liquid oxygen or air than 200 c.cm. was the circumstance that this quantity was quite sufficient for my experiments; for my apparatus can be enlarged at will, without changing anything in its construction. I have very often used large quantities of liquid oxygen and air whilst attempting to liquefy hydrogen, and to determine its critical pressure, as well as to inquire into the optical properties of liquid oxygen, as is proved by the whole series of researches, performed together with Prof. Witkowski.

CHARLES OLSZEWSKI.

University of Cracow, Austria-Hungary, December, 1894.

I HAVE read the letter of Charles Olszewski, and but for your courtesy in drawing my attention to it would have allowed it to pass without notice. Considering the Royal Society, in the year 1878, awarded the Davy medal to Cailletet and Pictet for their achievements of the liquefaction of the so-called permanent gases, it is hardly likely I could put forward in England any claim for such a result. A reference to the *Proceedings* of the Royal Institution between the years 1878 and 1893 will be sufficient to remove the suggestion that the apparatus I use has been copied from the *Cracovie Bulletin* of 1890. The work of the late Prof. Wróblewski has been fully acknowledged in England, and I am not aware of any injustice done to Charles Olszewski on account of the alleged omission of his subsequent investigations from public notice.

JAMES DEWAR.

The Term "Acquired Characters."

I AM afraid that as Sir Edward Fry has endeavoured to show that the explanation, given by Mr. Galton and accepted by me, of the term "acquired characters" is an absurdity when applied to the consideration of the question as to whether those characters can be transmitted by generation, I must proceed to convict Sir Edward of a loose and unwarranted use of language whilst availing himself of the plausible form of strict logical statements. I am a little disappointed with the value of the results hitherto accruing from the intervention of high judicial authority in a scientific discussion.

Sir Edward Fry asked for a definition of the term "acquired characters." From the observations which accompanied his request, it was evident that he wished for a statement of the meaning attached to the term when it is either asserted or denied that the acquired characters of a parent may be inherited by its offspring.

Mr. Francis Galton gave (and I accepted) as a brief explanation of the term the following: "Characters are said to be acquired when they are regularly found in those individuals only who have been subjected to certain special and abnormal conditions." I took the trouble to expand this explanation of the term at considerable length. Whether Sir Edward Fry has understood what was said, or not, is uncertain. Whether he has, or has not, he proceeds to state that this definition excludes the possibility of the inheritance of acquired characters, and renders the inquiry as to whether characters acquired in one generation may be handed on to the next by inheritance impossible! And therefore, according to Sir Edward, the definition is a worthless one for the present purpose. Sir Edward's argument runs: "Characters can only be found regularly either in individuals exposed to conditions which induce them, or in individuals which have inherited them. If then a character appears *only* in those individuals exposed to certain conditions, it does not appear in individuals by inheritance." That is perfectly correct; but where Sir Edward Fry is entirely wrong, is in his illogical assumption that the words "does not appear by inheritance" are equivalent to "is not transmissible by inheritance"; in fact, that "does not" means "never will or can." Surely when Sir Edward takes pains to use such a technical term as "identical proposition," he should remember the difference between "particular" and "universal." Mr. Galton's definition enables the observer to recognise and select for inquiry an acquired character, viz. one which is found in those individuals only which have been subjected to certain special conditions—that is to say, one which is at a given time and place so found. Nothing is said or implied as to future possibilities. It is the purpose of the inquirer to ascertain whether this acquired character can appear in a later generation as a transmitted character. In the specimens examined it *has not* yet so appeared. As Sir Edward justly observes, since it appears *only* in those individuals exposed to certain conditions, it *does* not appear in individuals by inheritance. But that has nothing to do with the question as to whether it *will* or *can* appear in individuals by inheritance. Accordingly the conclusion reached by Sir Edward Fry, that Mr. Galton's definition of the term "acquired character" reduces the proposition that acquired characters are not transmissible to an identical one, is erroneous, and due to a confusion by Sir Edward of a statement of what is observed at a particular moment with a statement of what must be for all time.

It should be noted that Mr. Galton's words do not furnish, or profess to furnish, a definition by which any character may be assigned to its class as either acquired or inherited. It may

well be doubted whether such a definition can be framed in the present state of knowledge. What Mr. Galton's definition or phrase does accomplish, is to point out *some* characters which may certainly be classed as "acquired" and not "inherited," and from the study of which we may accordingly start in the inquiry as to whether or not the acquired characters of one generation may become inherited in a subsequent generation. "Characters," writes Mr. Galton, "are said to be acquired when, &c." This by no means asserts that there are not other characters which should be regarded as acquired, if we knew fully about their history; for instance, at the very moment when our observation is being made on a group of individuals, some might conceivably be exhibiting a character inherited from the last generation, and other specimens might be exhibiting exactly the same character acquired *de novo*. Such cases (supposing that they ever occur) would not help us at all in the attempt to determine whether acquired characters are transmissible; and the fact that they are not included in Mr. Galton's definition (though their existence is not expressly denied) renders that definition a more practical one, and more useful to the experimental naturalist than a more comprehensive definition which could not be brought to a practical issue.

Lastly, it seems to me that Mr. Galton's definition is precisely what Lamarck pointed to in his "Première loi" and the first sentence of his "Deuxième loi." The reciprocally destructive nature of the propositions contained in those two laws I pointed out, in a former letter, and have not yet had the pleasure of seeing, in reply, any defence of Lamarck's position from one of his adherents. E. RAY LANKESTER.

Oxford, January 4.

Boltzmann's Minimum Theorem.

THE remarkable differences of opinion as to what the H-theorem *is*, and how it can be proved, show how necessary is the discussion elicited by my letter on the oversight in Dr. Watson's proof. Each of the four authorities who have replied takes a different view.

Dr. Larmor enforces the view I put forward at the close of my letter, and says that the theorem *is* what I said appeared an *à priori* possibility; and I may here point out that his letter is a complete answer to the argument I used in the *Phil. Mag.* 1890, p. 95, urging that, as there were as many configurations which receded from the permanent state as approached it, there was an *à priori* improbability that a permanent state would ever be reached. This argument was criticised at some length, not really answered, in Messrs. Larmor and Bryan's Report on Thermodynamics (British Association Report, 1891), but the suggestive remarks there given helped me, I think, to arrive (independently) at the complete answer given in Dr. Larmor's recent letter. But my present use of the argument is not that which Dr. Larmor criticises; I now use it as a test of a particular proof of the H-theorem. I say that if that proof does not somewhere or other introduce some assumption about averages, probability, or irreversibility, it cannot be valid.

Mr. Burbury appears to consider that the theorem can only be proved if we assume that some element of the distribution does tend to an average (quite a different position from Dr. Larmor's), and he is as yet unable to state the appropriate assumption except for the case of hard elastic spherical particles colliding or "encountering" (for since a is constant in his last letter, it seems as if the $q_1 \ldots q_{n-3}$ coordinates are really dummies). Yet Mr. Burbury has already given what purports to be a *general* proof of the theorem for any number of degrees of freedom.

Mr. Bryan thinks that a condition which excludes the reversed motion is implied in Dr. Watson's proof, for he says that in taking unaccented letters Ff as proportional to the number of molecules passing from one configuration to another in the reversed motion, I make a less "natural" supposition than Dr. Watson, who takes accented letters $F'f'$. I cannot see what virtue there is in putting accents on or leaving them off, and after a very careful study of Mr. Bryan's letter, I can only think that he has fallen into some confusion owing to the way in which he uses at one time *accented* and at another time *unaccented differentials*, although (as he himself remarks) there is no difference whatever between their accented and unaccented *products*. But even if Mr. Bryan be right, would he put us any "forrarder"? What we want is a *proof* that the collisions will make H decrease, and we can hardly be satisfied with a proof which depends on the previous assumption that the particles do "naturally" tend to move in the desired way.

Dr. Watson meets my reversibility argument by saying that H decreases even in the reversed motion, when the system is confessedly *receding* from its permanent state. No other correspondent agrees with him in this view, which would indeed *take away all physical meaning from the H theorem*, for the decrease of H would then be quite unconnected with the approach to a permanent state. As to the other point, Dr. Watson does not amend his proof himself, but says it is "easy" to do, and so does Mr. Bryan. Yet one has an instinctive distrust of things which are said to be "easily seen," and at all events Dr. Watson's reference to the case in which the theorem is *applied* does not help one in the *proof*, where it is necessary to express *separately* the products of the differentials expressed by the small and capital letters respectively in his "Kinetic Theory."

Mr. Burbury asks why I say the error law has been proved for the case of hard spheres without the use of Boltzmann's Minimum Theorem. I thought Tait had done so (*Trans.* R.S.E. 1886), and at all events I thought the ordinary investigation showed that there was but *one* solution, that of the error law, in that case; but perhaps I am mistaken.

Mr. Bryan says Lorenz gives the clearest account of the assumptions in Boltzmann's theorem. He would earn our gratitude if he would state them in his next letter.

EDW. P. CULVERWELL.

Trinity College, Dublin, December 29, 1894.

Aurora of November 23, 1894.

OBSERVATIONS of this aurora, by Mr. James T. Pope, at Dingwall, in the north of Scotland, have been sent to me by Mr. H. Corder, of Bridgwater, a few particulars having also been recorded here of the appearance, which, although the distance of this place from Dingwall falls but very little short of 400 miles, yet showed some very excellent agreements with Mr. Pope's description.

Beginnings of the aurora were seen by Mr. Pope between 6 and 7 p.m., as a glow which brightened gradually along the eastern, and sent up a few faint streamers from the western parts of the horizon towards the north, until 6.30, gradually fading out, after that, till nearly 7 p.m. The glow then gradually reappeared as a bright band, brighter in the east than in its western half, stretched across the sky from east to west, somewhat southward from the zenith. This band of light continued very bright for some time, but faded out gradually towards 7.30, the streamers in the north-west at the same time increasing continually in brightness.

Near Slough the display was first noticed about 7.15 p.m. as a low ill-defined white bow, stretching, at about half the altitude of those stars above the horizon, from under ζ to under υ Ursæ Majoris (altitudes 19° and 24°, azimuths 13° W. and 16° E.) from north). A little later, towards 7.30 p.m., this arc had become a bright narrow band, a degree or two in width, and about 25° long, extending from η Ursæ Majoris in the west (altitude 15°, 19° W. of north) to a few degrees under γ and β Ursæ Majoris (altitudes 16° and 19°, 2° W. and 6° E. of north) on a slightly downward slope to some degrees eastward from the latter star. It faded out partially about 7.30 p.m., leaving two bright remnants across η, and under β Ursæ Majoris, each about 8° long, while a third just similar wisp of light appeared on the same line's far leftward prolongation; this western offshoot of the band continued with the other two short segments till all had faded out at 7.45 or 7.50, marking the arc's considerable but not otherwise traceable extension westwards, across ϵ, ζ Herculis (altitudes 17° and 15°, 60° and 55° W. from north).

Dingwall is about 390 miles distant from Slough, in the direction 18° or 19° west from north; so that it appears that the strong part of the glow-band seen most brightly in the east from Dingwall, was alone observable here (if we except the light-wisp in Hercules towards the west, at last), in the vapoury sky near the horizon.

Beginning with an average altitude of between 9½° and 12°, or of about 11°, at 7.15, the band in growing stronger reached an altitude, at Slough, of 14° or 15° towards 7.30, during about the space of time when it was most distinct, and seen most strongly in the east at Dingwall extending from east to west somewhat southward from the zenith. If its altitude there was at that time about 60°, and at Slough about 13°

above the south and north horizons, respectively, of those places, making the considerable corrections needed by the earth's curvature in the 6° of latitude between them, the resulting height of the luminous arch appears to have been about ninety-five miles above a place about fifty miles south of Dingwall. But the times of observation and the altitudes used being only roughly assigned, and only somewhat vaguely comparable together, an uncertainty of, it may be several miles, must no doubt attach itself to this determination.

Two very slender and fugitive streamers only were seen at Slough to rise from the horizon-glow before half-past seven. But between about 7.35 and 7.40 p.m. a dense tuft of them, 8° or 10° wide, rose from a low, faint light-band then visible at about half the altitude of the short arch-segment across ζ, η Ursæ Majoris, crossing and enclosing that wisp of light, to about half as high again as the wisp's altitude from the horizon. This pillar of light grew faintly red before disappearing, which it did in three or four minutes after springing up, while the rest of the glow and the wisps (the one in Hercules being the last one to be seen) also faded away entirely between 7.45 and 8 p.m. The distinct light-band and the tuft of reddish streamers were the only conspicuously bright phases seen at Slough in the aurora of November 23, between 7.15 and 7.45 p.m., with the exception of the two very faint and slender streamers which rose suddenly to a great height across Ursa Major at about 7.30 p.m.

The base of the pillar-like projection, resting on the faint lower light-bow, was at about 8°, and its summit when highest at about 24° above a part of the north-western horizon between 8° or 10°, and 18° or 20° west from north. Its western side would thus be just vertically over Dingwall, if the lower arch which formed its base was at the same time in the zenith of the latitude of Dingwall; and this, it seems quite probable was actually the case, from the following description of the closing scene, by Mr. Pope, of the aurora's progress after the main belt of light had broken up and dispersed itself, at about 7.30. He writes: "At 7.30 p.m. the glow had almost disappeared, while the streamers at this hour were most intensely bright, and appeared to radiate from a small and distinct part of the sky situated in R.A. 358°, Decl. 43° north. Previous to 7.30, no streamers had been observed to radiate towards the south, but between this time and 8 p.m. streamers were seen radiating from the aforesaid part in *all* directions. After 8 p.m. the display gradually faded out, and at 8.30 very little trace of it could be seen. The appearance at the apparent radiant point when the display was at its height was most interesting; appearing sometimes as a solid mass of aurora, then suddenly breaking up into fragments, and assuming most curious forms, uniting again, and so on. Not the slightest trace of the display was visible at 10.30 p.m."

The altitudes of 8° and 24° observed at Slough, at the base and top of the dense column of reddish streamers, nearly in the direction (as described above) of Dingwall, must evidently have related as directly and definitely to this fine display of radiation in the north of Scotland, as the foregoing altitudes at Slough of the bright band of light, before 7.30, seemed clearly and obviously to supply good means for determining approximately the band's real height, by comparing them with Mr. Pope's description of his view of the same band at Dingwall.

Making the same needed correction, as before, for the diminution brought about upon the apparent altitudes observed at Slough by the effect of the earth's curvature, we may thus deduce a resulting real height of 75 miles above the earth's surface, approximately, at the bases, and of 193 miles, approximately, above the earth for the summits of the streamers which clustered over the neighbourhood of Dingwall, and produced the magnificent spectacle of the auroral corona in that part of Scotland.

Should notes have been fortunately preserved at any other towns in Scotland at considerable distances from, and especially in lower northern latitudes than Dingwall, of the aspect, times and bearings, or astronomical positions of this short but bright aurora's rather peculiar features of development in its transient display, much better conclusions regarding the real positions and the extent and distribution of the spectacle might, without doubt, be gathered from them, than those above roughly extracted from only very slight descriptions. But the roughly reached results of the heights of the appearance may yet, for the present, not be entirely worthless, on account of the scarcely doubtful identities of the aurora's bright features, which were recorded most dissimilarly in this rather surprising instance, at two so very extraordinarily far separated places.

A. S. HERSCHEL.

Observatory House, Slough, December 24, 1894.

Peculiarities of Psychical Research.

ON page 200 I see that Prof. Karl Pearson suggests that it would be a good exercise for some one with a strictly logical mind and plenty of leisure to criticise "the products of the chief psychical researchers." May I say, as a member of the S.P.R., speaking for myself and fellow-workers, that we ask nothing better than such a studious and searching criticism. One of our main difficulties is that our critics will not take the trouble to study or even read our evidence, but are content to ridicule what they conjecture to be our methods and results from so great an altitude of assured contempt, that we fail to recognise ourselves in their travesty, and are therefore unable to derive much benefit from their utterances.

