THURSDAY, MARCH 26, 1896.

THE SCIENTIFIC CORRESPONDENCE OF GEORGE ROMANES.

The Life and Letters of George John Romanes. Written and edited by his Wife. Pp. viii + 360. (London: Longmans, Green, and Co., 1896.)

THE life of most men of science is uneventful so far as the rest of the world is concerned, and can hardly interest more than the circle of personal friends. And the letters of men of science also have, as a rule, but a limited interest. Any scientific information which they contain has usually been published elsewhere, and if of importance, is already familiar to the scientific reader. The account of the life, and the selection of the letters of George Romanes, which is here presented, offer in some measure an exception to the general rule, for they contain matters which will keenly interest others than those who may desire to follow merely the scientific career of the man. But it is the scientific correspondence which will, without doubt, be that which will chiefly interest the readers of NATURE, and it is this, therefore, with which alone we propose here to deal. And of the scientific correspondence, that which Romanes carried on with Charles Darwin during a period of nine years would alone furnish enough interest to ensure a cordial welcome to this work. For Mrs. Romanes has not confined herself, as is so often done by the biographer, to presenting only the one side of a correspondence, but has wisely decided in this and certain other instances to allow both sides to appear, far more than doubling thereby its value and interest. And since, with one exception, none of these letters of Darwin have hitherto been given to the world, and moreover he seems in them to have opened up his heart with the frankest confidence to the young devotee whose powers of thought he was one of the first to recognise, it is obvious that this correspondence must have an altogether exceptional interest. It deals mainly, as might be supposed, with subjects bearing on the question of inheritance, and especially with Darwin's hypothesis of Pangenesis. In attempts to prove this theory, Romanes devoted an immense amount of time in patient experimentation, but as the experiments yielded for the most part a negative result, showing neither for nor against the hypothesis, they were never systematically published. On this account the descriptions of some of these experiments, which are here given at length, will be welcomed by those who may be carrying on similar work in the future. The subject was one upon which Romanes was "keen" to the very last, and almost the latest experiments which he planned, had a direct bearing upon the doctrine in question. And even when his time was fully occupied with the fascinating experiments upon Medusæ, by which he first found fame as a scientific inquirer, he was able to devote attention to the carrying out of laborious work on this subject. In July 1875, he writes to Darwin:

As you have heard about the Medusæ, I fear you will infer that they have diverted my attention from Pangenesis; but although it is true that they have consumed a great deal of time and energy, I have done my best to keep Pangenesis in the foreground.

Then follows a precise account of numerous experiments on grafting of tubers and the like, after which he continues—

But as I am a young man yet (he was just 27), and hope to do a good deal of "hammering," I shall not let Pangenesis alone until I feel that it does not admit of being any further driven home by experimental work; and even if I never get positive results, I shall always continue to believe in the theory.

And a little later—

I have an idea that you are afraid I am neglecting Pangenesis for Medusæ. If so, I should like to assure you that such is not the case. . . . I confess, however, that but for personal reasons I should have postponed Pangenesis, and worked the Medusæ right through in one year. There is a glitter about immediate results which is very alluring.

To which Darwin replies—

So far from thinking that you have neglected Pangenesis, I have been astonished and pleased that your splendid work on the jelly-fishes did not make you throw every other subject to the dogs.

In another letter from Darwin the following occurs—

As you are interested in Pangenesis, and will some day, I hope, convert an "airy nothing" into a substantial theory, therefore I send by this post an essay by Häckel, attacking "Pan.," and substituting a molecular hypothesis. If I understand his views rightly, he would say that with a bird which strengthened its wings by use, the formative protoplasm of the strengthened parts becomes changed, and its molecular vibrations consequently changed, and that their vibrations are transmitted throughout the whole frame of the bird. How he explains reversion to a remote ancestor I know not. Perhaps I have misunderstood him, though I have skimmed the whole with some care. He lays much stress on inheritance being a form of unconscious memory, but how far this is part of his molecular vibration I do not understand. His views make nothing clearer to me, but this may be my fault.

In a letter written in 1877, after referring in enthusiastic terms to a lecture by Romanes on the "Evidences of Organic Evolution," he says:

I am very sorry to hear about the failure in the graft experiments, and not from your own fault or ill-luck. Trollope, in one of his novels, gives us a maxim of constant use by a brick-maker, "It is dogged as does it!" and I have often and often thought this is the motto for every scientific worker.

With characteristic generosity Darwin handed over to Romanes, who was preparing his book on "Animal Intelligence," his notes on instinct.

You are quite welcome to have my longer chapter on instinct. It was abstracted for the Origin. I have never had time to work it up in a state fit for publication, and it is so much more interesting to observe than to write.

The book in question was heralded by a lecture on the subject given before the British Association at its meeting in Dublin in 1878. A copy of the lecture, as well as a newspaper account, from which it appeared that the lecture (especially an allusion in it to Darwin himself) was most cordially received, was sent by Romanes to Darwin, who thus acknowledges the receipt:

I am most heartily glad that your lecture (just received and read) has been so eminently successful. You have indeed passed a most magnificent eulogium on me, and I wonder that you were not afraid of hearing "Oh! oh!" or some other sign of disapprobation. Many persons think that what I have done in science has been much overrated, and I very often think so myself; but my comfort is that I have never consciously done anything to gain applause.

He jocularly adds in a short note sent a few days after—

Frank says you ought to keep an idiot, a deaf mute, a monkey, and a baby in your house.

To which Romanes rejoins—

Frank's idea of "a happy family" is a very good one; but I think my mother would begin to wish that my scientific inquiries had taken some other direction.

The baby too, I fear, would stand a poor chance of showing itself the fittest in the struggle for existence.

And two years afterwards the joke is continued (the baby having in the meantime put in an appearance).

I have now got a monkey. Sclater let me choose one from the Zoo, and it is a very intelligent, affectionate little animal. I wanted to keep it in the nursery for purposes of comparison, but the proposal met with so much opposition that I had to give way. I am afraid to suggest the idiot, lest I should be told to occupy the nursery myself.

The following postscript to a letter from Darwin, dated September 14, 1880, will be of interest.

We went to the Lakes for three weeks to Coniston, and the scenery gave me more pleasure than I thought my soul, or whatever remains of it, was capable of feeling. We saw Ruskin several times and he was uncommonly pleasant.

The postscript to another of Darwin's letters (dated January 24, 1881) is the following parable :—

N.B. Once on a time a fool said to himself that at an ancient period small soft crabs or other creatures stuck to certain fishes; these struggled violently, and in doing so discharged electricity, which annoyed the parasites, so that they often wriggled away. The fish was very glad, and some of its children gradually profited in a higher degree and in various ways by discharging more electricity and by not struggling. The fool who thought thus persuaded another fool to try an eel in Scotland, and lo and behold electricity was discharged when it struggled violently. He then placed in contact with the fish, or near it, a small medusa or other animal which he cleverly knew was sensitive to electricity, and when the eel struggled violently, the little animals in contact showed by their movements that they felt a slight shock. Ever afterwards men said that the two fools were not such big fools as they seemed to be.

About this time Romanes began to consult Darwin concerning experiments as to the relative effect of flashing and continuous light upon seedlings. These experiments were pursued at intervals during the next ten years, and the results were published in a paper read before the Royal Society in 1892. He tells also of a curious experiment on the sense of direction in cats.

I have got a lot of cats waiting for me at different houses round Wimbledon Common, and some day next week shall surprise our coachman by making a round of calls upon the cats, drive them several miles into the country, and then let them out of their respective bags. If any return, I shall try them again in other directions before finally trying the rotation experiment.

Not one cat, however, did return! Romanes used to describe with much amusement the ludicrous nature of the experiment as seen by passers-by.

Darwin was engaged just now (1881) upon his book on earthworms, and writes regarding it :

Your letter on intelligence was very useful to me, and I tore up and rewrote what I sent you. I have not attempted to define intelligence, but have quoted your remarks on experience, and have shown how far they apply to worms. It seems to me, that they must be said to work with some intelligence, anyhow, they are not guided by a blind instinct.

The following interesting remarks occur in the same letter :—

Dr. Roux has sent me a book just published by him, "Der Kampf der Theile," &c., 1881 (240 pages in length). He is manifestly a well-read physiologist and pathologist, and from his position a good anatomist. It is full of reasoning, and this in German is very difficult to me, so that I have only skimmed through each page, here and there reading with a little more care. As far as I can *imperfectly* judge, it is the most important book on evolution which has appeared for some time.

I do not know whether you will discuss in your book on the "Mind of Animals" any of the more complex and wonderful instincts. It is unsatisfactory work, as there can be no fossilised instincts, and the sole guide is their state in other members of the same order and mere probability. But if you do discuss any (and it will perhaps be expected of you), I should think that you could not select a better case than that of the sand-wasps, which paralyse their prey, as formerly described by Fabre in his wonderful paper in *Annales des Sciences*, and since amplified in his admirable "Souvenirs." Whilst reading this latter book, I speculated a little on the subject. Astonishing nonsense is often spoken of the sand-wasp's knowledge of anatomy. Now will any one say that the Gauchos on the plains of La Plata have such knowledge, yet I have often seen them prick a struggling and lassoed cow on the ground with unerring skill, which no mere anatomist could imitate. The pointed knife was infallibly driven in between the vertebræ by a single slight thrust. I presume that the art was first discovered by chance, and that each young Gaucho sees exactly how the others do it, and then with a very little practice learning the art. Now I suppose that the sand-wasps originally merely killed their prey by stinging them in many places (see p. 129 of Fabre, "Souvenirs," and p. 241), on the lower and softer side of the body, and that to sting a certain segment was found by far the most successful method, and was inherited, like the tendency of a bull-dog to pin the nose of a bull, or of a ferret to bite the cerebellum.

Darwin's attitude on the subject of vivisection is very manifest in several of the letters. As all the world knows, he did not himself practise vivisection, and the probability is that his gentle nature caused him to regard with more than ordinary dislike the necessity for experiments upon animals which might involve pain. But he saw so clearly that no real advance can be made in science without experiment, that he was ready even to come forward as a champion of the cause of physiology. In 1877, when the first antivivisection agitation was at its height, he writes :

I am inclined to think that writing against the bigots about vivisection is as hopeless as stemming a torrent with a reed. . . . It seems to me the Physiologists are now in the position of a persecuted religious sect, and they must grin and bear the persecution, however cruel and unjust, as well as they can.

And in 1881—

Do you read the *Times*? As I had a fair opportunity, I sent a letter to the *Times* on Vivisection, which is printed to-day. I thought it fair to bear my share of the abuse poured in so atrocious a manner on all physiologists.

Darwin's regard for physiologists was reciprocated; he and Sharpey were the first honorary members elected by the Physiological Society (of which Romanes was one of the first secretaries), a "mark of sympathy" with which he expresses himself as being "very much gratified." Needless to say Darwin's death was an untold loss to Romanes.

Even the death of my own father—though I loved him deeply, and though it was more sudden—did not leave a desolation so terrible. Half the interest of my life seems to have gone when I cannot look forward any more to his dear voice of welcome, or to the letters that were my greatest happiness. . . . And when I think how grand and generous his kindness was to me, grief is no word for my loss.

In the words of his biographer—"Thus closed a very significant and important chapter in his life."