Thus, for instance, Prof. Karl Pearson, before writing his recent letters, has evidently not taken the trouble to refer even to the abbreviated summary of certain card-drawing experiments contained in Mr. Podmore's little book; otherwise he could hardly make the statements he does concerning the S.P.R. record of them.

He objects to M. Richet's results as giving insufficient odds in favour of telepathy, so that, as he says, it shows want of acumen to adduce them. Would he then regard it as more scientific to suppress them? On the other hand, the enormous odds against chance, shown in Mr. Gurney's trials, he also says, on page 153, show a want of acumen (I don't know why, but I expect because nothing could possibly exhibit anything else on the part of an S.P.R. worker), and that such odds might be otherwise accounted for. Does he then suppose that the odds of, as he reckons them, two thousand million to three are accepted by us as the odds in favour of telepathy? Probably he does, because there is at present no need to be fair to investigators in an unorthodox field; but Mr. Podmore is careful to state the opposite, as follows (footnote to p. 27 of Mr. Podmore's little summary, in the *Contemporary Science Series*, of the evidence for Thought-transference so far as it exists at the present time): "Of course the statement in the text" [viz. that "the probability for some cause other than chance deduced from this result is '99999998"] "must not be taken as indicating the belief of Mr. Edgeworth, or the writer, or anyone else, that the above figures demonstrate thought-transference as the cause of the results attained. The results may conceivably have been due to some error of observation or of reporting. But the figures are sufficient to prove, what is here claimed for them, that *some* cause must be sought for the results other than chance." And another quotation may be permitted from Mr. Podmore's preface, which ought to silence irresponsible detractors like Mr. H. G. Wells, and others, who seek to lead the world to suppose that we have some cause at heart other than the simple ascertainment of the truth, whatever it is, and that Mr. Podmore, in particular, is a bigoted upholder of the certainty of telepathy. This is the quotation: "The evidence, of which samples are presented in the following pages, is as yet hardly adequate for the establishment of telepathy as a fact in nature, and leaves much to be desired for the elucidation of the laws under which it operates. Any contribution to the problem . . . will be gladly received. . . ."

Now, I observe that Prof. Karl Pearson has a contribution to the problem, for in NATURE of December 27, 1894, p. 200, he refers to certain experiments of his own, wherein by pure chance he obtained results against which the theory of probability also gave large odds. Would he be good enough to let us have these results more precisely, as recorded at the time and signed by witnesses, so that they may furnish us with an example of the methods of a "real scientific investigator"? It will be very unsatisfactory if we have nothing but his memory to rely on for the facts; and as he well knows, it is necessary to have the whole of a large number of trials before deductions from the theory of probability are legitimately applicable.

I observe, finally, that Prof. Pearson, with plenty of good-nature but some lack of originality, has refurbished Dr. Carpenter's old joke about an "ortho-Crookes" and a "pseudo-Crookes," and has directed it against me. I shall be well content if he never manages to find a keener and more effective weapon.

OLIVER J. LODGE.

Liverpool, December 29, 1894.

THE STUDY OF CLOUD.[1]

THIS monograph has been long and anxiously expected by all who take an intelligent interest in the advance of meteorology, and recognise the long and profound study that the Rev. Clement Ley has made of this subject. It is with great regret that we notice that the preface is signed by a member of his family, and that the zealous and energetic watcher of the clouds has not been able to see his own work through the press.

FIG. 1.—Cumulo-nimbus.

We have in this book to do emphatically with Mr. Ley's own observations, his own theories of cloud structure, and his own nomenclature. Although the author acknowledges in the preface the valuable assistance that he has received from the works of other writers, it is curious to notice how seldom in the text these authors are referred to by name. One cannot help feeling that it would have added much to the interest and the instructive character of the book, if Mr. Ley had systematically drawn attention to the work of those who have laboured with scarcely less industry than he has in this department, if he had exhibited the points of difference from, and support given by, other observers, such as Abercromby, Hildebrandsson, Weilbach, and a host of other authorities, who seem sometimes almost ostentatiously ignored. It will be seen that Mr. Ley does not offer anything approaching a history of the subject, either on the theoretical or observational side. Opening with a preliminary chapter on the atmosphere and the movements of vapour-laden air, we have the general principles of cloud formation explained. Although we have been accustomed to think that moisture condensed into cloud can only be driven or rolled about in a limited number of ways, and hence but few really distinct varieties of cloud can be formed, our author subdivides the process of cloud formation under several heads. The process which he terms "interfret" seems very nearly allied to the Luftwogen of Helmholtz, though there is no mention of this authority in the text. Mr. Ley states that when approximately horizontal currents of air differing in velocity and direction move over one another, an intermingling of the particles will result, accompanied by whirls, ripples, and waves, varying in size and shape according to the velocity and direction of the current. This effect he attributes to friction, and this seems to be the chief difference between him and the German physicist, who sees a more complex problem in the mixing of two fluids of different specific gravities. If the colder current is uppermost, the resulting action is called "interfret"; if the warm moist current is above, then "reversed interfret." To clouds formed by the descent of moist particles through warmer and denser air, the term "inclination" is applied, and the final nomenclature adopted rests on subdivisions of these classes of formations.

An adequate nomenclature of clouds has long been, and we think it may be said, is still, a desideratum. Luke Howard's terms still survive, and after nearly a century's use cannot, and will not, be entirely superseded. Stratus, cumulus, and cirrus have too strong a hold on the vocabulary to be dislodged, and however much they may be subdivided, they must remain the basis of classification. Mr. Ley therefore retains these terms, but an eye educated by some fifty years of constant study, has

FIG. 2.—Cumulo-nimbus (same cloud as in Fig. 1).

[1] "Cloudland: a Study on the Structure and Characters of Clouds." By Rev. W. Clement Ley. (London: Stanford, 1894.)

seen and learnt to recognise many varieties of shape and form, arising possibly from real differences of structure, which require distinctive appellations, and make the description somewhat cumbrous. To quote the entire list of subdivisions would occupy no small space. Leaving out of the question fog, which is itself divided into three classes, we have the clouds of interfret, inversion, and inclination, each subdivided into five different varieties. To this list, large as it is, must be added several additional subdivisions, all presenting marks of dissimilarity, and it is suggested, typical of special states of weather in different portions of the globe. Each of these classes is described at considerable length, and many of them are admirably illustrated, both by coloured plates and photographs. We have recently reproduced (NATURE, vol. xlix. p. 342) some admirable specimens of cloud photography, due to S. Manucci of the Vatican Observatory, illustrative of the distinctive characteristics of cloud formation. Mr. Arthur Clayden has secured some very admirable specimens, worthy to be classed with those of the Italian artist. We give in Figs. 1 and 2 the reproduction of the same cloud (cumulo-nimbus) after an interval of ten minutes, in which the shifting character of clouds is well illustrated. The truthfulness to nature is shown very conspicuously in an evening picture of the same variety of cloud (Fig. 3).

But the important question is, will illustrations, however carefully executed, give to persons of ordinary intelligence that insight into cloud structure which enormous experience has given to Mr. Ley, and enable them to discriminate with facility and certainty between the various classes? The author raises the objection, not as existing in his own mind, but as having been suggested to him by others whose opinion he values, that the classification here presented is too complex. We would respectfully associate ourselves with those who have suggested this doubt. Mr. Ley's contention is, that greater simplicity of description might induce a larger number of observers to contribute something, but that the *value* of the whole mass of such observations would be of small amount, through however long a space of time they were continued. The main value consists in the evidence it affords of the different forces at work in the air, and its consequent trustworthiness as a weather guide, and on this point there will be many different opinions. The same description of cloud does not prognosticate the same weather in all countries, or at all times in the same country. The method and cause of development are as important as the character of the cloud itself. Cumulus may sometimes be the promise of a fine day, or prove the precursor of a shower. A man who "forecasts" by the clouds alone, is in the same position as a man who relies on the indications of a wheel barometer. He simply considers one variable in a very complex result. But Mr. Ley looks forward to a time when every man shall be his own "weather prophet," and when every individual and institution may be provided with weather telegrams and the means of correct and intelligent interpretation. In the multitude of counsellors so created there may be wisdom; there will certainly be confusion.

Waiting for this consummation, it seems most desirable that the same kind of cloud should be called by the same name by all observers; and simply having regard to the main divisions, it will be admitted on all hands that this amount of progress has not yet been effected. We have then to consider whether this book, valuable as it is, will promote this end, and we are afraid that it will prove an edged-tool to beginners. To the advanced student it can easily be understood that this work is most welcome, but there still seems necessary a simpler system to serve as an introduction for the tyro. Mr. Ley may very well say that he addresses himself only to skilled observers, and to some this will be a sufficient defence, but this skill is not easily acquired, and we look for a graduated system, along which a student may advance confidently and scientifically. Abercromby and Hildebrandsson recognise and would recommend a classification of ten divisions, a system of which we believe the author disapproves. Captain Wilson Barker would, if we understand his arrangement correctly, still further simplify this system, and therefore it does not seem impossible to lead the student along an easy incline in which he would gradually accumulate experience, rather than plunge him at once into the subtleties and pitfalls which Mr. Ley prepares for the beginner.

FIG. 3.—Cumulo-nimbus (evening).

It is easy to understand how difficult a problem was submitted to the International Meteorological Committee when they were asked to adopt and sanction a uniform nomenclature of clouds, and how prudent they were in declining the invitation (NATURE, vol. xxxviii. p. 491).[1] Simply having regard to the fact, that meteorologists are generally agreed that the same cloud forms and cloud structure are to be met with all over the world, it would seem that an International Congress was admirably adapted for the settlement of such a scheme. But it was felt, and the feeling will be still more general after the perusal of Mr. Ley's book, that our knowledge of the physical and structural process of cloud formation is in a progressive state, and therefore final classification impossible. Mr. Ley would probably be the last to consider that his book possesses the element of finality. He has not only learnt and taught much, but he has also learnt, better than most of us, how much more there is to learn.

W. E. P.

[1] This subject is still engaging the attention of an International Congress (See p. 185.)

SIR CHARLES NEWTON, K.C.B.

THE hand of death has lately fallen heavily on the ranks of the older scholars; and classical archæology has especial losses to record Only a few months back, there passed away Heinrich Brunn, the *doyen* and most picturesque representative of German Hellenism; and we in England have now sustained a loss no less severe. Though Newton had of late years become too infirm for active work, and had in fact done little since his retirement in 1885, it is now, when he has gone from among us, that his loss will be most keenly felt. It was not so much in his actual achievements, though these were considerable enough, that his truest claim upon our recollection lay; nor yet in the fact that he had practically opened up a new science for English scholarship: it was more than all in the personality and force of character of the man, which impressed itself on all with whom he came in contact, and the masterful influence which was by no means confined within the limits of his own science. It was to this that he owed his success; and there have been few instances in which a necessity has been so opportunely met by the man most adapted for it. For when Newton joined the Museum in 1840, the study of actual monuments was still in its infancy; Greece itself was very little known, and a pseudo-classicism had been evolved from the mistaken illustration of literary sources with an often inferior Græco-Roman art. Behind him lay the period of learned and ingenious but useless theory; two things were needed to clear away this tangle of ideas—a fuller supply of the best practical material, and a wider scientific method.

At that time the Departments of Antiquities at the Museum, which now are four, were all united in one. The disadvantages which such an arrangement must have entailed are obvious enough, but there was this compensating advantage, that a young man in Newton's position was at the outset enabled to attain a certain familiarity with the wider aspects of his study, and perhaps a breadth of view and sympathy which is more difficult at present. He was thus by his training, as well as by his natural bent, led to a large view of things.

In an address to the Archæological Institute at Oxford, in 1850, he urges a powerful plea for the comparative method in archæology and, as the necessary corollary, for enlargement of museums. In this address, which as archæological teaching was singularly in advance of its times, the writer has laid down the formulæ upon which the modern science of archæology may be said to take its stand. A museum must not be a mere collection of disjointed, disconnected phenomena, but the central consulting-room, as it were, to which all scientific questions may be referred for comparison and elucidation. Classical art and archæology, like all other studies, cannot but lack perspective in isolation: the external conditions, the ethnographical characteristics, the position of the Hellenic race in its relation to the rest of mankind, their art, architecture, life, and thought must be collated and classified with a due regard to the continuity and correlation of things. The archæologist, in short, "must travel, excavate, collect, arrange, delineate, decipher, transcribe, before he can place his whole subject before his mind. But the plodding drudgery which gathers together his materials must not blunt the critical acuteness required for their classification and interpretation: nor should that habitual suspicion which must ever attend the scrutiny and precede the warranty of archæological evidence give too sceptical a bias to his mind." The key-notes here sounded were kept steadily in mind throughout his whole life. It was but a few years after, that his sojourn in the East, as consul at Mytilene, enabled him to put his ideas into practice, and to initiate for England the "era of the spade."

The discovery with which Newton's name will always be inseparably associated is that of the Mausoleum at Budrum, collections from which now fill almost an entire room at the British Museum. Budrum had been visited by Prof. Donaldson early in the century, and the presentation to the Museum, in 1846, of the twelve slabs removed from the castle of the Knights of St. John, had called renewed attention to this monument. In 1847 Newton published a memoir, in which Donaldson's site was selected as that which probably concealed the ruins—a conjecture which other travellers contemptuously rejected. It was not till 1857 that Newton was enabled to verify his conjecture by actual digging, and the account which he gave of his discovery, in his "Travels and Discoveries in the Levant" (p. 86), is one of the most fascinating episodes in a fascinating book. Even when the site was thus determined beyond all doubt, the difficulties had only begun; the obstacles of Turkish officialism and native greed were enough to have broken the heart of a less indomitable energy; but his own untiring efforts, backed by the friendly assistance of Lord Stratford de Redcliffe at Constantinople, brought the undertaking to a well-merited success.

Lord Stratford was only one out of many friends whom Newton succeeded in enlisting in the cause he had at heart; he had pre-eminently the priceless faculty of inspiring others with his own enthusiasm; possessed of considerable social gifts, he was enabled to make many friendships, which served him in good stead both at home and abroad. If a special grant were required, whether for excavating a promising site, or for enriching the Museum with an important collection, he rarely failed to wring a reluctant consent from a Treasury too apt to neglect any cause which is not sufficiently self-assertive. During most of the period of his keepership he was thus able to maintain or to encourage enterprise or exploration abroad, set on foot by men who had caught the infection of his energy in personal contact with himself. Smith and Porcher at Cyrene, Dennis at Benghazi, Pullan at Priene, Salzmann and Biliotti at Budrum and Rhodes, Wood at Ephesus, and, more recently, Ramsay in Asia Minor, all owed the initiation of their enterprise, or very material support, to Newton at home. Perhaps one of his most solid claims to our gratitude lies in the fact that he was thus instrumental in obtaining no less a sum than £100,000 in special grants for the purchase of collections for the British Museum, over and above the annual sums voted by Parliament. Of these the most important was probably the great Blacas collection in 1867, a transaction which is admirably illustrative of Newton's resourceful self-reliance and power. The French Government (and probably others also) were known to be inclined to treat for the collection, and the English representative had at short notice to determine a sum which should be at once enough to carry the position, and yet not be deemed extravagant. Newton telegraphed on the Friday to Panizzi; next day the trustees of the Museum met, Disraeli came purposely to the meeting, and the historic treasure was ours.

To his energetic guidance the Hellenic Society and the British School at Athens both owe in a large degree their initiation and their present position. It was indeed in such practical initiation, and in the inspiration of others rather than in actual teaching, that Newton's true sphere lay. Yet all who know his writings, and still more those who had the privilege of personal intercourse with him, will acknowledge the debt they owe to his teaching, either direct or indirect. To any one regarding the period over which his activity extended, from a time when archæological science was, as it were, casting its skin, down to the complete transformation of to-day, to any one who knows the masses of now useless literature which form the cast-off slough, it is really astonishing to turn

to Newton's "Essays on Art and Archæology," and to see how fresh and how living the opinions expressed even more than forty years ago still remain. Though cautious sagacity and a conservative temperament were his prevailing characteristics, yet when the occasion needed he could speak with no uncertain voice; it is a remarkable fact, for instance, that his article on the epoch-making discoveries of Schliemann, written at a time when the attitude of scientific men was still undetermined or opposed, remains to-day, so far as it goes, an admirable exposition of the subject. His attitude on such subjects was specially characteristic of his favourite study—Greek epigraphy—for which a man needs a wide range combined with a patient methodical accuracy. He might, indeed, have said of himself, with his great contemporary, Brunn, "In a critical discussion I would rather err methodically than hit upon the truth without method": a golden watchword for this age of hurry and competition.