Of Romanes' other scientific correspondence, the

earliest (1875–76) was with Prof. Schäfer, and related to his experiments upon Medusæ. In these letters he describes many interesting results which he was obtaining, and which were, for the most part, afterwards published in the *Philosophical Transactions*. He had then and always the pen of a ready writer (in hand as well as in tongue), and was besides in the habit of illustrating his descriptions by rough diagrams, so that they are admirably clear and instructive. Nearly all the other letters to scientific men are of comparatively recent date, and deal mainly with the controversies on problems of inheritance (physiological selection and Weismannism) in which, as the readers of NATURE well know, he was so deeply engaged. His paper on physiological selection[1] was read before the Linnean Society in May 1886. It raised a storm of opposition, largely, as he thought, because its opponents would not take the trouble to understand it. To Prof. Meldola he writes :

> Physiological selection seems to have brought a regular nest of hornets about my head. . . . It seems to me that there is a good deal of misunderstanding abroad, due, no doubt, to the insufficiency with which my theory has been stated.

There are also several long letters to Mr. Thiselton-Dyer and Mr. Francis Darwin on the same subject, and a friendly controversial correspondence with Prof. Poulton on the subject of Weismannism. But most of these letters have a more or less continuous thread of argument running through them, and do not lend themselves readily to extracts. The reader who is interested in the controversies is therefore referred to the originals. Even after he had been stricken by paralysis he was not to be deterred from continuing to discuss the problems which most interested him, and he carried on a long correspondence with the Rev. G. Henslow on the subject of the direct action of the environment on plant structures. In his last illness the personal sympathy which he received from his scientific friends much touched him, hard though he felt his fate to be. In a letter to Mr. Thiselton-Dyer, dated September 1893, he writes :

> When one is descending into the dark valley, scientific squabbles seem to fade away in those elementary principles of good will which bind mankind together. And I am glad to think that in all the large circle of my friends and correspondents there is no vestige of ill will in any quarter, unless it be with —— and ——, who both seem to me half-crazy in their enmity, and therefore not of much count.
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> As for "fortitude," sooner or later the night must come for all of us; and if my daylight is being suddenly eclipsed, there is only the more need to work while it lasts. But, to tell the truth, I do not on this account feel less keenly the pity of it. With five boys—the eldest not yet in his teens and the youngest still in his weeks; with piles of note-books which nobody else can utilise, and heaps of experimental researches in project which nobody else is likely to undertake, I do bitterly feel that my lot is a hard one.

Throughout the letters the character of the man comes openly to the surface, and all the world may see in them the simple child-like nature, the unvarying good humour, the gentle disposition, which were combined in him with the highest intellectual attainments ; qualities which won for George Romanes the affectionate regard of all who were privileged to know him.

E. A. SCHÄFER.

[1] An admirable epitome of this theory (and of each one of the scientific subjects which chiefly engaged Romanes' attention) is given by his biographer in the book before us.

EARLY LEGENDS AND PREHISTORIC FOLK-LORE.

The Life and Exploits of Alexander the Great; being a Series of Translations of the Ethiopic Histories of Alexander by the Pseudo-Callisthenes and other Writers, with Introduction, &c. By E. A. Wallis Budge, Litt.D. Pp. xv + liv + 610. (London : C. J. Clay and Sons, 1896.)

WITHIN recent years it has been recognised that the legends and epics of ancient peoples are something more than collections of quaint and amusing tales, that they have a scientific value, and that they yield important results when studied, classified, and compared. The sagas of many nations are well known, and have been already subjected to an exhaustive process of inquiry, but those of others have still to be unearthed. Among this latter class the legendary literature of the Ethiopians had until recently to be set, but the volume by Dr. Wallis Budge, the title of which stands above, will go some way to remove the obscurity in which the beliefs and traditions of that nation have been shrouded. Hitherto the Ethiopic literature that has been published, has in the main been biblical and of interest chiefly to biblical students ; Dr. Budge, however, has collected a goodly body of Ethiopian traditions from MSS. in the British Museum and in the Bibliothèque Nationale, Paris, two of the former having been among those which were brought to England from the Treasury of King Theodore by the British Army in 1868. The Ethiopic texts of these MSS. have been edited by Dr. Budge, and they have been printed for private circulation by Lady Meux. An English translation and introduction which accompanied the text has, however, been published separately on smaller paper, for the use of those to whom the subject-matter, rather than the text of the MSS., would be of interest ; and it is with some of the results to be obtained from a perusal of this latter volume, that we propose in the present article to deal. It is not our purpose, however, to treat the legends from a literary point of view ; our object is rather to extract from them such information as will indicate what was the condition of geographical and astronomical knowledge among early Oriental nations, and to notice briefly the stories of heroes and others which grew up when the world was yet in its childhood, and when early man was himself still mystified by the phenomena of nature he beheld around him.

The central figure round which the stories group themselves is Alexander the Great, many of them being based on traditions or stories borrowed originally from other races. For instance, the book comprises the Ethiopic version of the Pseudo-Callisthenes, which has found its way into many languages ; extracts from the Ethiopic versions of larger historical works by Al-Makîn and Abû Shâker, Arabic historians of the thirteenth century ; and an extract from the Ethiopic version of Joseph ben-Gorion's "History of the Jews." The book also contains a short account of Alexander's death, and the utterances of the sages thereon ; the "Christian Romance," which is probably an original Ethiopian work ; and an account of the "Vision of Abbâ Gerasimus." None of the Ethiopic MSS. which contain these works is actually older than the seventeenth century ; they are, however,

copied from originals which must be put back many hundreds of years, and some of the legends that are inserted are of primeval antiquity.

Among all races, and especially in the East, the figure of some great national conqueror has always served as a centre around which floating legends and stories have gathered. An historical kernel no doubt underlies the mass, but it has been overlaid with numberless accretions, comprising some ancient legends to a certain extent the common property of all races, and others the special product of the race to which the writer belonged. Each nation that has retold the story of Alexander has modified and added to it to suit its own national ideals, so that the epic in its various forms comprises legends, the sources of which range from traditions of the ancient East down to those of mediæval Europe. Thus in the history of Alexander we find the ancient legends of Babylon have been laid under contribution. Alexander makes himself small, and flies through the air on the back of an eagle, exploring the heights of the heavens, "the beauties and the terrors thereof, and the stations of the birth and the going forth of the stars," in the same way as the Babylonian hero Etana flew to heaven with the eagle, who described to him the fashion and likeness of the earth as it seemed to recede from under them; and the same legend seems to be reproduced in another form in the "Christian Romance" (p. 474), when Alexander sends scouts from the Country of Darkness to the Country of the Living by making them ride on the backs of eagles. Alexander, too, is related to have travelled in the same regions, and to have met with the same adventures as the Babylonian hero Gilgamish; while his slaying of the dragon is clearly a reminiscence of the fight of the Babylonian god Merodach with the monster Tiâmat. As an instance of the way one of his Ethiopian biographers has incorporated material from contemporary sources, we may mention the story of the musical city (pp. 457 *ff.*) which Alexander at first cannot take, as his soldiers, after scaling the walls, are overcome by the beauty of the music produced by cunning contrivances of brass, to which figures of brass continually danced—a story which probably reflects some mechanical invention famous at the time of the writer.

The travels of Alexander furnish ample opportunities for the display of his biographers' knowledge or theories concerning geography and the extent and formation of the world. Thus, when travelling in the neighbourhood of Armenia, Alexander "came down to a very great mountain gate (*or* pass) wherein were many large roads by which merchants travel." Alexander makes inquiries, and he is informed by certain sages that the mountain only "ends at the sea that surroundeth the world, that is to say the sea Bôntôs (Pontus)," and this leads to a description of the far East and the nations who were said to dwell there. The same mountain, which was supposed to surround the world "like a ring," is referred to in another passage by the angel whose duty it is to hold it firm, and who describes it as "the father of all the mountains which are upon the earth," and adds that if plucked up by the roots the destruction of the earth would follow. Another curious geographical conceit occurs in an account of the origin of the Dead Sea, which is said to "stink horribly," because of the dead bodies of men and women and the carcases of beasts and birds which lie in its depths, whither they were brought by the waters of the Flood.

We gather, too, some interesting details concerning the ancient practice of magic and astrology. For instance, Aristotle is recounted to have presented to Alexander talismans to protect him against his foes, to enable him to enter fortified cities, for supplying him with water in the desert, and for protecting him and his army against fatigue. He also gave him certain amulets with somewhat similar powers, and furnished him with a device for destroying his enemies by means of waxen figures:

"And Aristotle also made for Alexander a chest, and he placed therein figures which were made to represent his enemies, and they had leaden swords, which were curved backwards in their hands, and which they held downwards, and bows the strings of which had been cut; and he placed them in the box with their faces turned downwards, and he nailed them down with iron pegs and fastened the box with an iron chain."

Alexander had to keep the box carefully, and by laying his hand on it, and reciting certain prayers, he was assured of success against his foes. Aristotle is also credited with a knowledge of astrology, for he compiled for Alexander

"a number of tables, that is to say, plans or drawings, wherein a star showed the time when he should go forth against his enemies . . . and he spake unto him, saying, 'Know, O King, that the stars are the head and foundation of the dispensation of this universe, and that it is by means of them that the world which is beneath the lowest heaven of the moon standeth. Know too that a certain section of the starry vault ruleth over each district and country on the earth. Now the portion that is over Persia hath therein the planet Mercury, and its regent is Venus, and its guardian is Jupiter, and its adversary is Saturn, and the star which hath dominion over it and worketh misery therein is the planet Mars, but the Sun keepeth it in safety, and the Moon giveth it strength and power. And each of these seven planets hath power over its fortune and over its days; therefore, O King, do thou direct thy course by the dispensation of the planets Saturn and Mars, and by the spiritual force which is in them, so that thou mayest be victorious over thine enemies thereby.'"

In the course of a review it is impossible to do more than briefly indicate the value of but a few of the legends and beliefs to be found throughout the 600 pages covered by the English translation. Reference, however, at least should be made to the stories of the magic stone, the fishes and the water of life, Alexander and his diving-bell, the monsters of the deep, Alexander's converse with beasts and birds, and the ride of Gerasimus upon the lion. The material here collected is, in fact, of great interest from many points of view, and not least from that of the student of folk-lore, who will find much useful information in the notes in which Dr. Budge has worked out the origin of many of the legends incorporated or referred to in the text. Our knowledge of ancient and mediæval science and superstition is gradually becoming more extended, and we venture to think that the volume before us will do much to help on the study. To summarise the universal character of the epic of Alexander, we cannot do better than quote Dr. Budge's own words:

"Given a brave, fearless soldier marching with an army through a certain country for conquest and pleasure, it seems that the same stories must be told of his progress and exploits, whether he be Etana, Gilgamish, Nimrod, or Alexander. With the advance of time the first tolerably accurate descriptions of his life will be first distorted and then enlarged, and when he has become a mere memory his name will be made a peg on which to hang stories, legends, and myths. The details of the fabulous history of such an one will be modified to suit the country and ideas of the people among whom the writers live, and eventually it will become the popular expression of the national views of each country through which the history passes of what a hero should be. This is exactly what has happened to the Alexander story in the hands of Semitic and other writers. The Egyptians made Alexander the son of an Egyptian king, and a worshipper of Amen; the Greeks made him the type of the victorious Greek conqueror; the Persians made him a Persian; the Arabs made him a servant of Allah; the Syrians made him a Christian; and the Ethiopians depicted him as a believer in the Trinity and in the Christian doctrine of the resurrection of the dead."

FISHES, LIVING AND FOSSIL.

Fishes, Living and Fossil: an Outline of their Forms and Probable Relationships. By Bashford Dean, Ph.D. Pp. xiv + 300. (New York and London: Macmillan and Co., 1895.)

DR. BASHFORD DEAN is known to zoologists, first, as the author of exhaustive and critical articles in the publications of the United States Fish Commission, on the systems of oyster culture pursued in Europe, and, secondly, as an embryologist who has lately been doing good work on the development of various Ganoid fishes and the comparison that may be instituted with Teleostei. His recent addition to the well-known "Columbia University Biological Series," now being brought out by Macmillan and Co., under the editorship of Prof. H. F. Osborn, is an interesting volume upon fishes, in which considerable prominence is given to the fossil forms, and the whole subject is presented to us from the point of view of the evolutionist. This is the characteristic feature of the book. From the very first page of the introduction to the last page in the volume, preceding the index, which is a table of the supposed descent of the groups of fishes, the book is full of the spirit and the language of evolution.

The fossil forms are introduced in their places amongst the living members of their group, and the plan of treatment of the groups in each chapter may be exemplified by No. vi., dealing with the Dipnoi, where we have first a short account of the lung-fishes, then the description of their structural characters, with an account of the fossil and of the living forms, and finally a discussion of their phylogeny and relationships with other groups. The figures in all parts are numerous and good, and many of them original.

The classification adopted is in the main that of Smith Woodward, in which the class Pisces excludes the Marsipobranchii (not that these are excluded from the book), and includes as sub-classes the Elasmobranchii, the Holocephali, the Dipnoi, and the Teleostomi. Our author considers then the Chimæroids as a distinct group equivalent to Elasmobranchii and Dipnoi, but adds: "The kinships of the Chimæroids seem unquestionably nearer the stem of the sharks than that of other fishes." He considers that the lung-fishes (Dipnoi) as a group "may not unreasonably be looked upon as descended from the primitive Elasmobranch stem." They are "an advancing phylum from which the amphibians may early have diverged." The remarkable fossil Arthrodira (*Coccosteus*, &c.), he follows Smith Woodward in considering provisionally as an order of extinct and highly-specialised lung fishes. A fine figure of the head of the giant predatory member of the group *Dinichthys intermedius*, one-tenth of the natural size, forms the frontispiece. These forms are now dissociated from *Pterichthys* and other lowly Ostracoderms, and also from the Siluroids, with which at various times they have been compared, and are united with the Dipnoi. The author believes, however, that the Arthrodirans may almost as well be referred to the sharks as to the lung-fishes, and that they may, perhaps, ultimately come to be regarded as worthy to rank as a distinct class. Dr. Dean builds his phylogeny largely on the solid basis of Palæontology.

After the systemic part of the book comes a chapter on development, in which, in addition to general remarks on eggs and breeding habits, a brief but adequate account is given of the embryonic and larval development of the five types—Lamprey, Shark, Lung-fish, Ganoid, and Teleost, with the view of contrasting the groups of fishes. This section includes a summary of Semon's observations on *Ceratodus*, and is illustrated by useful figures.

Throughout, structure is treated largely from the developmental point of view, which adds to the value, interest and freshness of the book. The author sums up against Gegenbaur's archipterygium, and in favour of the derivation of paired fins from lateral fin-folds. This view is supported by the simple condition of the pectoral and pelvic fins in the ancient fossil shark *Cladoselache*, the knowledge of whose archaic characters we owe to Dr. Dean himself. The vexed question of the precise function of the sense organs of the lateral line is still left undetermined. Beyond "feeling," in a broad sense, the author merely suggests "the sensory tracts along the sides of the body are certainly well situated to determine the direction of the approach of friend, enemy or prey." It is interesting—even if one can scarcely help feeling slightly disappointed—to read that: "It must for the present be concluded that the pineal structures of the true fishes do not tend to confirm the theory that the epiphysis of the ancestral vertebrates was connected with a median unpaired eye." He considers rather that the epiphysis was connected with the innervation of the sensory canals of the head.

At the end of the book we find a list of derivations of names, a good bibliography classified under groups and systems of organs, and, lastly, a series of tables giving in contrast form a statement of the comparative anatomy and embryology of the different groups of fishes, illustrated, like the rest of the work, by a series of clear figures drawn from the best sources, and many of them original. No doubt specialists on fossil fishes will be able to find defects and omissions, but for the ordinary student of the subject Bashford Dean's volume will prove useful and interesting. W. A. H.

OUR BOOK SHELF.

British Moths. By J. W. Tutt. Pp. xii + 368. Illustrated. (London: George Routledge and Sons, 1896.)

THE last of the many recent additions, superficial and profound, to the stock of books on British Lepidoptera, is essentially a book for the beginner, but one which challenges consideration as an attempt "to deal with our moths on lines which the study of the last twenty-five years has convinced all true naturalists are the correct ones." The points by which this claim is redeemed consist mainly in the substitution of an arrangement based on Dr. Chapman's division of the Lepidoptera by pupal characters for the old order so long accepted, and by numerous statements of phylogenetic relationship. Supported as they are by very little in the way of explanation to make them intelligible, these innovations are not so much an improvement as a snare; it is of no use to talk glibly in a beginner's book about "Obtectæ and Incompletæ," "offshoots from a Pyralid stirps," and the like, unless these things are fully and clearly explained. Much of the phylogeny so confidently put forward is not that accepted by other recent writers on Lepidoptera and is unfit matter for dogmatic assertion, especially as first impressions thus acquired are hard to unlearn. Neither is the writer consistent, for the Hepialidæ, Micropterygidæ, and Eriocephalidæ are separated from each other by numerous families, although the position, remote from all other Lepidoptera, that has been assigned to the three is one of the most important and widely-accepted of recent changes. Turning to those parts of the book which have no special claim to novelty of treatment, we find, as is to be expected from so competent a lepidopterist, that his statements are accurate and often valuable. But far too much space is taken up, particularly in the Noctuæ, with brief remarks on species which convey no real information. In spite of another claim put forward in the preface, it is only here and there that a species is described in recognisable terms. If all perfunctory mention of species had been excluded, and the work confined, as a book of limited scope may well be, to such moths only as are common and of wide distribution, space could have been gained for an adequately-full treatment of the species retained. The coloured illustrations are fairly good; there is but one diagram of neuration, and that is incorrect. W. F. H. B.

Moorland Idylls. By Grant Allen. Pp. 257. (London: Chatto and Windus, 1896.)

By Tangled Paths. By H. Mead Briggs. Pp. 203. (London: Frederick Warne and Co, 1896.)

THE descriptions of scenes of pastoral life contained in the first of these volumes have, we believe, already appeared in one of the monthly magazines, though no reference is made to that fact. They may be regarded as science diluted with sentiment, and that is the kind of literature which the average man and woman will sometimes read. Nevertheless, if Mr. Allen's idylls lead people to observe and think about the habits and characteristics of common plants and animals, they will accomplish a useful purpose. The sympathetic spirit in which they are written will attract lovers of nature, and will do much to foster a feeling for the preservation of our native fauna.

Mr. Briggs's dainty volume is much the same in character as that of Mr. Grant Allen's, the chief differences being that it is a little more poetical, and a little less instructive. The contents furnish suitable reading for persons who muse over the poetry of nature; and judging from the abundance of literature of a similar character, there must be many who like to engage their minds on natural things.

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.*]

Sun Columns at Night.

A REMARKABLE phenomenon, similar to that which I described in 1888 (NATURE, vol. xxxviii. p. 414), was witnessed by me on the evening of March 13. At 7h. 7m. p.m. I saw on the western sky five silvery white columns coming evidently from the sun, which set at 6h. 1m. The columns extended over the whole sky, and, like meridians on a globe, converged to a point in the eastern sky, which was about as high above the eastern horizon as the sun was below the western horizon. The sky was full of stars, a powerful wind having swept it clear; and at 7h. 25m., fifteen minutes before complete night had set in, the rays still reached the zenith. The rays cannot be *straight* sun rays, for the calculation of the height of the atmosphere by Alhazen's method would yield an abnormally high value, and they could not meet in the east, like meridians, but they must be *curved* and pass *along* the upper strata of the atmosphere. This is either due to reflection, or, more probably, the phenomenon is one of an electrical nature, similar to that described in NATURE of March 12 (p. 437), which has just reached me, by Dr. O'Reilly.

The remarkable fact that at 7h. 25m., when the sun was about 14° below the horizon, the perpendicular arc reached the zenith, whereas that passing along the equator extended to about Cancer, appears to prove that the equatorial diameter of the atmosphere greatly exceeds the polar diameter. The phenomenon disappeared at 7h. 28m. BOHUSLAV BRAUNER.

Bohemian University, Prague, March 16.

Kathode Rays or X-Rays?

To the reader of the numerous papers that have recently been communicated from various sources on the subject of Dr. Röntgen's great discovery, considerable obscurity is caused by the confusion of the above terms. Until quite recently what has been meant by "kathode rays" or "the kathodic discharge" has been that discharge of matter from the negative electrode in a highly-exhausted vacuum tube, which can be deflected by a magnet, produce heat, mechanical energy, and phosphorescence, can be brought to a focus by using a curved kathode, and in this case will project an inverted image of the kathode upon either the inside walls of the tube, or upon a phosphorescent screen placed inside the tube to receive it. As is well known, this discharge has been very thoroughly investigated abroad by Hittorf, Puluj, and others, and in England by Crookes, and has been called by him the discharge of "radiant matter." The X-rays of Dr. Röntgen are said to be generated at the spot where the kathodic discharge of radiant matter impinges upon an obstacle, be it the phosphorescent walls of the vacuum tube, or a plate of metal similarly placed to receive it. The distinction is perfectly clear in Dr. Röntgen's paper, as the following extracts from the translation, published in this journal on January 23, show.

"In general, other bodies behave like air; they are more transparent for the X-rays than for the kathode rays. A further distinction, and a noteworthy one, results from the action of a magnet. I have not succeeded in observing any deviation of the X-rays even in very strong magnetic fields. The deviation of kathode rays by the magnet is one of their peculiar characteristics."

"Hence I conclude that the X-rays are not identical with the kathode rays, but are produced from the kathode rays at the glass surface of the tube."

"I have obtained them in an apparatus closed by an aluminium plate 2 mm. thick."

It will therefore surely be better to retain the term proposed by their discoverer, X-rays, or else to call them Röntgen rays, and thus avoid the confusion that must result from calling them "kathode rays." JAMES H. GARDINER.

A Remarkable Meteor.

THE slow-moving meteor of March 1, 8h. 31m., described by Mr. J. E. Clark at York (NATURE, March 12, p. 437), was observed by Mr. T. W. Backhouse at Sunderland, and he noted

the path as from $\beta - \alpha$ Canis Minoris eastwards passing $170° \pm 0°$ and disappearing behind a cloud about 5° beyond the latter point. The duration was 6½ seconds.

Comparing the two observations, I find the radiant was in Pisces at $18° + 5°$, which at the time of the meteor's appearance had an altitude of about 4° only in due west. The meteor was first seen from Sunderland when it was over a point near York at a height of 59 miles, and when last seen from York it was over Heligoland at a height of 49 miles. The Sunderland observer noticed the meteor a little earlier in its flight than the observer at York; while at the latter place it was retained much longer in view than at Sunderland, where a cloud appears to have obscured the terminal stages of the phenomenon. The whole length of its path was about 370 miles; Mr. Backhouse, at Sunderland, watched the meteor traverse 195 miles, so that his estimate of the duration would give 30 miles per second for the velocity. Mr. Clark saw 338 miles of the path, and his estimate of 32 seconds would give 10½ miles per second. The difference may be partly accounted for on the supposition that owing to the resistance of the atmosphere the meteor slackened considerably in speed during the latter part of the flight.

When last seen by Mr. Clark, the meteor was close to its anti-radiant and travelling in a nearly direct line away from the observer, so that its apparent motion would be very very slow, and the object must have looked like a hazy almost motionless star near the eastern horizon.