NOTES.

PROF. RICHTHOFEN has been elected a Correspondent in the Section de Minéralogie of the Paris Academy of Sciences.

DR. D'ARSONVAL has been appointed to the Chair of Medicine in the Collège de France, in succession to the late Prof. Brown-Séquard.

THE death is announced of Dr. Josef Schröter, Professor of Bacteriology in Breslau University, and distinguished for several important researches in the domain of botany. Among the deaths of other foreign scientific men are: M. Stieltjes, the eminent Professor of Pure Mathematics in the Toulouse University; Dr. C. Studiati, Professor of Physiology in the University of Pisa, and Dr. J. G. Brinton, at Philadelphia. Dr. Brinton was known for his botanical works.

PROF. BLAKE has been appointed by the Government of Baroda to the temporary Directorship of the newly-built State Museum at Baroda, and sails this week for India.

MR. J. E. DUERDEN, Demonstrator of Biology at the Royal College of Science, Dublin, has been elected Curator of the Institute of Jamaica.

THE Paris correspondent of the *Lancet* reports that arrangements have been made at the Pasteur Institute for the immediate despatch of tubes of anti-toxic serum to any part of France. It will thus be seen that M. Roux and his assistants have not been idle. Indeed, both the Institute authorities and the public have worked with a will; the latter having, through the *Figaro*, and by means of gifts made directly to the Institute contributed up to December 31, 1894, no less a sum than 611,000 francs (£24,440). This does not include 100,000 francs (£4000) just voted by the Chambers, and which will doubtless become an annual subsidy. The Institute now possesses, for immunising purposes, a stud of 136 horses, a total that will probably be ultimately increased to the maximum of 150. Of these, twenty are kept by the Municipal Council of Paris at a cost of 20,000 francs (£800) a year, for the benefit of the Paris hospitals and poor. At Villeneuve-d'Étang—a property ceded by the State to M. Pasteur in 1886—there are seventy-nine horses cared for by a capable veterinary surgeon and his staff. That the animals flourish under the *régime* of good feeding and periodical bleedings adopted, is proved by the presence in good health at Alfort of a sturdy Brittany pony which has hitherto supplied no less than 420 litres of blood.

THERE will be a special technical meeting of the Royal Geographical Society, in the Map Room of the Society, on Tuesday, January 22, at 4 p.m., when Prof. A. W. Rücker, F.R.S., will read a paper on "Terrestrial Magnetism."

AN Austrian polar expedition is being organised by Herr Julius von Payer, with the view of securing the artistic representation of the physical features of the east coast of Greenland. The actual work will begin in latitude 74°, and will extend beyond latitude 77°. It is anticipated that the expedition will be ready to start in June 1896.

THE weather has continued very disturbed over the British Islands during the past week; northerly gales have occurred with considerable frequency on our northern and western coasts, but the conditions have been quieter than of late over the southern portion of the kingdom. Heavy snow has fallen in Scotland, causing serious interruptions to the railway and telegraphic services; snow has also fallen in many other parts of the country. Sharp frosts have occurred in the Midland districts, as well as in the north and east; and on Tuesday the thermometer in the screen registered 19° at Wick, while ten degrees of frost occurred in several parts of the United Kingdom.

THE study of the "ejected blocks" from a volcano is a peculiarly interesting one, for by the careful piecing together of evidence much may be learnt of the internal processes which accompany the outward and visible eruptions. This study has been undertaken by Prof. Johnston-Lavis for Monte Somma, and some recently published papers contain a portion of the results at which he has arrived (*Transactions* Edinburgh Geol. Soc. vi. 314). Of the many varieties of stratified rocks that have been torn off from the walls of the volcanic chimney by the rising lava, those of Tertiary age show the least metamorphism; while in the deeper-derived Cretaceous limestones all stages of metamorphism are to be found. The earliest changes appear to be the carbonisation of any organic matter to form graphite, and the recrystallisation of the calcite in larger grains. Then as interchange of constituents takes place between the limestone and the metamorphosing lava, various lime-silicates appear in a fairly definite order, until finally we have formed that great variety of minerals for which Monte Somma has long been famous. The occurrence of *periclase* (MgO) is of interest in view of the abundance of hydrochloric acid among the gases emanating from Vesuvius, for that mineral is artificially prepared by heating magnesia in hydrochloric acid gas. Many of the minerals formed under these conditions of metamorphism tend to decompose rapidly under more normal conditions, and associations of serpentine, tremolite, brucite, &c., are formed, such as are well known in areas of regional metamorphism.

THE analogy between these Vesuvian blocks and certain Archæan rock-masses is carried to a striking extent in a further paper, in the authorship of which Dr. J. W. Gregory joins with Prof. Johnston-Lavis (*Trans. Roy. Dublin Soc.*, vol. v. ser. ii. No. vii.). Here many specimens are described which show in the most complete manner the association of characters that led to the belief in the organic nature of the Canadian *Eozoön*. The authors consequently suggest that the Eozoonal structure in its typical localities was developed in the limestones by the contact metamorphism of the associated crystalline rocks—a view which, they point out, is in harmony with the conclusions arrived at by Prof. Lawson on purely stratigraphical considerations. The disproof of the organic nature of Eozoon may therefore be considered complete.

THE disease of Anbury, or Finger and Toe, is met with wherever the turnip crop is cultivated, but it is probably nowhere more destructive than in the north of England. An experiment bearing on the disease, briefly described in the *Journal* of the Royal Agricultural Society, by Prof. W. Somerville, will therefore interest all agriculturists. The experimenter emphasises the fact that the disease is extremely infectious, and may be easily induced by inoculating a soil perfectly sound with soil from a diseased field. Such diseased soil, however, may be easily disinfected by lime, a fact which points to the patho-

logical phenomena being due to an organism—presumably *Plasmodiophora brassicæ*. This being so, too great care cannot be taken to prevent soil or diseased roots being conveyed from a field which is diseased to another which is sound.

A SOCIETY which has a total of more than eleven thousand governors and members, may fairly be said to be in a flourishing condition. Such is the Royal Agricultural Society; and with so great a membership, it is no wonder that a large amount of important work is carried on under its auspices. The current quarterly *Journal* of the Society has among its contents special articles on the rotation of crops, light railways, and the trials of oil engines at Cambridge. It also contains the annual reports of the consulting chemist, Dr. J. A. Voelcker; the consulting botanist, Mr. W. Carruthers, F.R.S.; and the zoologist, Mr. Cecil Warburton. The report of the Council shows that in the Department of Comparative Pathology and Bacteriology, established at the Royal Veterinary College by the aid of a grant from the Society, the work in the research laboratory has included investigations on tuberculosis, diphtheria, anthrax, and other diseases, and the use of mallein and tuberculin for the detection of glanders and tubercle in the earliest stage. The further experiments which have been made, have materially strengthened the evidence in favour of both agents as aids to diagnosis in doubtful cases of disease. We note that the Council have elected as an honorary member of the Society, Prof. W. Fleischmann, Director of the Agricultural Institute of the Royal University of Königsberg, in recognition of his distinguished services to European agriculture. The annual country meeting of the Society will be held this year at Darlington; Leicester has been chosen as the place of meeting for next year.

EVERY naturalist is acquainted with the elaborate spring-like mechanism by which the woodpeckers and humming-birds are enabled to protrude their tongues with such rapidity for the capture of insect prey. These remarkable instances of adaptation have been more than once described, and some other special modifications of the avian tongue and its bony supports will be recalled by ornithologists. In a recent number of *Der Zoologische Garten* (Frankfurt, xxxv., November, 1894), Herr Schenkling-Prévôt redescribes these cases after a renewed investigation, and also supplies a quantity of interesting information on the form of the tongue and hyoid apparatus of birds in general. The old idea that the woodpecker transfixes its prey with its sharp-tipped tongue is probably not yet extinct, but Herr Prévôt adds his opposition to this opinion, and states that the insects are agglutinated to its tongue by the sticky secretion with which its surface is copiously covered. Although the form of the tongue usually corresponds to the shape of the bill, there are exceptions to this rule, as, for example, in the waders, kingfisher, and hoopoe, which, in spite of their long bills, only possess small cartilaginous tongues; in the pelican, indeed, the tongue is altogether rudimentary. In most birds, whose food consists of seeds, the tongue is dart- or awl-shaped; in others, spatulate; rarely, vermiform or tubular. In some birds, such as the owl, which swallow their prey entire, the tongue is broad and serves as a mere shovel. In the hedge-sparrow, nuthatch, woodcock, and others the tongue is bifid or trifid at its apex, while in the humming-birds the tongue is split into two branches almost to its base, and is used for actually gripping the small insects on which these resplendent little creatures subsist. In a family of parrots (Trichoglossidæ) the tongue is provided at its apex with a brush of some 250–300 hair-like processes. In the parrots, the tongue is thick and fleshy, devoid of horny barbs or papillæ, and is even suspected to possess sense-organs of taste. Herr Prévôt concludes his concise but interesting paper with some remarks on the influence of the form of tongue in birds on their varying powers of articulation. It is interesting to note that the parrots, the form of whose tongues most closely resembles that of man, are able to imitate his language more nearly than any other birds.

THE first number of the *Botanisches Centralblatt* gives, from the annual report of the Société des touristes du Dauphiné, an account of the various attempts to establish Alpine botanic gardens in the Jura, Tirol, Styria, the Bavarian Alps, Switzerland, &c.

THE number of *Bonnier's Revue Générale de Botanique* for December 15, 1894, contains a biographical sketch of the late Prof. Duchartre, with an enumeration of his contributions to physiological, morphological, and systematic botany, amounting to 240 papers or separate publications.

THE first part is published of the *Jahrbücher für wissenschaftliche Botanik* under the new editorship of Prof. Pfeffer and Prof. Strasburger. It contains the following papers:—"Investigations on Bacteria," by Dr. A. Fischer, and "Physiological investigations on the formation of callus in cuttings of woody plants," by Herr H. Tittmann.

LORD LILFORD'S "Coloured Figures of British Birds" have now reached their twenty-ninth number, and contain a series of excellently-drawn chromo-lithographs of our native species. Four or five more parts are required to finish the work, which, when arranged, will fill ten or twelve crown-octavo volumes.

THE veteran naturalist, Dr. R. A. Philippi, of Santiago, has just issued an illustrated memoir, in quarto, on the stags of the Andes, which will form part of the "Annals of the National Museum of Chili." Besides the two ordinarily recognised species of the sub-genus *Furcifer*—*Cervus chilensis* and *C. antisensis*—Dr. Philippi describes a third species, *Cervus brachyceros*, from Northern Peru, which appears to be well established.

THE birds of Bulgaria and the adjacent provinces of Turkey have, hitherto, been little investigated by European ornithologists, and are consequently imperfectly known. A good contribution to our knowledge of this subject has just been made by the publication of Reiser's "Ornis Balkanica." The author is Custos of the Museum at Sarajevo, in Bosnia, and has travelled extensively in the Bulgarian provinces.

THE 119th number of the *Biologia Centrali Americana* of Messrs. Godman and Salvin, which has recently been issued, contains continuations of the "Birds" by Messrs. Salvin and Godman, of the Coleoptera by Dr. D. Sharp and Mr. Champion, of the Hymenoptera by Mr. Cameron, and of the "Butterflies" by Messrs. Godman and Salvin, all illustrated by coloured plates of the highest excellence. Various other subjects are in progress, and there can be no doubt that the work, when complete, will give us an account of the zoology of an important region of the New World, executed in a style and with a completeness which has hardly ever been approached by any similar undertaking.

AN important paper on tropical fodder grasses appears in the *Kew Bulletin* for November. The object of the paper is "to draw attention to a few grasses that have attained to first rank for fodder purposes in the tropics, and to give particulars respecting the conditions under which they have been found to thrive." The information given will be of considerable assistance in indicating grasses suitable for cultivation in tropical countries. It will also show some countries that, while they have been spending time and money in endeavouring to introduce foreign grasses, they have overlooked excellent indigenous grasses close at hand.

MESSRS. BLACKIE AND SON have published a small book entitled "First Stage Mathematics." The contents are limited to the requirements of the Code of the Education Department for mathematics as a specific subject.

THE publication of Mr. Hutchinson's "Archives of Surgery," which has lapsed for six months, is now being resumed. No. 21 will appear in a few days, with additional letterpress as well as nine plates, and this number, which commences vol. vi., will contain a chronology of medicine from the fifteenth to the nineteenth century. The publishers will in future be Messrs. West, Newman, and Co.

A ROUGH list (No. 147) of rare and valuable books for sale, has been issued by Mr. Bernard Quaritch. The list includes a number of important archæological works, and a few works belonging to the natural sciences. Mr. W. F. Clay has also just issued a list of scientific books, including the works on chemistry lately purchased by him from the library of the late Prince Lucien Buonaparte.

WE have received a copy of *El Obrero*, a fortnightly paper published at Quito, Ecuador, with a summary of meteorological observations made at the astronomical observatory at that place for the month of September. Observations in that locality are very desirable, and we are glad to see that their publication is to be continued, and copies to be distributed to a number of places.

THE Meteorological Office of Argentina has just issued vol. ix. of its *Anales* in two large quarto parts, forming a splendid contribution to the climatology of that part of the globe. The first part, which contains 678 pages, gives the observations and the means deduced from them, for Cordova, during the years 1872–1892; while the second part, which extends to 400 pages, contains an exhaustive discussion of the data, and of the influence of the various elements on each other, *e.g.* of wind on temperature, &c. It is not possible to give in a brief space any summary of so comprehensive a work. We merely note that the monthly mean temperature varies between 73° in January and 50° in June. The rainfall varies considerably; the mean of a number of years gives about 26 inches. The Director of the Service is G. G. Davis, who is also a member of the International Meteorological Committee, and attended the meeting at Upsala in August last.

Science Gossip is now one of the brightest and most diversified monthlies for the lover of science. The January number is remarkably good. Mr. J. T. Carrington, one of the editors, contributes a number of replies he has received to a letter asking for an opinion upon the use of the word "scientist." The word is never allowed knowingly to appear in contributions to NATURE. A twin-elliptic pendulum, exhibited by Mr. Joseph Gould at the Royal Society's soirées last year, is described by the inventor, and seven exceedingly fine figures, drawn by means of the apparatus, are reproduced. There is also a summary of Schiaparelli's views about Mars; and a page of astronomical ephemerides and notes, as well as scientific news, and notes on various branches of natural science. We are glad to see that physical science comes in for a fair share of attention, but there is still room for improvement.

SIX volumes have lately been added to the comprehensive series of reprints, "Ostwald's Klassiker der Exakten Wissenschaften," published by Engelmann, of Leipzig. No. 54 contains J. H. Lambert's paper, published in 1772, on the projection of terrestrial and celestial maps. The following number is also on map projection, and is made up of memoirs by Lagrange (1779) and Gauss (1822). Translations of two papers by Sir Charles Blagden, from the *Philosophical Transactions* for 1788, appear in No. 56. The subject is the effect of various substances in lowering the freezing point of water. Treatises on thermometry find a place in No. 57, which includes five of Fahrenheit's papers, three of Réaumur's, and a paper by Celsius. The volume thus comprises all the important communications connected with the foundation of the three thermometric scales. The classical work of Scheele on the nature of air and of fire is reprinted in No. 58 of the series; and No. 59 contains Otto von Guericke's experiments with Magdeburg hemispheres, carried out in 1672. The quaint illustrations of the original paper give this volume additional interest.