The radiant point at $18° + 5°$ in Pisces indicates a place in the heavens where no meteor shower has ever been observed in the first quarter of the year—in fact, on March 1 it is only 35° east of the sun. In the summer and autumn, when the constellation Pisces is favourably presented in the dark sky, many meteor showers radiate from it and some brilliant fireballs have been directed from a similar position. The following instances may be noted:—

1884 Aug. 25	$10° + 5½°$	Fireball	Niessl
1858 Aug. 26	$11 + 0$	,,	,,
1868 Sept. 5	$14 - 2$	,,	,,
Sept 3–10	$17 + 9$	Meteor shower	Schmidt
1877 Sept. 12	10 ± 0	,,	Denning
1885 Sept. 15	$13 + 6$	,,	,,
1875 Sept. 24	$2 + 2$	Fireball	Herschel
1864 Sept. 27	$12 - 2$	Meteor shower	,,
1891 Sept. 30	$14 + 7$	Fireball	Denning
1887 Oct. 11	$13 + 6$	Meteor shower	,,
1876 Oct. 19–21	$11 + 8$	,,	,,
1872 Oct. 30	$14 + 7$	,,	Backhouse
Nov. 11–14	$10 + 5$	,,	Heis

The mean position seems to be about $13° + 5°$. It declines so far to the west in November that no showers have been seen from it afterwards, though it occasionally yields fine slow-moving fireballs. Thus in 1891 Dec. 20, 8h. 38m., I saw a meteor, equal to Venus, moving very slowly from $124° + 64°$ to $159° + 49°$, and presumably from this radiant in Pisces.

Bristol, March 19. W. F. DENNING.

Barisal Guns.

IN regard to the "barisal guns" or "mist pouffers," lately described in NATURE, similar sounds have been heard in this region.

On July 4, 1808, the expedition of Captains Lewis and Clark was at this place. Under that date we find the following entry in their journal: "Since our arrival at the Falls we have repeatedly heard a strange noise coming from the mountains in a direction a little to the north of west. It is heard at different periods of the day and night, sometimes when the air is perfectly still and without a cloud, and consists of one stroke only, or five or six discharges in quick succession. It is loud, and resembles precisely the sound of a six pound piece of ordnance at the distance of three miles. The Minnatarees frequently mentioned this noise like thunder, which they said the mountains made, but we paid no attention to it, believing it to be some superstition or falsehood perhaps. The watermen also of the party say that the Pawnees and Recaras give the same account of a noise heard in the Black Mountains [Black Hills] to the west of them."

The mountains towards which these noises were heard were the main range of the Rockies, and distant about eighty miles. In 1854, Mr. Doty, of Governor Stevens's party, heard similar noises. He was near enough to the mountains to be certain that the noises came from them. The locality where Mr. Doty heard them was where the direction observed by Lewis and Clark would strike the mountains.

Plenty of white men have been in this country for the last thirty years, or since 1866. I have made careful inquiry among pioneers, but cannot learn that the noises have been heard since Mr. Doty's report.

In 1810 a party, outfitted by John Jacob Astor, made an overland trip from the Missouri to the mouth of the Columbia. They tried to go through the Black Hills, but were obliged to withdraw and flank them. In these hills they note as follows: "In the most calm and serene weather, and at all times of the day or night, successive reports are now and then heard among these mountains, resembling the discharge of several pieces of artillery. Similar reports were heard by Messrs. Lewis and Clark in the Rocky Mountains.

Such explosions are also said to occur frequently in Brazil. "Vasconcellis, a Jesuit father, describes one which he heard in the Sierra, or mountain region of Peratininga, and which he compares to a park of artillery." CHAS. H. ROBINSON.

Great Falls, Montana, March 5.

Ostwald's Energetics.

IT may not perhaps be irrelevant to point out that even were it permissible to assert—as Prof. Fitzgerald conclusively shows that it is *not*—that because certain natural processes do not under actual conditions reverse, therefore they are irreversible, the examples of irreversibility in nature, on which Prof. Ostwald founds his "fourth attack" on the mechanical theory, are singularly ill-chosen. He directs us to the life-histories of organisms, these life-histories themselves being but a very brief portion of the indefinitely long series of transformations which the matter for that short time identified with them is going through. Yet even within this narrow range reversible actions are to be found. Surely all metabolic processes must be regarded as such. Moreover at this very moment there may quite possibly be built into our own bodily tissues, matter which some generations ago entered into the physical composition of our ancestors, has since been degraded from the rank of organic substances altogether, and is now through new-old combinations and re-combinations once more raised to its former position and forms part of a living organism. If this can come to pass, vital phenomena are clearly not irreversible. It may take much more than the lifetime of a man or of a tree for the whole cycle of operations to be complete; but when it is complete, we have as fair an example of a reversible series as we are likely to find in nature. E. M. C.

"E. M. C." calls attention to the fact that if trees do not grow into seeds they do grow seeds. This and other cases of reproduction are no doubt cases of *reproducing* the original condition, but Prof. Ostwald would rightly refuse to recognise them as cases of *reversion* to the original condition in the dynamical sense. In the case of a dynamical reversal the flow of energy is reversed. In order to have a case the reverse of the growth of a tree, it would be necessary to have a tree which radiated heat back to the sun in the reverse direction to the flow which at present takes place from the sun to the tree. Otherwise Prof. Ostwald would rightly deny that it was a genuine case of dynamical reversion. It was on account of this complication involved in Prof. Ostwald's example that I cited the very much more simple cases of irreversible thermodynamic operations, such as friction and flow of heat from hot to cold. To cite the very complex organic cases of irreversible operations instead of the simple ones, is only to cloud the question with complexity.

Prof. Boltzmann has already devoted himself to combat Prof. Ostwald's Energetics, and it would be well for those who feel any leaning towards the latter to study the views of this father of the kinetic theory of gases. GEO. FRAS. FITZGERALD.

Trinity College, Dublin, March 18.

Classifying Crushed Ore by Trommels.

IT was very pleasing to me to read in your valuable publication of November 7, 1895, the favourable criticism written by your correspondent, Mr. T. K. Rose, on my report on the loss of gold in the reduction of auriferous veinstone in Victoria. Nevertheless, permit me to make a few remarks to endeavour to

remove a misapprehension under which, it seems to me, that he was labouring, after perusing my report, with regard to the limit to which I suggest volumetric sizing. He seems to think I advocate that the grading of the sand, which has been separated, as far as feasible, from the slimes (which are to be subsequently classified separately in four Spitz-Kästen), should be effected through very fine sieves—60-mesh screens, or under. I quite agree that to attempt to do so would fail. Such, however, is not the meaning, or, I think, the construction which can be placed on the context of my report. A glance at the diagram illustrating the sequence of the methods of reduction, clearly shows, I submit, that it is only the *coarser sands issuing from the bottom of the slime separator*, that are subjected to "volumetric sizing" in a trommel, which classifies them into three grades, the finest being through a 40-mesh sieve, which is, I apprehend, practically, the most suitable grade for the Frue-vanners to do close work; the overflow from the concentrates flowing into the Spitz-Kästen.

I trust that these observations will dispel the misapprehension which your correspondent entertained on this point at the time when he wrote his article, as I respect his opinion, and would regret to be misunderstood by him. HENRY ROSALES.

I REGRET to have misunderstood Mr. Rosales, whose report is certainly entitled to most respectful and careful consideration. My mistake (a natural one, I think) arose from a statement made on p. 13 of the report. Here Mr. Rosales says, in speaking of the Johnson's Reef Gold Mines Company, Eaglehawk, that "the battery sand should previously be classified into different grades by 'sizing'. . . . Such could be accomplished by delivering it into trommels fitted with screens of different meshes. The mantel of the first trommel might be a sieve of 40 to 50 holes to the lineal inch, and the second trommel might be covered with *a screen of* 64 *holes to the lineal inch*. . . . This system of sizing would certainly be applicable." (The italics are my own.) On p. 50, where Mr. Rosales recurs to the subject of trommels, he does not mention any screen finer than 40-mesh, but, on the other hand, does not state that this is the finest that should be used, and refers to it merely in the following words:—"Supposing it [*i.e.* the trommel] to be covered with $\frac{1}{32}$ or $\frac{1}{40}$ wire gauze." Mr. Rosales' explanation will, I feel sure, be gladly received by others, besides myself, who have read his valuable report.

T. K. ROSE.

Crush-Conglomerates in Ireland.

IN your issue of March 5 there is a letter from Mr. McHenry, in which he mentions the occurrence at Portraine and Lambay Islands, Co. Dublin, of conglomerates which he considers to be of the nature of crush-conglomerates. During the past two summers we have been examining these sections, and can corroborate Mr. McHenry's statements with regard to the presence of crush-conglomerates; but our investigations have not led us to conclusions altogether similar to his, with regard to the igneous rocks of the district. We hope to publish our results before very long.

S. H. REYNOLDS.
C. I. GARDINER.

CLAUDIUS PTOLEMY AND HIS WORKS.

CLAUDIUS PTOLEMY! What reader of the most elementary science is not familiar with his name, at least in adjectival form, in connection with the Ptolemaic system, and yet how little is known of him as a personality. That he lived in Egypt during the reigns of Hadrian and Antoninus Pius, and made astronomical observations chiefly on a terrace in Alexandria, sums up nearly the whole. But his works (addressed to Syrus, of whom also nothing is known) were the standards of authority in geography and astronomy for many centuries after his death; and though the tide of science has left them far behind, they can never be quite forgotten or cease to be of high interest in scientific history. His great astronomical work was translated into Arabic (changing its name in the process), and on the revival of learning in Europe was translated from that language into Latin, as it afterwards was from the original Greek. A French version was published by Halma at Paris in 1813-16, but no English rendering (except of small portions) has ever appeared. The British Museum Catalogue shows that our national collection contains a large number of Greek editions and Latin translations of the Almagest (as the Μαθηματικὴ Σύνταξις is always called, from the Greek for "greatest," with the Arabic definite article prefixed) and Geography of Ptolemy, as well as of most of his smaller works; Halma's editions of the Greek of the Almagest and Geography, with French translation in parallel columns; and Italian translations of the latter and of the Optics. Every student of Ptolemy must be under so much obligation to Halma, that it may be of interest to state that he was born at Sédan in 1755, and after being Principal of the college of his native town, became Professor of Mathematics at the Prytanée at Paris, where he held at various times other offices, one of them being that of librarian to the Empress Josephine. Besides his version of Ptolemy and of the not very lucid Commentary of Theon (father of the ill-fated Hypatia) on part of the Almagest, he published a French translation of the Phenomena of Aratus, and died in 1828. His edition of the Almagest is preceded by an elaborate and interesting preface, and has appended to it some Notes by Delambre. Two of Ptolemy's minor works, the Planisphærium and the De Speculis, appear to be extant only in Latin versions; the chronological table, however, of reigns up to his own time still exists in the original, whilst of the astrological work called "Tetrabiblos" or "Quadripartitum," we have not only the Greek, but Latin, French, and English translations.

The Almagest was so exhaustively examined and commented on by Delambre, that little can be added to his conclusions.[1] It is evident that Ptolemy's work is founded chiefly upon the observations of Hipparchus, which were made at Rhodes about three centuries before. Lord Macaulay's omniscient schoolboy probably believed that Ptolemy founded the system by which sun, moon, planets, and stars all moved round the earth, though the thought may have crossed his mind that this view was held before the appearance of the Alexandrian astronomer. This is, in fact, somewhat akin to the extensively-believed idea that Newton discovered the fact that external bodies are drawn or attracted to the earth. What is really due to Ptolemy as the author of the Ptolemaic system, is the reducing into a systematic form for explaining the planetary motions the ingenious imaginative machinery of epicycles and deferents. This is now so generally understood that we need not enlarge upon it here. It is almost remarkable that his discussion of the motions of the inferior planets, Mercury and Venus, did not lead him to the elaboration of the Tychonic system, something akin to which Vitruvius and Pliny seem to have had in mind, and which would in that case have held its ground for centuries; when actually started by the Danish astronomer, it was behind the age and soon stranded by the advance of science, his own contemporaries seeing that its cause was hopeless from the first. More credit is due to Ptolemy for his investigations respecting the motions of the moon, which led him to the discovery of the inequality known as the lunar evection. The inequalities he endeavoured to explain by epicycles, but for the latter he introduced in addition an eccentric, the centre of which turned about the earth in a direction contrary to that of the motion of the epicycle. A not inconsiderable portion of the Almagest is devoted to eclipses and their prediction; and we are indebted to Ptolemy for an account of three eclipses of the moon which were observed at Babylon in the years B.C. 721 and 720 under a king whom he called Mardokempados, but whose real name was Merodach-Baladan, and who, after a long contest, was completely crushed and de-

[1] A very able though shorter discussion is given in Narrien's "Historical Account of the Origin and Progress of Astronomy."

prived of his dominions by Sargon, the greatest of the Assyrian monarchs.

Ptolemy describes his method of attempting to determine the distances of the moon and of the sun. To the former he obtained a very fair approximation, making it equal to about fifty-nine semidiameters of the earth; but the sun's distance he thought to be only about 1210 of these semidiameters, or about twenty times the distance of the moon, which is in that unit only about the square root of its true amount. The eighth book of the Almagest contains the earliest extant catalogue of stars, founded upon that of Hipparchus. Six stars are marked red or reddish, one of which, Sirius, has ceased to be so, furnishing a remarkable instance of change of colour; the reading in Ptolemy was contested, but there is no real reason (as has been pointed out by Dr. See) to doubt its genuineness, and the red colour of Sirius in ancient times is confirmed by the testimony of several classical writers.

We must now turn from Ptolemy as an astronomer to Ptolemy as a geographer. If his work in the former department is founded principally upon that of Hipparchus, so does he take for the basis of his geographical system the work of Marinus the Tyrian, which in its latest form but little preceded his own. Those only who are ignorant of both can accuse Ptolemy of plagiarism in this, seeing how fully he recognises his obligations to his predecessor whilst pointing out the necessity of modifying some of his conclusions with regard to the most distant known regions of the world. But for Ptolemy, indeed, we, in these days, should never have heard of Marinus at all. "It is clear," says the late Sir E. H. Bunbury, "that he did not attempt to present his readers with a complete body of descriptive geography such as was furnished by the comprehensive work of Strabo. His object, like that of Eratosthenes at an earlier period, was simply to correct and reform the map of the world so as to adapt it both to the increased knowledge of distant countries and to the improved state of mathematical science, which were possessed in his day." Much more was then known than in the time of preceding geographers of the extent of Africa towards the south and of Asia towards the east; but, in applying this increased knowledge, Marinus exaggerated the extensions so greatly as to distort his map of the world almost as much as theirs, though in the opposite way. This led him to what was, to some extent, a retrograde step—the idea that Asia had an indefinite extension towards the east, similar to that entertained by Columbus when he expected to reach the Indies by a voyage to the west, little dreaming of another isolated continent between.

Ptolemy refers to his astronomical in his geographical work, so that the latter must have been composed subsequently to the former, and its date was probably near the end of the reign of Antoninus Pius, who died in A.D. 161. He fully appreciated the necessity, if positions in the world were to be accurately laid down, of determining their latitudes and longitudes and mapping them thereby. But, unfortunately, in his time the number of places for which this had been done was so small that he was obliged, to a very great extent, to rely upon results obtained from itineraries by the old rough method. These he places before us, both on his map and in extensive tables, as if they had been really founded upon scientific determinations. To quote Bunbury again: "He saw clearly the true principles upon which geography should be based, and the true mode in which a map should be constructed. But the means at his command did not enable him to carry his ideas into execution; the substance did not correspond to the form, and the specious edifice that he reared served, by its external symmetry, to conceal the imperfect character of its foundations and the rottenness of its materials." Some of the exaggerated conclusions of Marinus, particularly with reference to the distances of places in the east of Asia, he rejects, but can only suggest conjectural reductions of them. But even in lands within the bounds of the Roman Empire, few indeed were the places of which even the latitudes, still less the longitudes, had been scientifically determined. Hipparchus had suggested the observation of lunar eclipses at different stations as a means of finding the difference of longitude of these stations; but even in the time of Ptolemy, no such determinations had been actually made, though he refers to one which took place on September 20, B.C. 331, shortly before the battle of Arbela, or rather Gaugamela, which was observed, but not with sufficient accuracy to make it the basis of calculation. In inquiries of this nature, a remark made by the late Sir George Airy often comes into one's mind: "The first man who made good astronomical observations was the first man who made good clocks"—a graphic way of saying how essential was an accurate means of measuring time.

We have reserved but a short space to speak of what may be called Ptolemy's minor works. The principal of these are his Tetrabiblos or Quadripartite, which is in fact a treatise on astrology in the modern sense of the word, and his Harmonics, in which he gives an account of the theory of music. The former (as well as the Centiloquy, or hundred aphorisms, which forms a sort of supplement or summary to it) has been translated into English, the last time by J. M. Ashmand, whose version was published in 1822, and dedicated (like the Prince Regent's famous bumper in Scott's presence) to the author of Waverley. There does not appear any good ground for doubting its genuineness, though many have wished to do so from their admiration of Ptolemy, and feeling that it was unworthy of him. Great astronomers, however, in later times than that of Ptolemy, have believed in the delusive and imaginary "science" of judicial astrology, which still serves to charm some of the ignorant and foolish, and excite apprehensions in others of that still large family. The translator of the Tetrabiblos (who appeared before the public only in that capacity) had no feeling of this kind, and endeavours in a note to parry an objection to astrological predictions as old as the time of Cicero by citing a case of a man who, he tells us, was born within a few moments of George III., and in the same parish, went into business in the same month (October 1760) in which that king came to the throne, was married, like him, on September 8, 1761, and died, like him, on January 29, 1820, "coincidences," we are told, "highly remarkable." However, if any one can derive amusement from astrology, we need not object. Flamsteed drew the horoscope of the Royal Observatory, Greenwich, at the moment of its foundation, though he affixed a line from Horace asking who could forbear laughter. So we may take a few of Ptolemy's notions, one of which was that natural characteristics in different regions and climates was caused by the planets and constellations holding sway there, whence the inhabitants of Britain, for instance (and let us remember that by the argument this still applies), are, he tells us, wilder, bolder, and more ferocious than others.

Ptolemy's Harmonics was edited, with a Latin translation, by Dr. Wallis, in 1682, and an abstract of it is given in Rees's Cyclopædia. We cannot describe here his proposals for the reformation of the musical scale; but we cannot help regretting to find him, in the third book, going off into fanciful musical relations amongst the celestial spheres in a way which reminds us of some portions of his book on astrology.

Our author wrote a work on Optics, which is only known to us through Latin versions made from incomplete Arabic manuscripts. He is said to have discovered the fact of the refraction of the rays of light by passing through substances of different density; but, like

Descartes with regard to the law of this refraction, he was probably anticipated, and by a much longer interval. His Planisphere and other smaller works scarcely call for notice. On the whole, it may be said that Ptolemy was rather a collector and condenser of the scientific facts and methods than an original discoverer or investigator. And with all proper Baconian admiration for the wisdom of the ancients, we may be thankful that in our time, at least in the domain of natural science, the wisdom of the moderns has been added to it.

W. T. LYNN.

A VIEW OF KILAUEA.

THE interest of Kilauea is perennial. Popocatapetls may arise in a night, or Krakatoas may be blown to shivers, and attention may thus be temporarily withdrawn from the great Hawaiian volcano. But such cataclysms are exceptional. Kilauea, on the other hand, is always available to the student of vulcanicity, while Dutton's beautifully illustrated memoir, and Dana's great monograph enable observers to use their opportunities to the fullest advantage. Dr. Benedict Friedlaender's papers in *Himmel und Erde* (Bd. viii. 1895) are the latest addition to the extensive literature upon this subject, and give a series of photographs, which are a useful supplement to those of the two American authors. Dr. Friedlaender's narrative shows that the mountain can now be studied without inconvenience. A good track runs from Kilo, on the north-eastern coast of Hawaii, to the summit of Kilauea. It passes first through plantations of sugar-cane and banana, and past clumps of screw-pine (*Pandanus*). At the height of about 1000 metres the tropical vegetation is left behind; trailing Freycinetias and great Cibotias give place to tree ferns and an undergrowth of plants of temperate affinities, such as cranberries (*Vaccinium*). On the north-eastern edge of the crater, at the height of 1230 metres, is a good hotel, in telephonic communication with the coast. Dr. Friedlaender's description of the mountain takes us over a good deal of old ground; but his account records recent changes, and his notes and views bring out several characteristic features of the volcano. In the first place he emphasises the fact that though Mauna Loa rises to the height of the Jungfrau, neither it nor Kilauea have any claim to be called mountains. Whereas some of the Italian volcanoes have slopes of 30°, that of Mauna Loa is only 6°, and that from the summit of Kilauea to the north-east cape of the island is only 1° 35′. The summits of the volcanoes are not mountain summits, but only a high plain. Orographically, Kilauea is only a lateral crater on Mauna Loa; but geologically they must be regarded as two distinct volcanoes, as eruptions sometimes take place on Mauna Loa, while the lava lake in the other is at rest. As Mauna Loa is 3000 metres higher than Kilauea, and the weight of a column of basaltic lava of that length is 900 atmospheres, this independence of the two volcanic centres appears at first sight to be in contradiction to the fundamental principles of hydrostatics. The author explains this by the assumption, that the lavas in the central pipe of Mauna Loa are of lower specific gravity than those of Kilauea, owing to the greater abundance of