THE additions to the Zoological Society's Gardens during the past week include a Black-eared Marmoset (*Hapale penicillata*) from South-east Brazil, presented by the Lord Auckland; a Pardine Genet (*Genetta pardina*), a Two-spotted Paradoxure (*Naudinia binotata*) from West Africa, presented by Lieut. F. E. W. Batt; a Sparrow Hawk (*Accipiter nisus*), British, presented by Mr. A. M. Lees Milne; two Long-nosed Crocodiles (*Crocodilus cataphractes*) from West Africa, presented by Captain F. W. Raisin; a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by Mr. G. R. Picton Thwaites; two Grey Parrots (*Psittacus erithacus*) from West Africa, deposited.

Erratum.—In NATURE of December 13, 1894, p. 157, column two, line one, for "of a" read "near the." The cascade represented in the note serves to show clearly the overhanging ledge of limestone.

OUR ASTRONOMICAL COLUMN.

THE GREATER NEBULA OF ORION.—The numerous photographs that have been taken by means of portrait lenses during the past few years, go to show that many of the so-called celestial spaces are really filled with filmy nebulosities. Dr. Roberts's classical photograph greatly extended the limits of the old Theta nebula in Orion, but few astronomers would care to say that it represents the great "tumultous cloud" in its entirety. Indeed, three photographs obtained by Prof. W. H. Pickering in 1889, with a portrait lens, revealed a large zone of nebulosity surrounding the belt and sword handle, and extending towards γ Orionis. The significance of these photographs has perhaps been somewhat overlooked, but attention is again directed to them by a paper communicated by Prof. E. E. Barnard to *Astronomy and Astro-Physics* for December. By means of a lens only $1\frac{1}{2}$ inches in diameter and $3\frac{1}{2}$ inches focus, Prof. Barnard has recently taken two photographs of the Orion constellation (for the lens takes in nearly the whole constellation at one view), with exposures of two hours and one hour fifteen minutes respectively. These pictures show "an enormous curved nebulosity encircling the belt and the great nebula, and covering a large portion of the body of the giant." Without doubt, the nebulous stream which has left its impression upon Prof. Barnard's photographs, is the same as that of which the existence was recorded by Prof. Pickering. The "Great Nebula" in Orion is therefore but a pigmy compared with the greater nebula thus revealed. It is not too much to believe that in a few years the immense band of nebulosity will be shown to be more or less filled with luminous haze, the old nebula being probably but the brightest part of a nebula involving the whole constellation.

THE TRANSIT OF MERCURY.—We have already noted observations of the transit of Mercury on November 10, 1894, made in Europe and America. News has now reached us of successful observations, made under the direction of Mr. J. P. Thomson, at Mr. F. D. G. Stanley's Observatory, Brisbane. The instrument employed was a 6 inch equatorial by Grubb, stopped down to four inches. Times of contact at egress were carefully taken. When the planet had come sufficiently above the horizon to be observable, it had advanced about two-thirds across the solar surface. The whole periphery of Mercury was remarkably clear and well-defined. There was no trace of haze or vapourous aureola around the disc of the planet, but a bright spot was distinctly seen near the centre. At the instant of internal contact at egress there was a faint phenomenon resembling ligament. This, however, was only momentary. When the external contact occurred, the planet's limb tangential with that of the sun was remarkably clear and sharp. There was not a trace of disturbance, and the phase was regarded as a pure

geometrical contact. No trace of the planet's periphery could be seen when it left the solar disc, although it was carefully looked for.

The Government Astronomer at Sydney, Mr. H. C. Russell, states that fifteen photographs were taken of the transit of Mercury. He reports that as the planet crossed the sun it presented the appearance of a round and intensely black disc without any fringe such as has been noticed in former transits, and owing to the unsteady state of the air towards the close of contact, the "black drop" phenomenon took place, preventing clear definition.

AN IMPORTANT ASTEROID.—The minor planet BE 1894 proves to be a very important member of the community to which it belongs. M. Tisserand remarks, in *Comptes rendus* for December 26, that, of all the asteroids, it has the smallest perihelion distance, leaving out of count Brucia (363), of which the elements are very uncertain. When BE is at its descending node, its distance from the orbit of the earth is only 0·67 the radius of this orbit. On account of this circumstance, the asteroid is most favourably situated for the determination of the solar parallax. The elements given by M. Tisserand are as follows :—

1894 November 4·7 Paris Mean Time.

		° ′ ″	
m	...	23 18 38·5	
π	...	357 25 53·5	Mean Eq. 1894.
Ω	...	212 36 51·4	
i	...	23 5 5·7	
ϕ	...	18 4 8·1	
μ	...	1002″·151	
log a	...	0·366049	

PROF. ADAMS' COLLECTED MEMOIRS.—A note in the *Observatory* informs us that Prof. R. A. Sampson, formerly Isaac Newton Student at Cambridge, is gradually reducing to order the large quantity of MSS. left by Prof. Adams. The memoirs relating to lunar theory have been completely separated and arranged, and the lectures on Jupiter's satellites are also well advanced. Memoirs on the solution of the infinite determinant, and others on some small matters, have been separated from incidental and preparatory work; but a considerable quantity of matter is still outstanding, so it may be one or two years more before the examination can be completed, and the collected works be ready for publication.

THE BIRD-WINGED BUTTERFLIES OF THE EAST.

IN the days of Curtis and Stephens, the late Mr. W. C. Hewitson was a diligent collector and observer of British insects of all orders, and likewise an ornithologist, who published several editions of a well-known work on British birds' eggs. But the day came when he was to discover, as he says in one of his own publications, that a butterfly might be beautiful, though it was not a British species; and he became thoroughly infatuated with these beautiful things, to the study and illustration of which he devoted the remainder of his life. And this is how it came about, as he used to relate to those who had the privilege of the acquaintance of a kind old enthusiast, whose work was of immense value to the progress of entomology in its day, though he was unable to sympathise with or to appreciate the vast revolution in modern biology which many men with whom he was intimate—and men, too, not much younger than himself, with Darwin, Wallace, and Bates at their head—succeeded in effecting in a comparatively short time.

One day of the days, as it says in the "Thousand and One Nights," he happened to be at Stevens's Auction Rooms, when a lot was put up containing several species of the well-known genus *Adelpha*, Hübner, or *Heterochroa*, Boisduval, as it was then called, which replaces our European White Admirals in South America. The butterflies attracted his attention, for at that time it was a novelty to him to see a number of butterflies so closely resembling each other, and yet quite distinct; and he bought the lot. He turned round, and saw Prof. Westwood, who said to him, "What, are you buying butterflies?" "Yes, I am," he answered; and thus he commenced the formation of his great collection of butterflies, now in the British Museum, which was fed by the cream of the expeditions of Wallace and Bates, and remained unrivalled up to the day of his death, in 1878, though there are now several collections in England, France, and Germany which surpass it.

The exact date when this epoch-making event in the history of the study of butterflies occurred, we do not know. It is true that the first paper published by Hewitson on exotic butterflies related to the genus *Heterochroa*, and was published in the *Annals and Magazine of Natural History* in 1847; but in the previous year, Edward Doubleday had commenced his great work on the "Genera of Diurnal Lepidoptera," the letter-press of which was completed after his death by Westwood; and Hewitson executed all the plates, as joint author. It is, therefore, probable that Hewitson had already commenced the formation of his collection before that time, especially as his own great work on exotic butterflies was commenced before the actual completion of the "Genera."

Yet, since the death of Hewitson, new countries have been opened up, and wonderful butterflies have reached Europe, never dreamed of by Hewitson, or which remained unattainable objects of his desire, to the last. Chief among these may be mentioned the butterflies of Central Asia, a *terra incognita* except for Eversmann's and Nordmann's papers, in Hewitson's time; and the butterflies of the Eastern Archipelago, for the older naturalists, and even Wallace and Lorquin, much as they were able to accomplish, only succeeded in sampling some few islands, and many others now known to produce some of the strangest and grandest butterflies in existence, remained unvisited and unexplored.

Chief among the butterflies of these islands are the grand species to which Boisduval applied the generic name of Ornithoptera, or bird-winged butterflies, of which only a few, and those not the most remarkable, are found on the mainland of India, the Malay Peninsula, and South China. Many of the species are very closely allied, but others are so different that they can hardly be regarded as congeneric; and it will be well to discuss them by groups.

First of all, we may divide them into the black and yellow species, and those with black and green, orange, or blue males; and each of these two main groups includes a variety of species, which are hardly all congeneric.

Two species only, *O. Priamus* and *O. Helena*, were known to Linné. Several more were figured and described before the end of the last century; but only eight species were described as late as 1836, and though several others were afterwards described, Hewitson's collection only included eighteen, counting several forms which he treated as varieties. Now, however, Mr. Rippon's large work, "Icones Ornithopterorum," at present in course of publication, is intended to extend to eighty folio plates. But there is always some difficulty in determining the exact number of species, for these butterflies are variable, and in the numerous islands of the East there are a great number of closely allied local races, and we are hardly in a position at present to determine whether it is best to treat them all as distinct species, or as different forms of two or three, and especially is this the case with the group of *Ornithoptera Priamus*.

It will be best to commence with the black and yellow species, which are found on the Asiatic Continent, and the Malay Islands, and therefore in nearer and more acessible localities than any of the green species, except *O. Brookeana*. They are also found in the Moluccas, &c., but less numerously, being more abundant in the Malay Islands.

Of this group, *Ornithoptera Pompeus*, Cramer, from Java, may be regarded as typical. The males of this and the allied species are of a velvety black, with the nervures more or less bordered with grey, and the spaces between the ends of the veins on the hind margin, bordered with white. The hind wings are of a beautiful golden yellow, intersected with the black veins, and bordered with black along the hind and inner margins. The inner margin forms a fold which conceals the brown scent-bearing scales, and is fringed with long hairs.[1] On the inner margin, the black border projects into the wing in a series of long cones between the nervures. The females are similar, but the grey markings of the fore wings are more extended, and on the hind wings the scent-organs are wanting, and there is a row of black spots opposite the cones of the border, which are often connected into a continuous series, as

[1] See, for a fuller description of the scent-organs in *Ornithoptera*, Haase, "Correspondenzblatt des entomologischen Vereins, *Iris* zu Dresden," I. pp. 93-94.

well as with the cones themselves. The fore wings are long and narrow, measuring about five or six inches from tip to tip, and the hind margin is very oblique. The hind wings are rounded and dentated, but form almost a right angle at the anal angle of the hind wings. Behind the head, we often find a red collar in one or both sexes. We have not thought it necessary to figure a species of this group, representatives of which may be seen in almost every collection of butterflies from India and the adjacent islands; but we have given figures of the larva and pupa of *O. pompeus* (Figs. 1, 2). The transformations of all the species of *Ornithoptera* are very similar, as far as they are at present known; the larvæ are rather short and thick, with rows of long fleshy spines, and with the retractile scent-producing and defensive bifid horn on the head, common to all the true *Papilionidæ*. In the yellow group, these larvæ are generally brown, with a broad pale oblique band about the middle.

The amount of yellow on the hind wings of the butterflies of the *Pompeus* group differs very much. Sometimes we find only a narrow black border, sometimes a very broad one, and sometimes the base is also black, the yellow colouring being restricted to a broad band, or even to a large spot in the centre. Two or three yellow species, found in Malacca, Borneo, &c., of

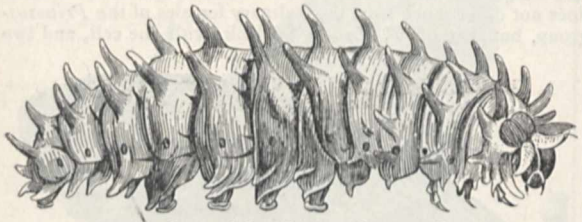


FIG. 1.—Larva of *Ornithoptera Pompeus*, Craw.

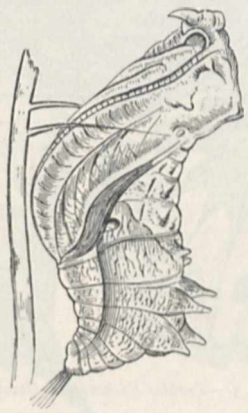


FIG. 2.—Pupa of *Ornithoptera Pompeus*, Craw.

which *O. Amphrysus*, Cramer, is the commonest, are distinguished from the others by having radiating yellow instead of grey lines on the fore wings of the males. Occasionally specimens of the yellow group are met with, with the yellow replaced by deep golden-red; but it is not certainly known whether this peculiarity is accidental or specific.

The grandest of all the yellow species, however, is *O. Magellanus*, Felder, a native of the Philippine Islands. If the butterfly is held towards the light, there is nothing to distinguish it from any other yellow *Ornithoptera;* but if you turn your back to the light, and hold the drawer on a level with your eye, you will see a marvellous iridescence of the most delicate pale silvery blue and green glancing over the whole of the hind wings of the insect. There is nothing to compare with it in any other butterfly, not even in *Morpho Sulkowskyi;* the nearest approach to it is in the iridescence over the red spots in some South American *Papilios* (which, though much smaller, are considered to be closely related to *Ornithoptera*), and in the iridescence over the yellow on the wings of some South American butterflies belonging to the genus *Euselasia*, Hübner. But these latter belong to a different family (*Lemoniidæ*), and are small butterflies, not exceeding an inch and a half in expanse, whereas *O. Magellanus* is a grand black and golden-yellow butterfly, measuring six inches across the fore wings. It is closely allied to several common Indian species, though none of these show more than the very faintest traces of iridescence. But in order to obtain the full effect, it is necessary that *O. Magellanus* should be set *flat*. If the wings are set sloping, according to the old English method, now being rapidly superseded by the flat setting which has always been in use on the continent, the effect of the iridescence is almost entirely lost. *O. Magellanus* is still a scarce insect in collections.

Among the more abnormally coloured species of this group we may mention *O. Plateni*, Staudinger, from the Island of Palawan, in which the male has two broad golden-yellow blotches on the centre of the hind wings, separated by the upper branch of the subcostal nervure; on the underside, and in the female, this colour fills up a large part of the centre of the hind wings. A still more remarkable species was lately discovered by Mr. Doherty in the Island of Salibobo, or Lirung, one of the Talautse Islands, and was described and figured by Mr. Rippon under the name of *O. Dohertyi*. The male is of an intense silky black above, with a slight greenish glow in certain lights; on the underside is a yellow band, parallel to the hind margin, and ceasing before the inner margin. The female has brown fore wings, with the usual grey markings inclining to reddish; the hind wings are darker, with a small irregular buff patch in the centre, divided by the nervures; on the underside this patch is larger, and the ends of the nervures are bordered with the same colour. These butterflies measure about six inches across the wings.

Next to the golden yellow group of *Ornithoptera*, we may place the splendid *O. Hippolytus*, Cramer, the female of which sometimes measures nearly eight inches across the wings.

It is not very closely allied to any other species. The fore wings resemble those of the last group, but the hind wings in the male are dark smoky brown, with a row of large yellow spots extending all round the wings, except on the side next the body; these are bordered, both outside and inside, by a row of nearly connected large black spots. In the female the yellow markings are more extended, and the base of the wings is black; the lower part is bluish-grey; and over the yellow and grey part of the wing runs a marginal row of large white spots. The fold on the hind wings is filled with long fluffy white hair. This insect is met with in Amboina, and Piepers, the Dutch entomologist, records his having seen a specimen mobbed and driven away by small butterflies, just as small birds will mob and drive away a hawk in Europe.