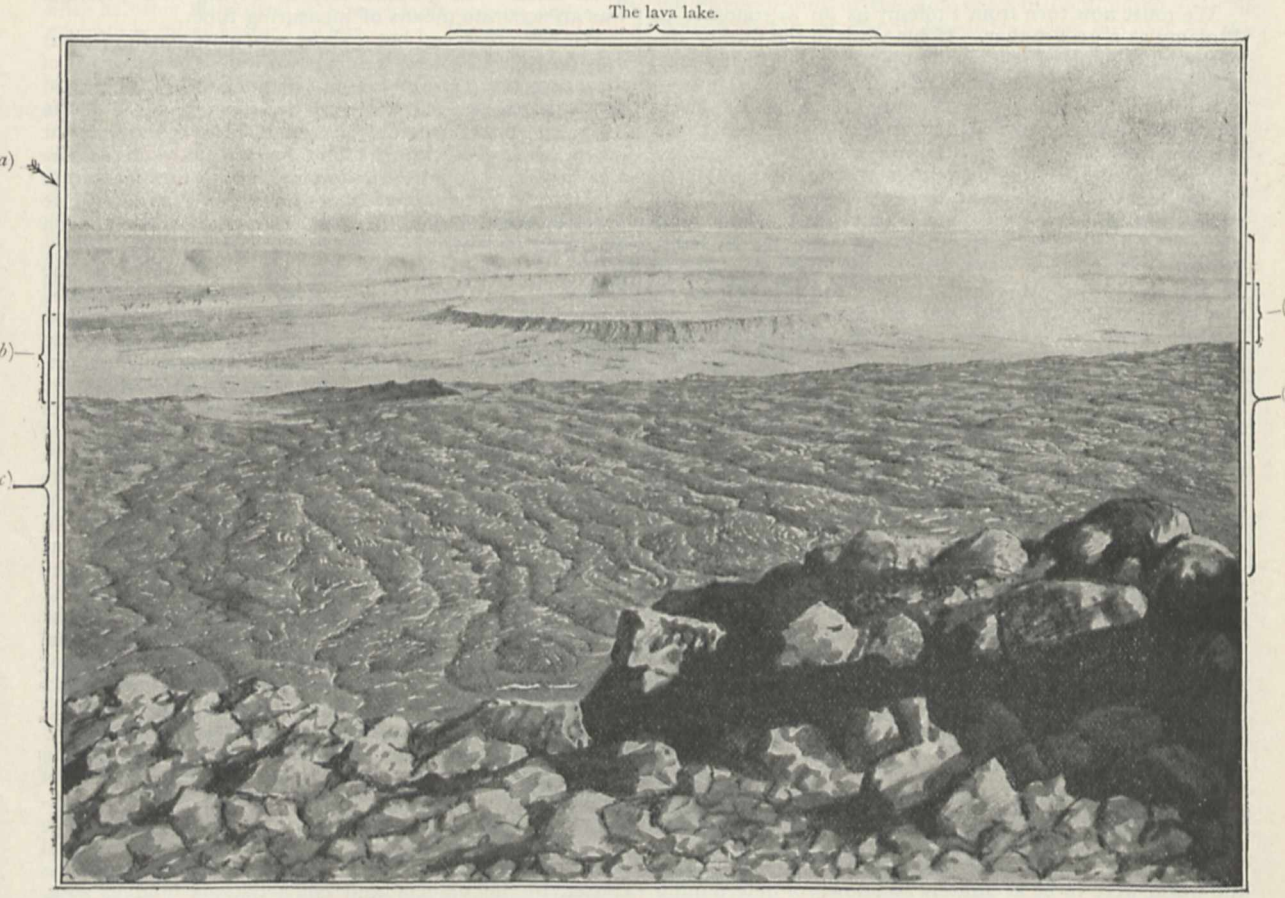

FIG. 1.—(*a*) Hut. (*b*) Margins of the secondary crater. (*c*) Margins of the primary crater. (*d*) Secondary crater. (*e*) Primary crater.

gas in them. The insignificant action of steam in Kilauea is declared by the author to be the most remarkable fact about it; for he says that it works "practically without steam, but with colossal quantities of highly fluid lava." Hence explosive action is very exceptional, though such an eruption did once occur in that year of violent upheavals 1789. It is owing to Kilauea having been built by the slow, quiet, piling up of lavas without explosions, that its crater is so very different from that of the Italian volcanoes. Instead of a narrow, deep, gullet, it is a broad, open, cauldron-shaped depression. The accompanying view illustrates the nature of the crater; it is from a photograph taken from the north-western corner, and looks due southward. In the foreground are some blocks of lava, on the margin of the plateau in which the crater lies; beyond this is the flat floor of the primary or major crater, at the foot of a vertical lava wall, 140 metres in height. The greatest diameter of the major crater is 4·7 kilometres; but the width to the opposite wall, seen in the figure as a long, low line in the far distance, is at this point only a little over 3 kilometres. In the centre of the view is seen the famous lava lake, 250 metres in diameter; this occurs in a raised tertiary crater in the centre of the depressed secondary crater. This latter extends across the view from side to side, but it is small in comparison with the primary crater; its average diameter is only 700 metres, so that its area is only about half a square kilometre, whereas the major crater occupies 10·6 square kilometres. The depth of the secondary crater is about 20 metres.

Dr. Friedlaender remarks that in addition to the subjective difficulty in the description of a volcano, there is, also with Kilauea, the objective difficulty of the rapid changes that take place there. These render necessary frequent periodical re-descriptions. One such change is now in progress, for after a pause of fifteen months the mountain is again in active eruption.

NOTES.

THE British Section of the International Memorial to Pasteur has now assumed definite shape, and the Provisional Committee, which already includes the names of the Dukes of Devonshire and Westminster, and many distinguished men of science from all parts of the United Kingdom, held its first meeting last Friday, at the rooms of the Royal Society, Burlington House, under the presidency of Sir Joseph Lister. It was unanimously decided to apply for subscriptions towards the erection of a monument to Pasteur in Paris, from persons in the United Kingdom, India and the Colonies, interested in science and the various industries which have been benefited by Pasteur's labours. An Executive Committee was formed, consisting of Sir Joseph Lister, Sir John Evans, Sir Henry Roscoe, Dr. Thorne Thorne, and Prof. Percy Frankland (Hon. Secretary). Subscriptions may be sent to Sir John Evans, who will act as Hon. Treasurer, at the Royal Society, Burlington House, W.

AT the stated meeting of the Royal Irish Academy, held on March 16, the Earl of Rosse, K.P., F.R.S., was elected President, in succession to Dr. J. Kells Ingram, whose term of office had expired. The President nominated as Vice-Presidents—The Rev. Dr. Haughton, F.R.S., the Most Rev. Bishop Donnelly, D.D., Dr. J. Kells Ingram, and Dr. Ben. Williamson, F.R.S. The following were elected Honorary Members in the Department of Science—Sir Joseph Lister, Bart., P.R.S., Sir W. H. Flower, K.C.B., Rev. T. G. Bonney, F.R.S., and Prof. Wm. Ramsay, F.R.S.

IN the Japanese Imperial Budget for the current year, we observe that a sum of 21,639 dols. has been set aside for earthquake investigation. This is a grant over and above the usual expenditure of the Central Observatory controlling the seismic survey of the country.

THE monument to Lobachevsky will be unveiled this autumn at Kazan. It consists of a bronze bust of the late geometer, one metre high, placed on a column of black polished granite, about 50 centimetres in diameter and 1·4 metres high, standing upon two steps of grey unpolished granite. The total height of the monument is 3·6 metres, and its cost about 3,300 roubles (£330).

WE learn from the *British Medical Journal* that Prof. Behring has given the half of the Alberto Levi prize of the Paris Academy of Sciences, recently awarded to him (amounting to £1000) to the Prussian Government Fund for the Furtherance of Research on Serum Treatment. The moneys received by the official control stations, where the diphtheria antitoxin is tested before it is allowed to be sold, will also be paid into this fund.

THE National Academy of Sciences, acting on the request of the Secretary of the Interior of the United States, has reported a Commission to investigate the forestry problem, consisting of Charles S. Sargeant, Alexander Agassiz, Henry L. Abbot, William H. Brener, Arnold Hague, and Gifford Purchot. The Secretary will recommend to Congress an appropriation of 25,000 dols. to cover the expenses of the Commission.

GENERAL JOHN B. WOODWARD, under whose able administration the Brooklyn Institute developed into the largest local scientific society in the world, with a membership of 3700, died on March 7, of pneumonia, after a short illness. General Woodward was for many years President of the Brooklyn Institute, but declined re-election last spring. He held many other prominent stations, having been a general in the army during the war of the rebellion, a bank president, candidate for mayor of the city, and President of the Society of Titans, none of whom were less than six feet two inches high. He was sixty years old.

THE Brooklyn Institute has completed negotiations for the purchase of the collection of Lepidoptera made by the late Berthold Neumoegen, comprising 40,000 to 45,000 specimens comprising 13,000 to 14,000 species, upwards of 1000 being type-specimens. This is the finest collection in America. As much as 100 dols. was paid by Mr. Neumoegen for a single specimen in several instances. The Institute will also secure the collection of Jacob Doll, of over 55,000 specimens, and will employ Mr. Doll as curator. Edward L. Graef will present his collection of about 20,000 specimens. The Institute already owns the Calverley collection; and the aggregate of all will give it the most complete collection of Lepidoptera in the world.

THE opening of the bicycle season shows the importance of that vehicle as a means of locomotion, and its potency as a factor in promoting good roads. The New York and Brooklyn Bridge has just been made free to bicycles, a change which required an Act of the Legislature to secure it. The grant for paving in New York City this year includes 1,000,000 dols. for asphalt pavement in a total amount of 1,250,000 dols. The pneumatic tire has been applied to ambulances in Brooklyn with great success. The ingenuity of inventors is taxed to devise improvements in all parts and appliances of the machine; and while the New York Cycle Exhibition last January was the largest exhibition of any special machinery that has been held in America, the exhibition now in progress in Brooklyn adds several apparently useful novelties not shown heretofore.

THE Governor of New Jersey has signed the Bill ceding the palisades of the Hudson to the United States Government for a national park.

THE General Electric Company and the Westinghouse Electric Company have combined, and each will be allowed to use the patents of the other.

IN connection with the Hungarian Millennial Exhibition, which will be opened on May 2, a Congress of Mining and Geology will be held at Budapest on September 25 and 26.

THE third International Congress of Dermatology will be opened in London on August 4, and will terminate on August 8. The President will be Mr. Jonathan Hutchinson, F.R.S.

WE regret to record that Prof. Sappey, the distinguished anatomist, died at Paris on March 14. His elaborate "Treatise on Descriptive Anatomy" is one of the best contributions to anatomical literature published in any language. He was a member of the Section d'Anatomie et Zoologie of the Paris Academy of Sciences.

THE *Scientific African* states that Mr. M. A. Schlechter, of the Botanical Museum, Grünewald Strasse, Berlin, is about to start on a collecting tour in South Africa. He will visit the Coud-Bokeveld, Namaqualand, Transvaal, and the Limpopo and Zambesi rivers.

RUSSIAN astronomers are completing their arrangements for viewing the forthcoming eclipse of the sun. The Pulkova Observatory will send an expedition to the Lower Amur; the Academy of Sciences has chosen Novaya Zemlya for the seat of its operations; so has the Kazan Society of Naturalists; while the Geographical Society will send the Director of the Irkutsk Meteorological Observatory, A. V. Voznesensky, to Olekminsk, on the Lena, for meteorological observations. Prof. Glasenapp and L. G. Vuchikhovsky propose to go to Finland on their own account. The young Russian Astronomical Society (it was founded only in 1891) directs its chief attention to physical observations, and it will have three parties of observers, provided with photographic appliances. The chief station will be on the Lena, where the duration of the eclipse is the longest, and it is proposed to photograph there the corona by Schaeberle's method, with an objective of long focal length, and also to photograph, by means of two spectrographs, the spectrum of the corona, as well as the limb of the sun, by means of a camera provided with a Rutherford prism. At the second station, on the bay of the Ob, the corona will be photographed by means of several ordinary cameras; while at the third station, in the eastern parts of the Uleaborg province, to the north of Enontekis, the corona will be photographed by means of several cameras following the movement of the sun; and it is intended to establish a comparison between the spectrum of the corona and that of helium. The usual determinations of the duration of the eclipse will be made at the first and third stations.

MR. R. H. SCOTT has sent us a cutting from the *Diario Oficiel*, which records that on March 2 a well-marked earth-movement passed over the capital of Mexico at 0h. 24m. a.m., Mexico time, the direction being from north-east to south-west, and the duration about twelve seconds. The shock was recorded at other places as follows:—

Place.	Time. h. m.	Duration. s.	Direction.
Tecuitatlan ...	11 57 ...	20 ...	—
Colima ...	12 3 ...	30 ...	W.N.W. to E.S.E.
Morelia ...	12 12 ...	...	S.S.E. to N.N.W.
Manzanillo ...	12 20 ...	30 ...	—

THE question as to the desirability of retaining the Museum of the Geological Society has formed the subject of long deliberations by the Council of the Society. It was announced at the recent annual meeting that, in accordance with the report of a special Committee, the Trustees of the British Museum had been asked whether they would undertake to house and care for the collections, keeping type-specimens and specimens illustrative of papers read before the Society distinct, and defraying also the expenses of transference. To these conditions the Trustees have assented, and the matter will before long be submitted to the Fellows for their decision at a special general meeting.