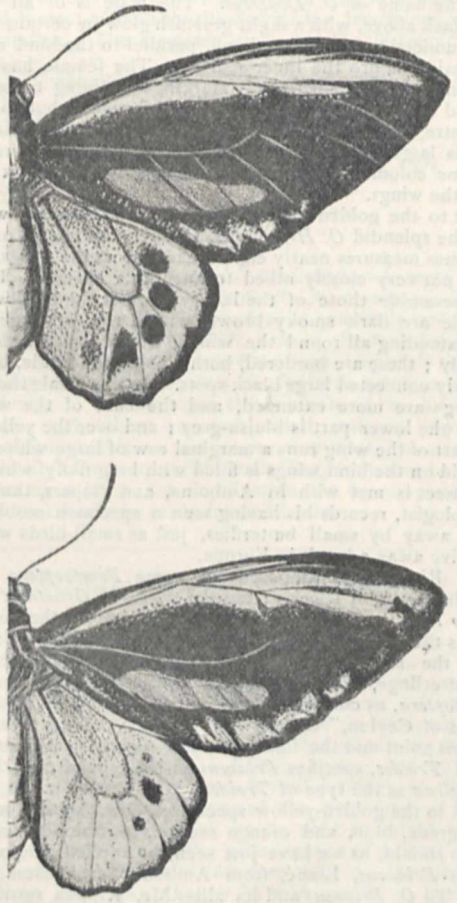
Mr. Rippon has proposed the name *Pompeoptera* for the foregoing series of species; but the types of *Ornithoptera* are *Papilio Priamus* and *Helena* of Linné, and as the former is fixed as the type of *Troides*, Hübner, by Hübner's inclusion of it in the second volume of his "Sammlung exotischer Schmetterlinge," *Helena* remains as the true type of the genus *Ornithoptera*, as correctly given by Mr. Moore in his "Lepidoptera of Ceylon," though Dr. Scudder, having overlooked both this point and the impropriety of regarding *Helena* as the type of *Troides*, specifies *Priamus* as the type of *Ornithoptera*, and *Helena* as the type of *Troides*.

Next to the golden-yellow species of *Ornithoptera*, we come to the green, blue, and orange section, to which the name of *Troides* should, as we have just seen, be applied, and of which *Papilio Priamus*, Linné, from Amboina and Ceram, is the type. To *O. Priamus* and its allies Mr. Rippon restricts the name of *Ornithoptera*.

The species of *Troides* are all very similar except in size and colour, and we have copied Mr. Rippon's figures of the smallest species, *T. Richmondia*, from Australia (Figs. 3, 4, ♂; Fig. 5, ♀). This insect varies in size from 4½ to nearly 6 inches in expanse, the female being always the largest; but in most of the other species in the group, the wings expand 6, 7, or even 8 inches in some of the females. The males of this section have velvety black fore wings, with a wide green bar parallel to the costa, and another, more or less extended, at the hinder angle of the wing, running along the inner margin towards the base, and curving upwards along the hind margin. The hind wings are green, with a row of black spots (sometimes reduced to one or two) along the hind margin. There is a long brown patch of raised scales towards the hind margin of the fore wings in the male, which is quite absent in the yellow group (*Ornithoptera*, true). The females are brown butterflies, with two irregular rows of white spots on the fore wings, the innermost very large (though obsolete in some

species), and with the hind wings pale beyond the middle, and crossed by a row of black spots; the pale part of the wing is whitish within them, and brownish, or yellow, beyond. The sides of the thorax are generally bright scarlet under the wings, and the abdomen is generally yellow in the males, and brown in the females. These green species are not found in the Malay islands, but throughout all the Moluccan and Papuan islands, as far as Australia; though many of the most remarkable are very restricted in their range, being confined to one or two small islands.

Sometimes, as in the male of *T. arruana*, Felder, a narrow green stripe runs along the median nervure and its branches, in the male. In certain lights the green of the fore wings exhibits very remarkable changes of colour to yellow, coppery-red, or blue; the copper-red is most conspicuous in *T. Pegasus*, Felder, from New Guinea, and the blue in *T. Eumæus*, Rippon, from the Aru Islands.



FIGS. 3, 4.—*Troides Richmondia* (male, two varieties).

T. Eumæus leads us on to *T. Urvillianus*, Guérin-Méneville, from New Ireland, from whence several specimens were obtained during the voyages of the *Coquille* and the *Astrolabe* between 1820 and 1830; but no more were brought to Europe for fifty years. They were named after the famous French Admiral, Dumont d'Urville, a worthy successor of our own Captain Cook; and who subsequently perished, with his wife and only son, in the great accident on the Versailles Railway, on May 8, 1842, one of the most terrible and fatal of all on record.

In the male of *T. Urvillianus*, all the portions of the wings which are green in other species, are of a deep blue; but with an iridescence or opalescence in various lights, showing green or coppery. *T. Urvillianus* has lately been found in New Guinea, New Ireland, Duke of York Island, and the Solomon Islands. The butterfly does not appear to be difficult to capture, as Mr. Gervase F. Mathew, R.N., frequently found them descend to low bushes; and he also obtained the larva, which is black, with carmine tentacles, and fleshy spines, the latter tipped with black; about the middle of the body is an oblique white stripe. It feeds on a species of Aristolochia, sometimes quite close to the ground.

From *T. Urvillianus*, we may pass on to other remarkable species. One is *T. Cræsus*, Wallace, from the island of Batchian in the Moluccas. Here the green or blue of the species we have already mentioned is replaced by a brilliant golden orange, shading into green in certain lights. Mr. Rippon treats *T. Cræsus* and *Urvillianus* as a separate *section* (*Priamoptera*) of *Ornithoptera* (which name he retains for the *Priamus*-group); but they can hardly be considered sufficiently distinct from the others to rank as a separate *genus*, as he himself admits.

After *T. Cræsus* we may place *T. Lydius*, Felder, which replaces that species in the island of Gilolo or Halmaheira, one of the Northern Moluccas, not far from Batchian. Here the subcostal band on the wings of the male is of a very deep coppery-red; but both in this species and in *T. Cræsus*, the only other mark on the fore wings, except a short dash at the base of the inner margin, is the very large oval brown sexual blotch. The hind wings are of a rather paler colour than the band of the fore wings, and varied with yellow. The female of *T. Cræsus* does not differ much from the ordinary females of the *Priamus*-group, but that of *T. Lydius* is black, with the cell, and two

FIG. 5.—*Troides Richmondia* (female).

complete rows of long spots, concave at the extremity, and the inner row very large, between the nervures beyond the cell. The hind wings are of a yellowish-brown, with the base, nervures, a submarginal row of mostly connected spots, and another on the hind margin, black.

From the genus *Troides*, we pass on to another splendid group, *Ætheoptera* (Rippon), in which the male has apparently no masses of raised scent-producing scales on the wings, and the hind wings are very long. Intermediate between *Troides Cræsus* and *Ætheoptera Victoriæ*, the type of *Ætheoptera*, stands *Æ.* (?) *Tithonus* (De Haan), from New Guinea, a butterfly which remained unique in the Leyden Museum for fifty years. The fore wings of the male, which are seven inches in expanse, are black, with three changing green and yellow bands, two united at the base, the first running narrowly along the subcistal nervure, and much widened before reaching the apex of the wing; the second, broader at the base, extending along the lower part of the cell, and growing broader beyond as it curves towards the hind margin; the third runs along the inner margin, nearly to the hinder angle of the wing. The hind wings are varied with green and golden-yellow, and are narrowly bordered with black. There are three black spots on the hind wings on the upper side, and more beneath, as well as on the hinder part of the fore wings; the abdomen is yellow, with some black spots above on the sides, towards the extremity.

The female is not certainly known, for it is doubtful whether the insect which has been regarded as such may not be that of another species.

Ætheoptera Victoriæ (Gray), the type of its genus, is likewise a species of which little was known for many years. A single female, damaged by shot, was brought back by Macgillivray from the voyage of the *Herald*, and remained unique in the collection of the British Museum for more than thirty years, when several specimens were obtained by Mr. C. M. Woodford in the Solomon Islands. The true *Æ. Victoriæ* proves to come from the island of Guadalcanar, and the male measures six inches across the fore wings, which are long, narrow, and rather pointed. It is black, with a wide green and yellow space for one-third of the distance from the base, and another blotch of the same colour near the costa before the apex, divided by the veins. The hind wings are very concave at the anal angle, and are green, bordered outside by a yellow band, on which stand three orange spots (also visible below, where they have black spots between and beyond them), and beyond this is a narrow

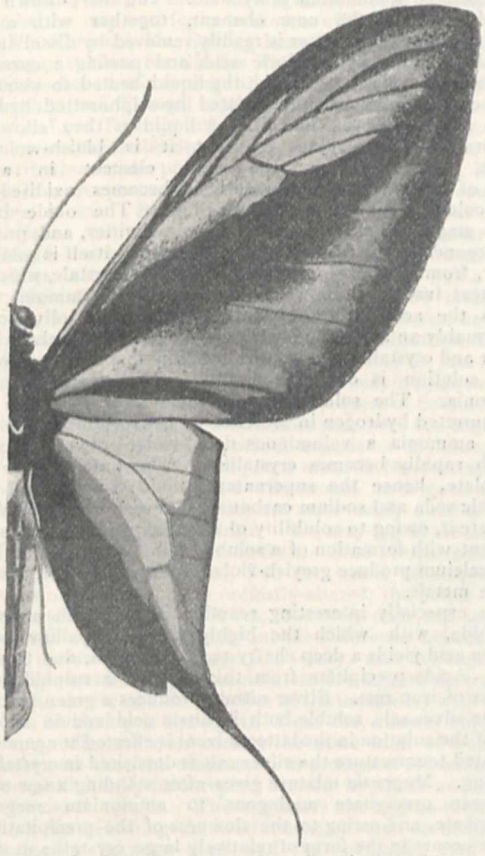


FIG. 6.—*Schoenbergia Paradisea*, Staudinger (male).

black border. The female is a black butterfly, with much broader wings, seven inches in expanse. There is a row of large white spots, and another of submarginal spots on all the wings; on the fore wings a yellow band, white at the extremity, runs along the cell, and another along the inner margin; on the costa of the hind wings is a yellow band. The larva is dark brown, with long carmine fleshy spines; the retractile fork is yellow.

In the island of Malayta is found the closely-allied *O. Reginæ*, Salvin, a larger insect, the male of which has more black on the hind wings, and three orange spots surrounded with green on the orange part of the wing, instead of the yellow band.

These butterflies, as well as *Troides Urvillianus*, frequent the sweet-smelling white flowers of *Cerbera Odollam*, a plant allied to the Oleander, which is common throughout the East Indies and Polynesia.

The next genus, *Schoenbergia*, Pagenstecher, is in some respects the most remarkable of all, as it is the only one allied to *Ornithoptera* which is tailed. The only species, *S. Paradisea*, Staudinger, was captured by natives in the Finisterre Mountains in New Guinea, at a height of 500 metres. The male (Fig. 6) measures five inches across the fore wings, which are black, with two broad green bands glossed with golden yellow, one below the costa, and the other between the cell and the submedian nervure, and curved upwards, opposite the hinder angle of the wing, to beyond the middle of the hind margin. The hind wings are remarkably short, not more than three-fifths of the length of the inner margin of the fore wings, but they are very long and narrow, with the hind margin almost straight, and a tail quite as long as the wing is broad, at the outer angle; the inner margin is lobate. The hind wings are green, more suffused with orange-yellow than the fore wings, and narrowly bordered outside with black, but with the base and inner margin very broadly black.

The females are larger, and exhibit nothing unusual in form or colouring, being black, with two more or less developed rows of white spots on the fore wings, large towards the costa, and diminishing towards the hinder angle, where they converge; on the hind wings is a pale submarginal band, extending over the lower half of the wing, but much narrowed towards the costa; the outer part is yellow, shading within to bluish-grey and whitish; across it runs a row of black spots.

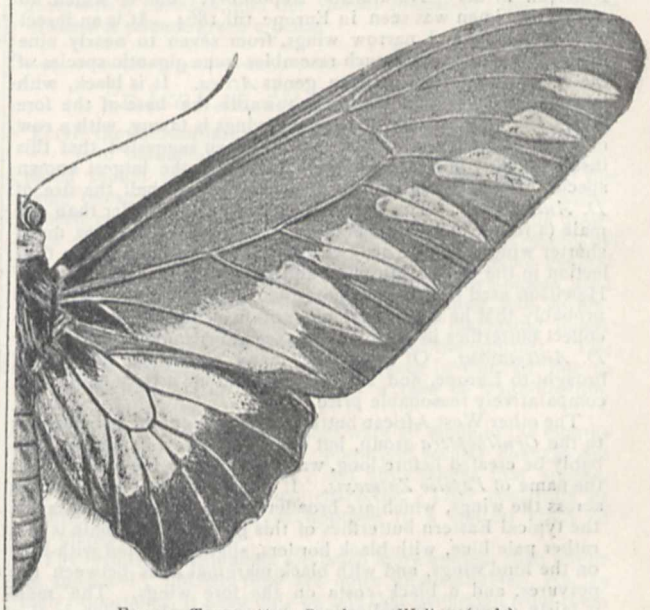


FIG. 7.—*Trogonoptera Brookeana*, Wallace (male).

This is the only known species of the group with tails on the hind wings; but this seems to be a tendency in some Papuan *Lepidoptera*. Thus the true Atlas Moths belonging to the East Indian and South American genus *Attacus*, Linné, are all tailless; but there is a closely-allied genus (*Coscinocera*, Butler) found in New Ireland and at Cape York, which has very long tails; in fact, these moths are probably the largest tailed *Lepidoptera* known.

We have one more Eastern genus to mention, which we have left till last because it occupies a rather isolated position, and would have interrupted the sequence of our genera. This is *Trogonoptera*, Rippon, the type of which is *T. Brookeana*, Wallace, which was discovered in Sarawak, Borneo, by Dr. A. R. Wallace, and named after Rajah Brooke (Fig. 7). It is the only green *Ornithoptera* which inhabits the mainland of Asia (the Malay Peninsula) and the adjacent islands of Sumatra and Borneo. It measures from six to eight inches across the wings, which are black, the fore wings very long, with the hind margin very oblique, and the hind wings short, rounded, and dentated. The front of the thorax and the sides below the wings are crimson. The fore wings have a row of large green submarginal triangles, with the pointed ends resting on the hind margin, and each triangle intersected by a nervure; on the hind wings the whole centre is green. In the female, the green is much more glossed with brassy, and is bordered within with blue,

which is rarely the case in the male, and the green markings, which disappear towards the costa in the male, are there in the female replaced by long bifid grey streaks between the nervures. An interesting account of the habits of this species, as noticed by various observers, is given by Mr. Rippon in his "Icones Orthopterorum."

One other species of this genus is known: *T. Trojana*, Staudinger, from Palawan, an island about a hundred miles from the north coast of Borneo. Here the brassy-green spots of the fore wings of the male are shorter and more subconical, instead of forming long isosceles triangles, and there is only a row of connected green spots across the hind wings, bordered within with blue; the base of the wings is also marked with rich blue across the nervures, and along the edge of the fold of the hind wings.

Some idea of the market value of conspicuous insects, before they are sent over in numbers, may be gathered from the circumstance that a specimen of this butterfly recently sold for £15 at Stevens's auction rooms.

This is the last genus included in *Ornithoptera* which is met with in the East, but the two largest West African butterflies are likewise considered to belong to this group, and may receive a passing notice here. One of these is the famous *Drurya Antimachus*, which was brought by Smeathman from Sierra Leone, and figured by Drury in 1782, and, afterwards, by Donovan in his "Naturalists' Repository," but of which no second specimen was seen in Europe till 1864. It is an insect with very long and narrow wings, from seven to nearly nine inches in expanse, and much resembles some gigantic species of the very characteristic African genus *Acræa*. It is black, with large tawny spots and markings towards the base of the fore wings, the greater part of the hind wings is tawny, with a row of black submarginal spots. It has been suggested that this insect possibly mimics an extinct *Acræa*, for the largest known species of that genus are not much more than half the size of *D. Antimachus*. The female is considerably smaller than the male (a rather unusual character in butterflies), and has much shorter wings. There are two specimens in the Hewitson Collection in the British Museum, and it was one of these that Mr. Hewitson used to say cost him £500. The real explanation is probably that he spent that amount in sending out agents to collect butterflies in Africa, with special instructions to look for *D. Antimachus*. Of late years, many specimens have been brought to Europe, and the butterfly can now be bought at a comparatively reasonable price.

The other West African butterfly now recognised as belonging to the *Ornithoptera* group, but for which a new genus will probably be created before long, was described by Hewitson under the name of *Papilio Zalmoxis*. It measures about seven inches across the wings, which are broader and more rounded than in the typical Eastern butterflies of this group. The male is of a rather pale blue, with black borders, slightly spotted with blue on the hind wings, and with black marginal lines between the nervures, and a black costa on the fore wings. The male is fairly common in collections, but the female, which is of a dull yellowish grey instead of blue, is still very rare.