PROF. STROUD informs us that in obtaining photographs with Röntgen rays, the time of exposure can be reduced by placing a card covered with barium platino-cyanide immediately in front of, and in contact with, the sensitive plate. A very good shadow-picture of the bones of the fingers was thus obtained by Prof. Stroud with a two minutes' exposure, whereas without the fluorescent card an exposure of from twelve to fifteen minutes was required to give a similar result. It is suggested that the introduction of some suitable fluorescent substance (rendered active by X-rays) into the sensitive film of photographic plates would greatly shorten the time of exposure requisite.

THE gigantic extinct birds of the order "Stereornithes," which are peculiar to the Eocene beds of Patagonia, have been until lately quite unrepresented in the museums of Europe. Sir William Flower has just acquired for our National Collection the series of the remains of these birds belonging to Señor Florentino Ameghino, of Buenos Ayres. This includes a complete skull of *Phororachos inflatus*, which is of most extraordinary size and appearance, and the lower jaw of an allied species (*P. longissimus*), about two feet in length.

UNDER the name *Canis holubi*, Dr. L. V. Lorenz has lately described a new wild dog from Western Matabeleland. The specimens of this new species, received by the K.K. naturhistorische Museum of Vienna from Dr. E. Holub, had been previously assigned to *C. adustus*, Sund., but Dr. L. v. Lorenz (*Verh. Zool.-Bot. Ges.* in Wien, 1895) now points out the differences between these two nearly allied species. In a subsequent paper (*Ann. d. K.K. naturh. Hofmuseums*, xi. h. 1), Dr. Lorenz gives further particulars, and figures the skull of *C. holubi*.

UPWARDS of sixty ornithologists assembled on Wednesday, the 18th inst., at the monthly meeting of the British Ornithologists' Club, held at Frascati's Restaurant in Oxford Street. The proceedings were of special interest on account of the splendid series of more than 900 eggs of the Cuckoo, which were on view on this occasion, having been assembled together from the cabinets of various collectors by the energy of Mr. Edward Bidwell. Most of the Cuckoos' eggs were accompanied by clutches of the eggs of the foster-parents, in the nests of which the mother-cuckoo had placed them. There are about 110 foster-parents at present known of *Cuculus canorus*, and examples of the eggs of 76 of these foster-parents, accompanied by one or more Cuckoos' eggs, were exhibited to the meeting. The conclusions arrived at by Dr. Eugene Rey, as stated in a recent number of this journal (see NATURE, December 26, 1895, vol. liii. p. 176), were well illustrated by this excellent series, which was believed to be the largest ever got together on one occasion.

IN a recent number of NATURE, February 27 (vol. liii. p. 393), under the heading "The Destruction of Trees by Lightning," we gave an account of the investigations which had been carried out by Jonescu and others to determine, if possible, the reasons underlying the observed facts that some kinds of trees are more liable to be struck by lightning than others. It was there stated that the whole question seemed to turn on the nature of the tree—that is, whether it was a tree rich in resin, or one rich in starch; further, the degree of conductivity seemed to increase the less oil and the more starch the tree contained. Some interesting statistics are given in the current number of *Prometheus* (No. 336, p. 383), concerning the white poplar. In the neighbourhood of Moscow, out of 597 trees struck by lightning, no less than half of them—more accurately 302—turned out to be the white poplar. This fact is sufficient to show that the degree of conductivity of this tree must be very high, and it has been suggested that country people should plant these

trees for natural lightning conductors. The pyramid-poplar has also for a long time been known to be specially attached to the lightning flash, so that by planting many of these round the farmhouses they should form natural and inexpensive lightning conductors, more effective perhaps than many now in use.

ACCORDING to Hermann Feigl ("Die Religion der Chinesen," *Oesterreich. Monatsschr. für den Orient*, xxii., 1896, 1), the primitive belief of the Chinese has been suppressed by Confucianism and Buddhism. Chinese religion has never had the puerilities, the animal cults, the cruelties and fanaticism of other religions. Like the Jews, the Chinese had very vague ideas of future rewards and punishments and of life after death. Their ancestor cult had no mythologic motive like that of India or Japan. The Chinese, like the Jews and ancient Egyptians, had the philosophic conception that continuation of life lies not in the immortality of the soul, but in the perpetual remembrance of the righteous by mankind. The Chinese could not persevere with metaphysical problems, and so did not advance. Confucius appeared at a time when the Chinese felt the need of a religion; but the greatest of their religious reformers was Lao-tseu, who was born about 604 B.C., or half a century before Confucius. He introduced the word Tao, "way," for the idea of divinity, which previously was confused with the visible sky (Schang-ti). Tao is the element from which everything comes, and to which everything returns. Lao-tseu also taught that the departure of the soul from the body was no disaster for us. But he was too vague to be a convincing reformer. Confucius was not an original thinker like Lao-tseu; he culled what he liked from the older writers, and allowed people to believe what they chose. When consulted he spoke in an oracular manner, and while satisfying no one he offended nobody.

PERHAPS the most interesting region visited by H.M.S. *Challenger*, during her memorable expedition, was that designated by Dr. John Murray as the "Kerguelen Region of the Great Southern Ocean." Leaving the Cape of Good Hope on December 17, 1873, the *Challenger* proceeded in a south-easterly direction, visiting in succession Prince Edward and Marion Islands, the Crozet Islands, Kerguelen Island, and Heard Island, then southward, until on February 16, 1874, having reached longitude 78° 22′ E., some ten miles beyond the Antarctic Circle, she turned north-easterly, for Melbourne, arriving there on March 17, 1874. During this three months' cruise many trawlings were made, and some of the rarest and most remarkable forms were met with. Each one of the staff of writers will remember with what excitement and delight he approached the examination of the results of some of the deep-sea dredgings, from this region, especially the eight trawlings from the most southerly position reached, where the depth was between 1260 and 2600 fathoms. It is of this region, and of the zoological treasures found therein, that Dr. J. Murray writes in a memoir published in the early part of this year in the *Transactions* of the Royal Society of Edinburgh (vol. xxxviii.), thus enabling the student to obtain, within a brief compass, the story, as far as it is as yet recorded, of the marine fauna of this part of the ocean. After a short introduction, we have full lists of the Metazoa found by the *Challenger*, arranged according to the depths. About some of the islands, Kerguelen especially, many of the species were taken from quite shallow water; this is followed by a list of Metazoa recorded from sources other than the *Challenger*, a list of great importance for purposes of comparison. A list is given of identical or closely-related forms, found in the extra-tropical regions of the Northern and Southern hemispheres, but unknown hitherto within the tropics. There are also lists of the Foraminifera, Diatoms, and surface organisms of the region, and of the Radiolaria found in the deposit dredged from a depth of 1950 fathoms, at Station 157 in the Southern Indian Ocean.

PROF. E. C. PICKERING has communicated to the *American Meteorological Journal* for this month, the results of an investigation carried out by Prof. S. I. Bailey, on the diurnal oscillation of atmospheric pressure at the Peruvian stations of Harvard College Observatory. The stations, which are eight in number, are situated along a line nearly four hundred miles long, drawn approximately north and south across the Andes. The lowest station has a very small elevation above the sea-level, while the highest, that on the Misti summit, has an altitude not far short of 20,000 feet, the others being admirably chosen with a view to obtaining meteorological results from a great variety of elevations. The stations are well supplied with instruments, including in every case a Richard barograph, although no mercurial barometer has been regularly in use at any station except Arequipa Observatory. The natural difficulties of visiting the Misti summit have been increased by the civil war, and in consequence of this the continuity of the record has suffered. Energy less active than that possessed by Prof. Pickering and his assistants would have led to the evacuation of the station. At Arequipa Observatory (elevation 8000 feet), where the annual range of the barometer varies from 22·626 inches to 22·404 inches, a comparison was made between the results obtained from the mercurial barometer and the Richard barograph, and after a certain uniform correction had been applied to the latter, it was found that the monthly barographic means were liable to an error as great as 0·034 inch, and that the mean error for the year was 0·013 inch. At all the stations the diurnal oscillations are well marked, and very uniform from day to day. There are striking differences, however, between the records in the different localities, especially in the hour of the morning maximum, and the intensity of the afternoon maximum and minimum. The paper contains the curves for the mean diurnal variation for the year April 1894–March 1895, together with the corresponding values for a single day, selected at random, and the investigation points out this important result, that "from these curves it appears that the retardation of the morning maximum is at least, in part, a function of the altitude." The diagram shows that the time of maximum near the sea-level is 9 a.m.; at 4000 feet, about 9h. 20m.; at 8000 feet, about 9h. 40m., while at the Misti summit the maximum pressure is near noon.

THE Pilot Chart of the North Atlantic Ocean for the current month contains a chart showing the tracks of the storms during March for the six years 1890–95, north of the 35th parallel and west of the 30th meridian. The diagram shows that the portions of the North Atlantic within the prescribed limits in which storms are most frequent during March are (1) the region immediately to the east of Cape Hatteras and the New Jersey coast, and (2) the area included between the parallels of 45° and 50°, and the meridians of 30° and 40°. Each track bears a number, by which the date of the appearance of the storm may be obtained by reference to a table. The information is both interesting and useful, and no doubt similar tracks will be given for other months.

THE Zi-ka-wei Observatory has published the first of a proposed series of papers entitled "Typhoon Highways in the Far East." The present paper is by the Rev. L. Froc, S.J., and refers to the storms which have occurred near the south end of Formosa Strait, between 1877 and 1895, and especially to the typhoon of September 19 last. The principal conclusions arrived at are (1) that a violent typhoon may be expected to traverse the south end of the Formosa Channel at least once a year; (2) the direction from the South Cape varies between N. 20° W. and N. 85° W., the *ensemble* of the storms forms a kind of fan, whose point lies upon the south end of Formosa Island, and which thence spreads out to the coast of China; (3) the period of occurrence is from the middle of July to the beginning of

October; a curve of the monthly frequency shows that a considerable maximum coincides with the equinox. The most striking characteristics are the suddenness of their appearance and the narrowness of the storm area; in some cases Father Dechevrens has shown that the diameter did not exceed fifty miles, and that the velocity of translation may vary from eight to twenty-six miles per hour. The author discusses, at some length, the various signs which precede the occurrence of the typhoons.

THE numbers of the *Naturwissenschaftliche Wochenschrift* for February 16 to March 8 contain an account, by Dr. H. Hallier, of a botanical investigation of Central Borneo, organised at the instance of the Dutch Government, under the direction of Dr. Treub, of Buitenzorg. This portion of the island is an almost unknown land from a natural history point of view; previous explorations having been made from Sarawak, Labuan, British North Borneo, and Dutch South Borneo. A very large collection was made, calculated to amount to about 3000 distinct species of dried plants, as well as a considerable quantity of alcohol material, and many living roots. These are now being examined at the Botanical Institution at Buitenzorg. The mountain K'nepai was ascended, about 1125 metres high. Its flora is described as being especially rich in Orchideæ and in species of *Nepenthes*.

THE interesting question has been recently again raised, by Messrs. Gotschlich and Weigang, as to whether the virulence of cholera cultures is dependent upon the number of bacilli present, or whether the age of the culture affects the toxic character of the individual bacilli. Estimations have been made of the number of bacilli present in cholera cultures at different periods of time, and it has been found that a rapid diminution takes place with the increasing age of the culture. Thus at 37° C. at the end of two days, only 10 per cent. remained of those present at the close of the fully virulent age of twenty hours, whilst after three days only 1 per cent. were left. Messrs. Gotschlich and Weigang have also determined the approximate number of individual cholera bacilli which constitutes a lethal dose, and this they state to be from 200 to 300 million bacilli, and that as long as this number is present, it is a matter of no consequence whether the dose is abstracted from a twenty hours' old culture or from a three days' old culture. The apparent diminution in the virulence of cultures some days old, is not due to the attenuation of the bacilli at this age, but is attributable to a smaller number being present in the culture, for equally fatal results were obtained when larger quantities of such cultivations were employed.