It is curious that, like the gorilla and chimpanzee, the nearest relatives of these two great West African butterflies (if we except *Papilio Ridleyanus*, White, a West African butterfly which has some resemblance to *D. Antimachus*, though it is much smaller and redder), are to be looked for in the islands of the Eastern Archipelago.

W. F. KIRBY.

A NEW ELEMENT IN THE NITROGEN GROUP.

A NEW element appears to have been discovered by Dr. Bayer in the residual liquors derived from the older process for the extraction of aluminium from red bauxite, and an account of it is communicated to the current issue of the *Bulletin de la Société Chimique*. The liquors in question consist chiefly of sulphate and carbonate of sodium, but there are also present considerable quantities of chromic and vanadic acids, and smaller quantities of molybdic, silicic, arsenic, phosphoric, and tungstic acids, together with alumina, magnesia, and lime, and an acid of the new element. In order to isolate the latter, the vanadium and chromium are first removed, the former as the difficultly soluble ammonium vanadate, and the latter as hydrated sesquioxide. The filtered liquid is then saturated with sulphuretted hydrogen, and the sulphides, all of which are soluble in the alkaline liquid, are precipitated by hydrochloric acid. This precipitate exhibits a deep brown colour, due to the new element. When dried it presents a brown earthy appearance, and burns readily with evolution of sulphur dioxide and formation of a bright brown powder. Concentrated nitric acid instantly causes ignition, and formation of a deep brown solution, from which a small quantity of a yellow precipitate of a compound of molybdic and arsenic acids is deposited. The brown liquid contains no tin, antimony, or tellurium, but still retains traces of vanadium, molybdenum, and selenium. These elements are best removed by calcination of the sulphides immediately after their precipitation with hydrochloric acid when selenium is volatilised, treatment of the residue with ammonia and ammonium nitrate, which precipitate the last traces of vanadium as ammonium vanadate, and concentration of the filtered liquid which causes deposition of ammonium molybdate. During the concentration two distinct crops of different crystals are obtained, the first and most sparingly soluble being cubic crystals of an olive-brown colour, and the second the much more soluble ammonium molybdate. The olive-brown cubic crystals contain the new element, together with a little molybdenium. The latter is readily removed by dissolving the crystals in dilute hydrochloric acid, and passing a current of sulphuretted hydrogen through the liquid heated to about 70°. The new element is not precipitated by sulphuretted hydrogen in an acid solution. The filtered liquid is then allowed to evaporate in the air. At first it is bluish-violet in colour, and contains the new element in a low state of oxidation; subsequently it becomes oxidised, and the colour changes to lemon yellow. The oxide in the latter stage possesses marked acid proclivities, and probably corresponds to the formula R_2O_5. The acid itself is soluble in water, from which it is deposited in yellow crystals, which at a red heat fuse to a brownish yellow mass. Ammonia transforms the acid into a crystalline powder of olive colour, presumably an ammonium salt, which readily dissolves in hot water and crystallises from the solution in cubes on cooling. The solution is olive green and is precipitated by strong ammonia. The solution of the acid after reduction with sulphuretted hydrogen in presence of hydrochloric acid yields with ammonia a voluminous deep violet-brown precipitate, which rapidly becomes crystalline. The precipitation is not complete, hence the supernatant liquid is coloured violet. Caustic soda and sodium carbonate likewise incompletely precipitate it, owing to solubility of the precipitate in excess of the reagent with formation of a soluble salt. Chlorides of barium and calcium produce greyish-violet precipitates of the salts of those metals.

An especially interesting reaction is that with ammonium sulphide, with which the highly oxidised yellow solution of the acid yields a deep cherry-red colouration, due to a sulfo-salt. Acids precipitate from this solution a sulphide of the colour of iron rust. Silver nitrate produces a green precipitate of the silver salt, soluble both in nitric acid and in ammonia, and if the solution in the latter solvent is effected at a moderately elevated temperature the silver salt is deposited in crystals upon cooling. Magnesia mixture gives after standing a few minutes a green precipitate analogous to ammonium magnesium phosphate, and owing to the slowness of the precipitation the latter occurs in the form of relatively large crystals; moreover, the precipitation is complete after a short time, for the liquid which at first is green becomes colourless. A yellow precipitate is likewise afforded with a nitric acid solution of ammonium molybdate, as in the case of phosphoric acid. The chlorides of the new element appear to be volatile, for very considerable loss occurs on attempting to remove by ignition any admixed ammonium salts, for instance from the solution obtained after removal of the vanadium as previously described. A yellow sublimate is produced having all the characters of a chloride of the new element, and which is readily soluble in water.

A sufficient quantity of the new element in the form of any of its compounds has not yet been accumulated to enable exact quantitative analyses to be carried out, but Dr. Bayer hopes shortly to have obtained the amount requisite for this purpose and for the determination of the atomic weight of the element. There appears to be little room for doubt that it will prove to be one of the missing elements predicted by Prof. Mendeléeff in the nitrogen-phosphorus group. It exhibits characteristic spectroscopic lines in the green, blue, and violet.

A. E. TUTTON.

SCIENCE IN THE MAGAZINES.

A FULLY illustrated description of Mr. Maxim's experiments in aerial navigation is contributed to the *Century* by Mr. Maxim himself. The account of the new flying machine and its various parts is the best we have seen. The total result of Mr. Maxim's experiments is now fairly well known. It has been proved that a machine, carrying its own engine, fuel, and passengers, can be made powerful and light enough to lift itself in the air. The experiments also prove that an aëroplane will lift a great deal more than a balloon of the same weight, and that it may be driven through the air at a very high velocity, and with an expenditure of power very much less than that required to drive a balloon at even a moderate pace. In addition to this, they have clearly shown that a well-made screw propeller obtains sufficient grip on the air to propel a machine at almost any speed, and that the greater the speed the higher the efficiency of the screw. These results have certainly forwarded the problem of aerial navigation. The *Century* also contains an article on customs, fêtes, and celebrations in American Colleges for Women; and, in the same magazine, a brief description is given of the new anti-toxin treatment of diphtheria.

In the *National*, Mr. Stanley Lane-Poole pays tribute to the memory of the late Sir Charles Newton. (A notice of some of the researches of this distinguished archæologist will be found on p. 250.) Prof. Foxwell replies, on behalf of professed economists, to Lord Farrer's article in the October number of the same review, upon the Standard of Value. Towards the end of a contribution on the present state of the Royal Navy, Mr. W. Laird Clowes expresses himself upon the subject of the education of naval officers. Referring to the training of a naval officer, he remarks: "A century ago . . . it was not necessary that he should know anything of chemistry, of engineering, of hydraulics, of pneumatics, of electricity, and of half a dozen other subjects concerning which he must now know more than a little. . . . But at present, if an officer goes to sea, he has to suspend, in a great measure, the progress of his education. Theory is at the base of nearly all of it, and the theory is just as requisite as the practical experience, and, indeed, in some matters, even more so. . . . The seaman is in process of becoming the engineer; every year he becomes more and more the engineer; and I am certain that a much briefer experience of the sea than was formerly needed is now required towards the formation of a good officer. *Per contra*, he who would be a good officer requires very many things which are more easily obtainable at Portsmouth than in mid-Atlantic. We may regret the change, but we must not shut our eyes to facts. And I think the sooner the change is fully recognised, and the whole scheme of the education of naval officers is radically altered, the better will it be for the service." Mr. Clowes, however, does not seem to have sufficiently taken into account the difference between the duties of the navigating officers of the navy, and the engineers. Naval engineers at the present time receive admirable training in both the theory and the practice of the machinery with which a modern battleship is equipped. Does Mr. Clowes hold that navigating officers should receive the same kind of training? The statement that the seaman is in process of becoming the engineer, will hardly be accepted literally by those acquainted with the naval service. The engineers and engine-room artificers are fast becoming the most important men on board, but the distinction between them and the navigating staff is as hard and fast as ever it was.

In the *New Review* are some verses having a singularly strange and appropriate rhythm, by the late R. L. Stevenson, in which he has expressed his keen sense of the struggle for existence; and we find in the critical article upon this last among the many losses of 1894, by Mr. Archer, how profoundly modern scientific thought had affected his philosophy. There is also the first instalment of an eccentric story by Mr. H. G. Wells, in which, after certain rather paradoxical dealings with the four dimensions, a "Time Traveller" starts into futurity upon a *Time Machine*. What he found there remains to be told in a subsequent number, but there certainly seems scope for the scientific imagination in such a story.

A paper on "Feeling of Beauty in Animals," in *Chambers's Journal*, will interest students of nature. So long ago as 1866 a letter was published in the *Athenæum* under the same title, and attracted the notice of Charles Darwin. Birds offer, perhaps, the best proofs of a feeling for beauty exterior to themselves There are the Bower Birds of Australia, and the Gardener Bower Bird of New Guinea, each of which decorates its bower with various objects. The Hammerkop or Hammerhead also nourishes æsthetic tastes, and other instances of birds showing a decided taste for ornament are described in the article referred to.

A passing notice will suffice for the remaining articles on scientific subjects in the magazines received by us. Some interesting reminiscences of the late Oliver Wendell Holmes as professor of anatomy, are given by Dr. T. Dwight in *Scribner*. *Good Words*—the first number of a new series—contains the first part of a paper on Sir Isaac Newton, by Sir Robert Ball; and some speculations by the Rev. Canon Scott on the physiographical consequences that would have resulted if the earth rotated from east to west instead of west to east. Mr. Grant Allen writes another "Moorland Idyll," in the *English Illustrated*. To the *Humanitarian*, St. George Mivart contributes the concluding part of his popular exposition of the doctrine of heredity. We are glad to note that the second number of the *Phonographic Quarterly Review* contains several scientific articles, each of which will help to familiarise phonographers with scientific phrases. The *Contemporary* has an article on the London County Council, by Mr. Sydney Webb, in which the work of the Technical Education Board is incidentally referred to. In addition to the magazines and reviews named in the foregoing, we have received the *Fortnightly*, *Longman's*, *Cornhill*, and the *Sunday Magazine*; but in none of these is science given a place.

SEASONAL CHANGES ON MARS.[1]

FOR the substantiation of changes on the surface of Mars, it is of paramount importance that the drawings to be compared should all have been made by the same person at the same telescope, under as nearly as possible the same atmospheric conditions. So much, at least, is fulfilled by the drawings referred to in this paper. For they were all made by Mr. Lowell at the same instrument, under the same general atmospheric conditions. Even the different eye-pieces used vary chiefly in a manner to minimise, if anything, and so emphasise the differences observed. For with increasing image the higher power used tends to decrease the contrast. The result is that it largely offsets the difference in contrast due to nearer approach, and leaves simply a case of magnification, with the values untouched.

Since, furthermore, the drawings were all made in the months preceding and following one opposition, secular changes are practically out of the question; and any changes that appear, are presumably of a seasonal character. They constitute of themselves a kinematical as opposed to a statical study of the planet's surface.

The resulting phenomena are much more evident than might be supposed; indeed, they are quite unmistakable. As for their importance, it need only be said that deduction from them furnishes, in the first place, strong inference that Mars is a very living world subject to an annual cycle of surface growth, activity, and decay; showing, in the second place, that this Martian yearly round of life must differ in certain interesting particulars from that which forms our terrestrial experience.

The phenomena evidently make part of a definite chain of changes of annual development. So consequent and, in their broad characteristics, apparently so regular are these changes, that it is not difficult to find corroboration of what appears to be their general scheme in drawings made at previous oppositions. In consequence it will be possible in future to foretell, to some extent, the aspect of any part of the planet at any given time.

The changes in appearance presented by the planet described by Mr. Lowell, refer primarily not to the melting of the polar snows, except as such melting forms the necessary preliminary to what follows, but to the subsequent changes in appearance of the surface itself. To their exposition, however, the polar phenomena become inseparable adjuncts, since they are inevitable auxiliaries to the result.

With the familiar melting of the polar snow-cap, therefore, this account properly begins, since with it begins the yearly round of the planet's life. With the melting of the Earth's Arctic or Antarctic cap might, similarly, be said to begin the

[1] Abstract of a paper by Mr. Percival Lowell, in *Astronomy and Astro-Physics* for December.

Earth's annual activity. But there appears to be one important difference here at the very outset between the two planets. In the case of the Earth, the relation of the melting of its polar snows to the awakening of surface activity is chiefly one of *post hoc* simply; in the case of Mars, it seems to be one of *propter hoc* as well. For unlike the Earth, which has water to spare, Mars is apparently in straits for the article, and has to draw on its polar reservoir for its annual supply. To the melting of its polar cap, and to the transference of the water thus annually set free to go its rounds, seems to depend all the phenomena upon the surface of the planet.

The observations upon which this deduction is based extend over a period of more than five months; from the last day of May, 1894, to the 7th of November. They cover the regions from the south pole to about latitude thirty degrees north. It is probable that analogous changes to those recorded, differing, however, in certain marked particulars, occur six Martian months later in the planet's northern hemisphere. For though it is likely that the general system is one for the whole planet, it is also likely that the distribution of the planet's surface details alters the action to some extent.

In order to appreciate the meaning of the changes, it should be borne in mind that the vernal equinox of Mars' southern hemisphere occurred on April 7, 1894; the summer solstice of the same hemisphere on August 31; and that its autumnal equinox will take place on February 7.

On the 31st of last May, therefore, it was toward the end of April on Mars. The south polar cap was then very large, upwards of 45° across, and already in active process of melting. The tilt of the planet's axis towards the Earth enabled it to be well seen, and disclosed the fact that it was bordered persistently by a dark band, broader in some places than in others, but keeping pace with the snow's retreat. The average breadth of the dark band was, in June, 220 miles. It was the darkest marking on the disc, and was blue.

As the season advanced and the snow cap diminished, its dark girdle diminished in breadth, with fluctuations dependent, doubtless, on the draining capacity of the ground. In August it showed as a slender dark thread.

This formation was water, beyond a doubt; for it was of the colour of water, it faithfully followed the melting of the snow, and it subsequently vanished—three independent facts mutually confirmatory to this conclusion.

That it was the darkest blue marking on the disc, implies that it was the deepest body of water on the planet. That it subsequently entirely drained off, implies that its depth could not have been very great. Both facts together make a first presumption in favour of its being not only the chief body of water on the planet, but the only one of any size.

This polar sea plays *deus ex machina* to all that follows.

So soon as the melting of the snow was well under way, long straits of deeper tint than their surroundings made their appearance in the midst of the dark areas. They were already there on the last day of May. The most conspicuous of them lay between Noachis and Hellas in the Mare Australe, and thence through the Mare Erythæum to the Hour-glass Sea (Syrtis Major). The next most conspicuous one came down between Hellas and Ansonia. Although these straits were very distinguishably darker than the rest of the seas through which they ran, the seas themselves were then at their darkest. The fact that these straits ran through the seas, suffices to raise a second doubt whether the seas be seas. The subsequent behaviour of the so-called seas renders their aquatic character still more doubtful.

At the initial stage of the Martian Nile-like inundation, the seas were at their darkest. This is probably due both to the fact that some water had already found its way down from the pole, and also to the fact that moisture had been deposited there on the water's journey up, and had quickened the vegetation of those relatively amphibious lands.

For some time the dark areas continued largely unchanged in appearance; that is, during the earlier and most extensive part of the melting of the snow-cap. After this, their history became one long chronicle of drying up. Their lighter parts grew lighter, and their darker ones less dark. For even to start with, they were composed of every grade of tint. Indeed, one of the most significant features about them was that at this epoch it was impossible to fix any definite boundaries to the south temperate chain of islands. The light areas and the dark ones merged indistinguishably into each other. Viewed from the standpoint of maps of Mars, the landmarks of this whole region lay obliterated by a deluge; not directly, but indirectly. Probably the region was in various stages of vegetal fertility in consequence of a comparatively small body of water then inundating it. The colour of the dark areas was then, and is now, to my eye, a bluish-green; quite unmistakably so. This tint gradually faded out to give place to orange-yellow.

The first marked sign of change was the reappearance of Hesperia; this took place in July. It was not till the end of October, on the 30 h, that Atlantis was caught sight of. About the same time the straits between the islands, Zanthus, Scamander, Ascanias and Simois, came out saliently dark, a darkness due to contrast.

Meanwhile the history of Hesperia continued to be instructive. From having been invisible in June, and conspicuous in August, it returned in October to a mid-position between the two. Vacillating as these fluctuations may seem at first sight, they will all be found to be due to one progressive change in the same direction, a change that showed itself first in Hesperia itself, and then in the regions round about it. From June to August, Hesperia changed from a previous blue green, indistinguishable from its surroundings, to yellow, the parts adjacent remaining much as before. In consequence the peninsula stood out in marked contrast to the still deep blue-green regions by its side. Later the surroundings themselves faded, and their change had the effect of once more partially obliterating Hesperia.

While Hesperia was thus causing itself to be noticed, all the rest of the south temperate zone, as we may call it for identification's sake, was unobtrusively pursuing the same course. Whereas in June all that part of the disc comprising the two Thyle, Argyre II. and like latitudes was chiefly blue-green, by October it had become chiefly yellow. The separate identity of these islands became then for the first time apparent. Still further south, what had been first snow and then water turned to yellow land. This metamorphosis went on till, on October 13, the remains of the snow-cap entirely, or practically entirely, disappeared—the first complete disappearance of it on record. After this event the whole south polar region was one yellow stretch.

Toward the end of October a strange and, for observational purposes, distressing phenomenon took place. What remained of the more southern dark regions proceeded unexpectedly to fade in tint throughout. This was first noticeable in the Cimmerium Sea; then in the Sea of the Sirens, and in November in the Mare Erythræum about the Lake of the Sun. This fading steadily progressed until it got so far that in poor seeing the markings were almost imperceptible, and the planet presented a nearly uniform yellow disc.

Now, this fading out of the dark areas is a highly significant fact, with a direct bearing upon their constitution. For it is not simply that portions of the planet's surface have changed tint, but that, taking the disc in its entirety, the amount of the blue-green upon it has diminished, and that of the orange-yellow proportionately increased. Mars appears more Martian than he did in June. Now, if the blue-green areas represent water, where has this water gone? Nowhere on the visible disc. That is certain. For in that case the amount of the dark areas should not be perceptibly lessened—which it is. Nor can it all very well have gone to that part of the planet that is hidden from view. For Schiaparelli's observations in 1882 go to show that the northern snow-cap forms late—one month *after* the vernal equinox of the northern hemisphere on that year. Since, therefore, the water fails to prove an *alibi*, presumption is instantly raised in favour of the alternate hypothesis, that the blue-green areas represent vegetation, fertilised by a comparatively small amount of water whose direct presence or absence is not very perceptible to us, but whose indirect effects are. For vegetation might change from green to yellow without requiring any corresponding inverse change elsewhere.

Now, though the passage of the water may not be traced by its amount, there is a further change which has lately appeared on the disc which hints at what has become of it. The canals have darkened. What is more, their darkening has pursued a perfectly definite course, proceeding steadily from south to north.

The following observations show, first, that the canals are not equally visible at all times; and secondly, that their invisibility is a matter of the Martian seasons.

In June the canals were very faint markings indeed. The least faint were those in the Solis Lacus region. As the planet

approached us, they all became naturally easier to make out; but until October no change apparently occurred in any of them, except those in the region about the Lake of the Sun. These by September were already dark. In October they began to show symptoms of growing lighter again. At the next presentation, in November, they showed further signs of change, though not differing as yet very unmistakably in tint. Meanwhile, when the Sinus Titanum region came round in November, I found that its canals had begun likewise to darken. The canals were not only darker relatively to the Mare Cimmerium and the Mare Sirenum than they had been, but actually darker themselves. In the next few nights the more northern canals about Ceraunius had followed suit. They had darkened relatively to the southern ones about the Lake of the Sun.

Now, on looking at a map of Mars, it will be seen that the Solis Lacus region is that part of the continental areas which lies nearest the south pole. Similarly, that the region about Sinus Titanum is the next farthest south. The matter of latitude therefore affects the point.

The canals and so-called lakes share, therefore, in the annual metamorphosis, with a season change dependent in a general way upon their latitudes. A wave of deepening tint passes successively through the blue-green regions from south to north, timed to the seasonal wave that travels from pole to pole. From being pale in winter, their colour comes with the spring, deepens through the summer, and dies out again in the autumn. In any given locality the change comes early or late, in proportion as the place lies, other things equal, distant from the pole.

That this change of tint is due indirectly to water, and directly to the vegetation that water induces, seems probable. For just as there is great difficulty in disposing of the water on the first supposition, so the second would lead us to expect just the phenomena observed. It may therefore be concluded that the formations known as the seas of Mars are probably midway in evolution between the seas of Earth and the seas of the Moon. That is to say, they are not barren ocean beds, but are in that half-way stage of the process when their low-level helps them catch what water still voyages upon the planet's surface, though they have long since parted with their own.

Throughout all these interesting changes that follow the seasons across the face of Mars, there is but one feature approaching permanence—the great continental areas. Except for a possible variation in brightness here and there, this great area has remained unchanged. Like the reddish desert regions of our Earth, its colour and immutability point to like character for cause. It does not change because it is already past such possibility. It is one vast desert waste.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A NEW post has been created under the Education Department for the purpose of obtaining special information and issuing special reports, from time to time, in relation to educational work at home and abroad. The frequent demand for fuller information on many educational subjects, and the great increase of purely administrative work, both at the Education Department in Whitehall and at the Science and Art Department, have made it desirable to have a separate officer in charge of a small additional branch for the above-named purpose, who will be designated "Director of Special Inquiries and Reports." This appointment has been accepted by Mr. M. E. Sadler, Student of Christ Church, and Secretary of the University Extension Delegacy at Oxford.

THE Technical Education Board of the London County Council will be prepared early in July, 1895, to award not more than five Senior County Scholarships of the annual value of £60 in addition to the payment of college fees, tenable for three years, and subject to annual renewal. The scholarships are intended to provide the means of obtaining advanced technical training in a university, university college, or technical institute of university rank for students (young men or women) of exceptional ability who would otherwise find it impossible to secure such training. Candidates must, as a rule, be under nineteen years of age on September 1, 1895, but the Board is prepared to consider very special cases in which the candidates are above that age. The scholarships are offered with the view of encouraging the study of science or art, with special reference to industrial requirements, and will be tenable at such institutions giving appropriate instruction within the statutory definition of technical instruction as may be selected by the scholars and approved by the Board. In the selection of scholars the Board will have regard, in the first instance, to the past achievements of the candidates, but the Board reserves the right to require any or all of the candidates to undertake an examination if it think fit. No candidate will be eligible whose parents have an income from all sources of more than £400 per annum.

SINCE November 1893, the Technical Education Board of the London County Council have awarded 721 Junior County Scholarships, each of the value of £20 and two years' free schooling. More than three thousand candidates presented themselves in competition for the scholarships, which are restricted to children whose parents are in receipt of not more than £150 a year. A detailed analysis of the occupations of the persons whose children competed for these scholarships is given in the *London Technical Education Gazette*. It indicates that the highest percentage of candidates who received scholarships is to be found in the leather trades, and next to these in the printing trades and jewellery and fine instrument trades. After these come the artistic trades and crafts, but the most remarkable feature is the comparatively poor results obtained by the children of clerks, agents and warehousemen, and the very poor success achieved by the professional classes. The time is not far distant when the scholarships granted by the Board will amount to the value of £30,000 per annum.

SCIENTIFIC SERIALS.

The Mathematical Gazette, No. 3, December, 1894.—The eccentric circle of Boscovich. In this continuation the editor considers a special case in which the centre of the eccentric circle lies on the straight line whose points of intersection with the conic are required. He then discusses the method as one of transformation, and finally points out a connection between reversion and perspective projection.—Dr. Mackay, in Greek Geometers before Euclid, writes upon Pythagoras and the Italic school.—Cajori's "History of Mathematics" is an all too short notice, by Dr. G. B. Halsted, of a book that has come in for a fair amount of praise and blame. There are some very interesting problems, solutions of examination questions, and questions for solution.—Prof. A. Lodge supplies an addition to his previous article on approximations and reductions.—We note, with pleasure, that in future the *Gazette* is to be enlarged to twelve pages. This additional space will greatly help to increase the use of this journal, which has so quickly made its way in school circles.

Bulletin of the American Mathematical Society (2nd series, vol. i. No. 3, December, 1894).—The group of Holoedric Transformation into itself of a given group, by Prof. E. H. Moore, is a paper read before the Society at its November meeting. The remaining article is by Dr. G. A. Miller, on the non-primitive substitution-groups of degree ten. A list of these was given in the *Quarterly Journal of Mathematics*, vol. xxvii. pp. 40–42. A result of the article before us is that the following six groups should be deleted from that list, viz. 200_2, 200_7, 200_8, 100_3, 50_2, 50_3.—In the *Briefer Notices* short accounts are given of H. Hertz, "Gesammelte Werke," Band iii. This volume, the first one as yet issued, contains a memoir on the principles of theoretical mechanics and mathematical physics, which was composed during the last three years of the author's life. The next notice gives a sketch of a new edition of Grassmann's mathematical works. It is to be hoped that, as was recently suggested in NATURE by Prof. Genese, a translation into English of the *Ausdehnungslehre* may soon be made, for the convenience of many students in this country. The other notices summarise the contents of the *Jahresberichte der Deutschen Mathematiker-Vereinigung* (vol. iii. 1893), of the *Proceedings* of the American Association—for the forty-second meeting, held at Madison, Wis. (August, 1893); of "Le Livret de l'étudiant de Paris" (Paris, 1894).—The *Notes* comprise accounts of the November meetings of the American and London Mathematical Societies. By the way, the reporter, who is a member of the latter Society, gives one of the names of the Council incorrectly. There is also an ac-

count of the meeting, in September last, at Vienna, of the German Mathematical Association. The *Bulletin* well maintains its position, and closes with its useful lists of new publications.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, Dec. 13, 1894.—Major Macmahon, F.R.S., President, and subsequently Mr. A. E. H. Love, F.R.S., Vice-President, in the chair.—The following communications were made:—On Maxwell's law of partition of energy, by Mr. G. H. Bryan. In his recent report to the British Association, the author had shown that if a large number of dynamical systems of any kind be taken, all similar in every respect, it is always possible to distribute their coordinates and momenta so that the distribution shall remain permanent, and shall satisfy Maxwell's law of partition of energy. By this is meant that if the kinetic energy of each system be reduced to a sum of squares, the mean values of these squares are equal. But the author had doubted whether it was possible in any case to infer that the *time averages* of the squares forming the kinetic energy of a single system were equal. In the present paper the connection between *time averages*, and *averages taken over a large number of different systems*, is examined more fully by means of an artifice suggested by Prof. Boltzmann's paper "On the application of the determinantal relation to the theory of polyatomic gases" (published as an appendix to Mr. Bryan's report). Instead of a vessel containing gas (as taken by Prof. Boltzmann), any single dynamical system is taken whose coordinates and momenta return to their original values after a long time T. If the time be divided into an infinitely large number (n) of infinitely short intervals (i), we can derive a stationary distribution by taking n systems and starting them, the first at time 0, the second at time i, the third at time $2i$, and so on, giving every system the same coordinates and momenta at the time of starting it. At the end of the time T, we shall have the systems distributed according to a permanent or stationary law, and at any subsequent instant the mean value of any function of the coordinates and momenta for the different systems will be equal to the time average of the corresponding function for the original single system. If, however, we *start* with a number of systems distributed according to a permanent law, we *cannot pass back to the original single system unless we can show that the law of permanent distribution is unique*. Now in any simple test case, such as that afforded by rigid bodies movable about fixed points or particles moving in planes after the manner of a Lissajou's curve tracer, a stationary distribution exists satisfying Maxwell's Law of Partition, but other stationary distributions are possible which do not satisfy the law. Hence the author concludes that the time averages of the squares into which the kinetic energy of a single system can be divided, are *not* in general equal, at any rate independently of initial circumstances.—The Spherical Catenary, by Prof. A. G. Greenhill, F.R.S. The pseudo-elliptic integrals developed in the *Proc.* L.M.S. xxv. are applied in this paper to the construction of solvable cases of the spherical catenary, given by the relation

$$\psi = \int \frac{A\,dz}{(1 - z^2)\sqrt{Z}},$$

where

$$Z = (1 - z^2)(z - h)^2 - A^2,$$

connecting ψ the azimuth, and $z = \cos\theta$, where θ denotes the angular distance from the lowest point of the sphere, the tension being $w(z - h)$ (Clebsch, *Crelle*, 57). Putting

$$u = \int \frac{dz}{\sqrt{Z}},$$

and

$$\chi = \psi - pu = \int \frac{-p(1 - z^2) + A}{(1 - z^2)\sqrt{Z}}\,dz,$$

then χ can be identified with the standard form of the pseudo-elliptic integral of the third kind, of order μ,

$$I = \tfrac{1}{2}\int \frac{\rho(s - \sigma) - \mu\sqrt{(-\Sigma)}}{(s - \sigma)\sqrt{S}}\,ds,$$

where

$$S = 4s(s + x)^2 - \{(y + 1)s + xy\}^2$$

by putting

$$\chi = \frac{I}{\mu},\ p = \tfrac{1}{2}\left(\frac{M\rho}{\mu} + A\right),\ A = M(y + 1),\ h^2 = A^2 - 2y - 1,$$

where

$$M^2 = -\frac{y + 1}{2x},$$

and x, y are Halphen's functions, defined in his "Fonctions Elliptiques," I. p. 102. If $u = a$ when $z = 1$, and $u = b$ when $z = -1$, then $u = \frac{1}{2}(a - b)$ when $z = h$; a and b are each of the form $f\omega_3$, a fraction of the imaginary period ω_3. Also

$$M^2 p(a + b) = -\tfrac{1}{3}(1 - h^2) - \tfrac{1}{4}A^2,$$

or $12p(a + b) = 8x - (y + 1)^2$, so that $\sigma = 0$, and

$$a + b = \frac{4\omega_3}{\mu}.$$

Thus, for instance, when

$$a + b = \omega_3,\ A = h^2 - 1,\ p = \tfrac{1}{2}A;$$

and the corresponding spherical catenary is given by

$$(1 - z^2)^{\frac{1}{2}}e^{\chi i} = \sqrt{\frac{h - 1}{2}}\sqrt{\{z^2 - (h + 1)z - 1\}} + i\sqrt{\frac{h + 1}{2}}\sqrt{\{-z^2 + (h - 1)z + 1\}}.$$

With

$$\mu = 3,\ a + b = \tfrac{4}{3}\omega_3,\ A^2 = h^2 - 1,\ p = \tfrac{1}{2}A;$$

and

$$(1 - z^2)^{\frac{3}{2}}e^{3\chi i} = A(z^3 - hz^2 - 2z) + i(hz + 1)\sqrt{Z}.$$

With

$$\mu = 5,\ a + b = \tfrac{4}{5}\omega_3,$$

then $y = x = -c$, suppose;

$$M^2 = \frac{1 - c}{2c},\ p = \tfrac{1}{8}(3 - c)M;$$

and

$$(1 - z^2)^{\frac{5}{2}}e^{5\chi i} = Hz^5 + \ldots + H_5 + i(Lz^3 + \ldots + L_3)\sqrt{Z},$$

where

$$H = \frac{2 - 5c + c^2}{c}M,\ L = \frac{2 - c}{c}h,\ \&c.$$

With

$$a + b = \frac{1}{2}\omega_3$$

the calculation is rather more complicated, as this case must be derived from $\mu = 8$; but the result is of the form

$$(1 - z^2)e^{2\chi i} = (Hz - H_1)\sqrt{(z_3 - z.z - z_0)} + i(Lz - L_1)\sqrt{(z - z_2.z - z_1)},$$

with

$$z_3 > z > z_2 > z_1 > z > z > z_0,$$

z_0, z_1, z_2, z_3

denoting the roots of the quartic $Z = 0$.—The Transformation of Elliptic Functions, by Prof. A. G. Greenhill, F.R.S. The function z_a, introduced by Prof. Klein in his paper on the transformation of elliptic functions (*Proc.* L.M.S. xi. p. 151), and developed in Klein and Fricke's "Modulfunctionen," ii. part v., is shown here to be connected with Halphen's γ function by the relation

$$\rho(-1)^a z_a = \lambda^{\frac{a^2}{n}}\gamma_a,$$

for a transformation of the nth order; and for an odd value of n,

$$\lambda^{2\rho+1} = \frac{\gamma_{\frac{n-2\rho+1}{2}}}{\gamma_{\frac{n+2\rho-1}{2}}},\ \rho = 1, 2, 3 \ldots \frac{n - 1}{2};$$

in this manner the relation $\gamma_n = 0$ is satisfied.

The biquadratic relations satisfied by the function z_a are now derived from Halphen's formula

$$\gamma_{m+n}\gamma_{m-n} = \gamma_{m+1}\gamma_{m-1}\gamma_n^2 - \gamma_{n+1}\gamma_{n-1}\gamma_m^2$$

The relation $\gamma_n = 0$ is treated as the equation of a curve with coordinates x and y; and when x and y can be expressed as functions of a parameter c, the quantities γ_a and z_a can also be expressed as functions of this parameter. For instance, $\gamma_{13} = 0$ reduces to the quadratic in p

$$p^2 - (1 - c^2 - c^3)p - c(1 + c)^2 = 0$$

by means of the substitutions

$$x = y(1 - z), \quad y = z\left(1 - \frac{z}{p}\right), \quad z = c(p - 1);$$

and now in Klein's Modular Equation of the Thirteenth Order, given in the *Proc.* L.M.S. ix. p. 126, it is found that

$$\tau = \frac{1 - c - 4c^2 - c^3}{c(1 + c)} = \frac{1}{c} + \frac{1}{1 + c} - c - 3.$$

When one root τ_∞ of this modular equation is given by

$$\tau_\infty = \frac{13c(1 + c)}{1 - c - 4c^2 - c^3} = \frac{13}{\frac{1}{c} + \frac{1}{1 + c} - c - 3},$$

the remaining 13 roots, typified by τ_r, are given by

$$\tau_r = \frac{\left(1 + \sum \frac{z_{2a}}{z_a}\epsilon^{36a^2 r}\right)^2}{\frac{1}{c} + \frac{1}{1 + c} - c - 3}, \quad \epsilon = e^{\frac{2\pi i}{13}},$$

where $a = 1, 2, 3, 4, 5, 6$; $r = 0, 1, 2, \ldots 12$,

(Klein, *Math. Ann.* xvii. p. 567).

It has been shown in the *Proc.* L.M.S. xxv. p. 252, that

$$\lambda = -\frac{cx^3}{yz};$$

and now, putting

$$\rho = \sigma x^3,$$

$$(\sigma z_1)^{13} = \frac{c}{x^4 yz}, \quad (\sigma z_2)^{13} = \frac{c^4}{x^3 y^4 z^4}, \quad (\sigma z_3)^{13} = \frac{x^3 c^9}{y^9 z^9},$$

$$(\sigma z_4)^{13} = \frac{z^{16} c^{16}}{xy^3}, \quad (\sigma z_5)^{13} = \frac{c^{25}}{x^4 y^{12} z^{12}}, \quad (\sigma z_6)^{13} = \frac{c^{36}}{x^{12} y^{23} z^{10} f},$$

all functions of c and $\sqrt{C}$, where

$$C = 1 + 4c + 6c^2 + 2c^3 + c^4 + 2c^5 + c^6.$$

The solution in the same manner of the Modular Equation of the Seventh Order has already been given in the *Proc.* L.M.S. xxv. p. 224; while the Fifth Order introduces Klein's icosahedron function. A similar procedure will serve for the Eleventh Order.—On certain definite theta-function integrals, by Prof. L. J. Rogers.—On a class of groups defined by congruences (second paper), by Prof. W. Burnside, F.R.S.—Electrical vibrations in condensing systems, by Dr. J. Larmor, F.R.S. It is only by the introduction of considerable capacity that the vibrations of electrical systems of simple geometrical form can assume a character at all simple and steady; for this reason it is of practical importance to be able to estimate the periods of vibrations in the dielectric plates of condensers. It is shown that the modes and periods for such a plate are precisely the same as those of the acoustical vibrations of a plate of air of the same form and the same law of thickness, enclosed on both faces, and also round its edge, by rigid walls, the only difference being that the velocity of electric propagation replaces the velocity of sound. For example, if the condenser is a spherical one, the periods of the free vibrations are equal to the time required for an electric pulse to travel round its circumference, divided by $(m^2 + n^2)$, where m is any integer; and this result will also practically hold good for a condenser of this form which is not a complete sphere, but has a hole through it at the point opposite to the place where the inner coating is connected with the exciter. The periods for a flat condenser of uniform thickness correspond to the well-known ones of standing water-waves in a cylindrical vessel of the same form of contour. If a condenser is divided by cutting across its conducting coats, as is done in the ordinary guard-ring, the separate parts will vibrate without interfering with each others periods. Various other cases are treated; for example, the propagation of electric waves in a compound plate composed, say, of air above and a liquid below.—On the integration of Allegret's integral, by Mr. A. E. Daniels.—On the complex number formed by two quaternary matrices, by Dr. G. G. Morrice.

Linnean Society, December 20, 1894.—Mr. C. B. Clarke, F.R.S., President, in the chair.—Mr. W. B. Hemsley exhibited a series of specimens and figures illustrating parasitism of *Loranthus aphyllus* and other plants, from the Herbarium, Kew.—Mr. J. E. Harting exhibited a specimen of a small Siberian warbler, *Phylloscopus superciliosus*, which had been obtained near Beverley, Yorkshire, in October last, and made some remarks on its haunts, habits, and migration, and upon the previous instances which had been noted of its accidental occurrence in the British Islands.—Mr. H. M. Bernard gave the substance of a paper on the spinning glands in *Phrynus*, not previously known, and described their position and their morphological importance in Arachnidan phylogen. The penis was described as a pair of rudimentary filamentous appendages of the genital segment, and consequently of importance as bearing further testimony to the view that the limbs on the abdomen of the ancestral form were not plates as in *Limulus*, but appendages like those on the thorax. The presence of these limbs explains the curious genital operculum of the *Pedipalpi*, which is not a primitive feature derived from Eurypterine ancestors, as some would maintain, but a purely secondary specialisation acquired within the Arachnid phylism.—A paper was then read by Mr. Percy Groom, entitled "Contributions to the knowledge of Monocotyledonous saprophytes," or plants which are dependent for their existence on the presence in the substratum of decaying organic matter. He observed that, like parasites, they may be divided into those which possess chlorophyll (*hemisaprophytes*) and those which have none (*holosaprophytes*). Hitherto very few experiments, he said, had been made on *hemisaprophytes*, and hence our acquaintance with them was largely speculative. The remarks which he had now to offer referred almost entirely to *holosaprophytes*, or at least to plants with very little trace of chlorophyll. After an interesting discussion, in which Sir D. Brandis, Mr. H. N. Ridley, and others took part, the Society adjourned to January 17.

PARIS.

Academy of Sciences, December 31, 1894.—M. Lœwy in the chair.—A study of graphites from iron, by M. Henri Moissan. At the ordinary pressure, the graphite is purer when formed at a higher temperature. The graphite produced at the highest temperature is the most stable in presence of nitric acid and potassium chlorate. Under pressure, the crystals and masses of graphite appear to have suffered incipient fusion. During the solution of the cast-iron by acids, hydroxy compounds are formed, which resist a dull red heat, but burn like the graphite itself.—Report was made favourably on a memoir by M. Riquier, to be printed in the *Recueil des Mémoires des Savants étrangers*, under the title "On the existence of integrals in any differential system, and on the reduction of such a system to a completely integrable linear form of the first order."—On the radial velocity of ζ Hercules, by M. H. Deslandres. A spectrophotographic determination in which the line displacements are measured on photographs taken with comparison spectra on each side of the star spectrum. The mean value of the radial velocity of this star is −70 km., as determined by M. Belopolsky; the author confirms this exceptional value, finding −60·41, a second observer finds the velocity −62 97.—On the determination of the number of roots common to a system of simultaneous equations, and on the calculation of the sum of the values of a function in these points, by M. Walther Dyck.—On the solution of numerical equations by means of recurring series, by M. R. Perrin.—On definite integrals of divisors, by M. N. Bougaïef.—On certain conditions to be realised for the measurement of electrical resistances by means of alternating currents and the telephone, by M. R. Colson.—On the sulphides of nickel and cobalt, by M. A. Villiers. This is a study of the conditions of precipitation of nickel and cobalt sulphides, and of the means whereby the precipitation may be wholly or partly prevented.—On calcium ethoxide, by M. de Forcrand. Calcium carbide, C_2Ca, gives with ethyl alcohol compounds of the type $n\,CaO + n'\,C_2H_6O$, and not an ethoxide. The compounds obtained are (1) $3CaO.4C_2H_6O$ and (2) $CaO.C_2H_6O$. At the same time gas is disengaged, consisting chiefly of acetylene (80 per cent.), and an easily liquefied ethylenic hydrocarbon (10 per

cent.).—On β-oxycinchonine, by MM. E. Jungfleisch and E. Léger. The preparation and properties of this compound are given in detail, and thirteen of its salts are described. β-oxycinchonine is an energetic diacid base; it turns litmus blue, and reddens phenolphthalein.—Action of chlorine on the secondary alcohols, by M. A. Brochet. The action of chlorine on alcohols of the type $R.CHOH.CH_3$ yields ketones of the form $R.CO.CCl_3$, the radical R being also chlorinated to the extent characteristic of the radical.—On the industrial preparation and physiological properties of the oxalate and of the crystallised salts of nicotine, by MM. H. Parenty and E. Grasset. The mortal dose of pure nicotine is 20–21 mgm. per kilogram weight of animal. The fatal dose in the combined state is much larger. An animal slowly accustomed to the action of the poison can support daily a dose greater than that fatal in ordinary cases.—On pine tar, by M. Adolphe Renard.—Remarks on the muscles and bones of the hind limb of *Hatteria punctata*, by M. A. Perrin.—Comparative study of the lobed and reticulated Rhizopoda of fresh water, by M. Félix Le Dantec.—On the nests of *Vespa crabro*, L.; order of appearance of the earlier cells, by M. Charles Janet.—The fragments of the uppermost stratum of Ubaye, by MM. E. Haug and W. Kilian.—On the conditions of propagation of typhoid fever, cholera, and exanthematous typhus, by M. Renard.

NEW SOUTH WALES.

Linnean Society, November 28, 1894.—The President, Prof. David, in the chair.—Re-description of *Aspidites ramsavi*, Macl., by Edgar R. Waite.—A review of the fossil jaws of the *Macropodidæ* in the Queensland Museum., by C. W. De Vis. The very fine collection of over eleven hundred dissociated jaws or portions of jaws in the Queensland Museum has been studied in the light of a knowledge of the nature and range of the variations, individual and specific, presented by the skulls of 479 individuals referable to sixteen existing species. The following species were described as new: *Palorchestes parvus*, *Sthenurus pales*, *S. oreas*. *Halmaturus vinceus*, *H. thor*, *H. dryas*, *H. odin*, *H. indra*, *H. siva*, *H. vishnu*, *Macropus magister*, *M. pan*, and *M. faunus*.—Notes on some Land Planarians collected by Thos. Steel, Esq., on the Blue Mountains, N.S.W., by Dr. A. Dendy.—On a British bivalve mollusc found in Australia and Tasmania, with its distribution; and on a new sub-genus of *Trochidæ*, by J. Brazier.—*Cryptodon flexuosa*, Montagu, was recorded for the first time from Port Stephens, N.S.W., and Esperance Bay, Tasmania.—The name *Solanderia*, Fischer (1880), being preoccupied by Duchassaing and Michelotti (1846), it was proposed to replace it by *Rossiteria*.—Description of a new Australian eel, by J. Douglas Ogilby.—*Gymnothorax prionodon*, sp.n., from Port Jackson, appeared to be closely allied to the Atlantic species *G ocellatus*.—On a new Typhlops previously confounded with *T. unguirostris*, Peters, by G. A. Boulenger, F.R.S.—Botanical notes from the Technological Museum (part iii.), by J. H. Maiden and R. T. Baker. The writers gave a list, with localities, of plants new to New South Wales; also notes on some rare or little known plants indigenous to the colony.—On a new species of *Enteropneusta* from the coast of New South Wales, by James P. Hill. The name *Ptychodera australiensis* was proposed for the first described Australian species of Enteropneusta. It is specially characterised externally by the great development of the genital wings which completely hide the gill-area, and extend far into the hepatic region, and by the presence of two longitudinal epidermal stripes, overlying the two ciliated bands of the intestine. In the mode of formation of the proboscis pore, it appears to be the most variable of all *Enteropneusta* hitherto described. The most interesting points in its internal anatomy are the presence of a median longitudinal infolding of the ventral wall of the heart bladder into the cavity of the same, the presence of a transverse vessel between the different proboscis vessels, and the much branched condition of the gonads.—On a Platypus embryo from the intrauterine egg, by J. P. Hill and C. J. Martin. The embryo described was taken from one of two eggs just ready to be laid. The eggs measured 18 mm. by 13·5—being somewhat larger than the eggs described by Caldwell. The embryo more nearly resembled that of the Virginian opossum (Didelphys) of seventy-three hours, described by Selenka, than any other embryo known to the authors. The Platypus embryo is, however, much longer.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

BOOKS.—A Monograph of the Mycetozoa: A. Lister (London, Brit. Mus.).—Reisen in den Molukken: Prof. K. Martin. 2 Vols. Text and Plates (Leiden, Brill).—Harvard College, by an Oxonian: Dr. G. B. Hill (Macmillan).—Annuaire, 1895, par le Bureau des Longitudes (Paris Gauthier-Villars).—La Fabrication des Eaux-de-Vie: L. Jacquet (Paris, Gauthier-Villars).

PAMPHLET.—An Essay on Southerly Bursters: H. A. Hunt.

SERIALS.—Natural Science, January (Rait).—Astronomy & Astro-Physics, December (Wesley).—Journal of the Royal Microscopical Society, December (Williams).—Bulletin de L'Académie Impériale des Sciences de St. Pétersbourg, September, October, November (St Pétersbourg).—Bulletin of the American Mathematical Society, December (New York, Macmillan).—Humanitarian, January (Hutchinson).—Century Magazine, January (Unwin).—Contemporary Review, January (Isbister).—Natural History of Plants, Part 9 (Kerner and Oliver (Blackie).—Fortnightly Review, January (Chapman).—Séances de la Société Française de Physique, 1894, 3e fasc. (Paris).—School Review, December (Hamilton, New York).—Zeitschrift für Physikalische Chemie, xv. Band, 4 Heft (Leipzig, Engelmann).—New Review, January (Heinemann).—Bulletin de la Société de Géographie, 3e Trim. 1894 (Paris).—Geological Magazine, January (Dulau).—Mind, January (Williams).—National Review, January (Arnold).—Cornhill Magazine, January (Smith, Elder).—Journal of the Royal Agricultural Society of England, Third Series. Vol. v. Part 4, No. 20 (Murray).—Annals of Scottish Natural History, January (Edinburgh, Douglas).—Internationales Archiv für Ethnographie. Band vii. Heft 5 and 6, and Supplement zu Band vii. (Leiden, Brill).—Quarterly Journal of Microscopical Science. December (Churchill).—Essex Naturalist, Nos. 6-10. Vol. viii. (Chelmsford, Durrant).—Scribner's Magazine, January (S. Low).—Phonographic Quarterly Review, No. 2 (Pitman).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Fourth Series, Vol. 8, No. 4 (Manchester).—Science Progress, January (Scientific Press).—Round the World, Part 1 (Newnes).—Medical Magazine, January (140 Strand).

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