PSYCHOLOGY has found in America a congenial field for development, one of the clearest marks of its vitality there being the excellent *Psychological Review*. The March number of that journal contains the address recently delivered by Prof. McKeen Cattell as President of the American Psychological Association; and how great has been the academic recognition of the subject in America during the past few years is shown by his remark, that "psychology is a required subject in the undergraduate curriculum wherever studies are required, and among university courses psychology now rivals the other leading sciences in the number of students attracted, and in the amount of original work accomplished." The following other indications of growth are recorded in the same journal:—The psychological department of Cornell University has moved to Morrill Hall, where it is said to have nine rooms and four thousand square feet of floor space. The psychological laboratory of the University of Nebraska has been moved into the first-floor of the new library building, and occupies a series of five rooms with a floor space of three thousand square feet. In the new biological buildings, which the University of Chicago will erect with a part of the million dollars given by Miss Culver, ample provision will be made for the psychological laboratory. In the new Schemerhorn Hall of Natural Sciences, to be erected for Columbia University at a cost of about 400,000 dollars, more than one-tenth of the building is allotted to psychology. At this rate of progress, America will soon rival Germany in psychological laboratories and productions.

THE Académie Royale de Belgique announce the following prize subjects for 1897:—New researches on the thermal conductivities of liquids and solutions. An important contribution to the geometry of straight lines. A discussion, from the theoretical point of view, of the question of variations of latitude, and their causes, the paper to include a criticism of the works of geometers on the subject, from Laplace to the present time. New researches on the physiological *rôle* of albuminoid substances in the nutrition of animals and plants. New anatomical and systematic researches on insects of the group Aptera. Does there exist a nucleus in Schizophytes? If so, what is its structure, and what its mode of division? A discussion of the changes made in the classification of the deposits which constituted the *Laekenian* system of Dumont, most of which are usually referred to the Upper Eocene; to bring forward new evidence in support of the classification adopted. The value of the prize to be awarded for the best work in each of these subjects is six hundred francs. Memoirs may be written in French or Flemish, and should be addressed to the Secretary of the Belgian Academies before the beginning of August next year.

MESSRS. WILLIAMS AND NORGATE have just issued a classified list of recent scientific publications, chiefly of foreign origin. Book-hunters seeking scientific works would do well to consult the list.

MR. HIRAM S. MAXIM is contributing a series of illustrated articles on "Automatic Firing Guns" to *Industries and Iron*.

A PAPER on "The Food and Labour-Power of Nations," contributed by Prof. F. S. Nitti to the March number of the *Economic Journal*, contains a large number of facts and figures of interest from a physiological, as well as from an economic and social, point of view.

THE Tōkyō Mathematico-Physical Society has recently published in its *Proceedings* a reprint of Clifford's Translation of Riemann's Habilitationschrift (1854), viz. on the hypotheses which lie at the bases of geometry (NATURE, vol. viii. Nos. 183, 184, and *Mathematical Papers*, pp. 55–71).

AN elaborate discourse on Helmholtz's investigations on the "Grundlagen der Mathematik und Mechanik," which was delivered in November last at Heidelberg University, by Prof Leo Koenigsberger, the occasion being a celebration in memory of the founder of the University, has now been published by B. G. Teubner, of Leipzig. A photogravure of Helmholtz forms a frontispiece to the reprint.

WE are glad to receive from the agricultural department of the University Extension College, Reading, the second annual report of field experiments on hay, pasture, potatoes, swedes and mangels, carried out in Berkshire, Hampshire, and Oxfordshire, during 1895, under the direction of Mr. Douglas Gilchrist and Mr. P. H. Foulkes. A notable feature of the work is that it was carried out on land placed at the disposal of the experimenters by various land-owners and farmers, who also gave assistance in the actual superintendence and cultivation of the plots. Two important Farmers' Clubs have also co-operated in the work. By thus enlisting the help of farmers, interest in agricultural experiments is greatly increased, and the results are more likely to command the attention of practical men than if they were obtained by flower-pot cultivation.

THE opening address for the Session 1894–95, delivered to the Royal Physical Society of Edinburgh by Prof. H. A. Nicholson, has recently been published in the *Proceedings* of that Society, and will be found to be an admirable summary of the evidence that has accumulated of late years against the doctrine of Ocean Permanence. The distribution of land and sea in former periods is discussed, and the truly abyssal characters of certain sediments now forming part of continental masses are pointed out in some detail, while mention is made of the evidence for a former Antarctic continent, and other matters are more briefly discussed.

A RECENT number of the *Annali* of the Meteorological and Geodynamic Office of Rome contains an interesting paper, by S. Arcidiacono, on the Syracuse earthquake of April 13, 1895. The disturbed area comprises the south-east corner of Sicily. On the map which accompanies the paper, eight isoseismal lines are drawn, corresponding to intensities 1 to 8 of the Rossi-Forel scale. These are elliptical in form, and have a common axis running from Cape Passero in a north-westerly direction through Vizzini, which is close to the centre of the meizoseismal curve. Applying the method of Dutton and Hayden, the depth of the seismic focus is estimated at about 7400 metres. The axis of the isoseismals coincides nearly with that of the ridge of Monte Lauro, and joins the two principal volcanic centres, now extinct, of the Val di Noto.

THE additions to the Zoological Society's Gardens during the past week include a Diana Monkey (*Cercopithecus diana*, ♂) from north of River Prah, Ashanti, presented by Captain Edgar E. Bernard; an American Tapir (*Tapirus americanus*, ♂) from Brazil, presented by Mr. Basil J. Freeland; a Markhoor (*Capra megaceros*, ♂) from Peshawur, presented by Colonel Paterson; three Canarian Laurel Pigeons (*Columba laurivora*) from the island of Gomera, Canary Islands, presented by Mr. E. G. B. Meade-Waldo; a Common Mynah (*Acridotheres tristis*) from India, presented by Mrs. Sibyl E. Kennedy; a Herring Gull (*Larus argentatus*), British, presented by Dr. E. Goddard; two Grey Ichneumons (*Herpestes griseus*) from India, deposited; two Amherst Pheasants (*Thaumalea amherstiæ*, ♀ ♀) from Szechusan, China; two Swinhoe's Pheasants (*Euplocamus swinhoii*, ♂ ♀) from Formosa, a Bar-tailed Pheasant (*Phasianus reevesi*) from North China, two Great American Egrets (*Ardea egretta*) from America, a Porto Rico Pigeon (*Columba corensis*) from the West Indies, a Vinaceous Pigeon (*Columba vinacea*) from South America, two Rosy Parrakeets (*Palæornis rosa*, ♂ ♀) from Burmah, two Musky Lorikeets (*Trichoglossus concinnus*, ♂ ♀) from Australia, purchased; two Barbary Wild Sheep (*Ovis tragelaphus*, ♂ ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE FIFTH SATELLITE OF JUPITER.—The opposition of Jupiter in 1894 occurred at a very unfavourable time for observations at Mount Hamilton, but a few measures of the fifth satellite were secured with some difficulty by Prof. Barnard. During the observations of the satellite, the planet was obscured by a piece of smoked mica covering half the field. For the measurement of distances the micrometer wires were usually placed perpendicular to the belts on the planet; but on November 18 they were set parallel to the belts, and these measurements accordingly enable the Jovian latitude of the satellite to be determined. Only one eastern elongation was observed. This was on December 3, and the distance was found to be 59″·5; or, reduced to the mean distance of the planet = 5·20 astronomical units, 48″·17. On this date the elongation occurred at 23h. 43·6m. G.M.T., the corresponding time in Marth's ephemeris being 23h. 42m. G.M.T., so that the observed time was over a minute behind the computed time. The ephemeris is based on a period of 11h. 57m. 22·6s., and the observed elongation indicates that this period will represent the motion of the satellite with sufficient accuracy to find it for several years to come (*Astronomical Journal*, No. 367).

THE YERKES OBSERVATORY.—Additional particulars as to the proposed equipment of the new Yerkes Observatory of the University of Chicago are furnished by Bulletin No. 1, the first of a series of notices which will be published at irregular intervals in the *Astrophysical Journal*. The resident staff is to consist of Messrs. Hale, Burnham, Barnard, Wadsworth, Ellerman, and Ritchey, the last-named as optician. The 40-inch object-glass has been completed by Mr. Alvan Clark, and recent tests have shown the definition to be fully equal to that of the Lick telescope, while the light-gathering power is considerably greater. Electro-motors are provided to give the various movements to the instrument and to the elevating floor. The attachments to the great telescope include a solar spectroscope, a spectroheliograph for photographing the solar chromosphere in monochromatic light, a stellar spectroscope, and a photoheliograph of long focus for photographing the direct image of the sun on a large scale. A 12-inch refractor and a 24-inch reflector will also be erected. The meridian-room is designed to contain a large meridian circle, but will be provisionally occupied by a transit instrument. An instrument shop and optical laboratory will be fully equipped with the necessary tools, and it is hoped that it will be possible to construct many of the instruments and laboratory apparatus which may be required in occasional investigations. The main building is now under roof, and will be completed during the summer.

THE PROPER MOTION OF τ TAURI.—A discussion of the meridian observations of τ Tauri, which has been undertaken by Dr. Fritz Cohen (*Ast. Nach.*, 3341), indicates a variable amount of proper motion in declination, but there is less certainty as to the motion in right ascension. For an explanation of the irregularities it is suggested that the star is attended by a dark companion similar to that associated with Procyon, and only giving evidence of its existence by its gravitational effects on the brighter star, causing it to describe an orbit round the common centre of gravity. It is true that the star is already known to be double, the magnitudes of the components being 4·5 and 8·5; but the distance of the visible companion is so great (79″), that the detection of an orbital movement in the comparatively short period covered by the meridian observations is scarcely probable. There is an increase of 11″ in the distance measured in 1823 as compared with that determined in 1783, but as the distance and position angle in 1823 agree substantially with those in 1895, the earliest recorded measure is not to be depended upon. An investigation of the movements of the star by means of micrometric measurements in relation to neighbouring stars is suggested. The association of dark bodies with bright stars, in some cases producing variability either by eclipses or other means, but in others having no appreciable effect on the brightness, is a very notable feature of recent astronomical discoveries.

TWO REMARKABLE SOLAR PROMINENCES.—Father Fenyi reports the observation of two very striking solar prominences (*Astrophysical Journal*, vol. iii. p. 192). One observed on July 15 last was remarkable for its enormous velocity of 858 km. per second in the line of sight; the other, on September 30, for its great height of 11′ 28″, which it attained with a mean velocity of 448 km. per second.

The first one was found precisely at a point on the sun's limb where a group of sun-spots was passing out of view, and its form changed with extraordinary rapidity.

The second prominence was unusually bright, and at 10 a.m. was about 1′ high; eleven minutes later it had mounted to 4′, and the maximum altitude of 11′ 28″ was reached at 10.20, the velocity in the line of sight then being 746 km. per second. Half an hour from the beginning, the prominence was only 3′ 16″ above the photosphere. The spot associated with the latter prominence showed a considerable proper motion in the earlier days of its existence, amounting to about 600 km. per hour The convergence of some of the brighter "stream lines" of the prominences towards a spot was especially marked in these observations, and it is suggested that they have a radial arrangement with respect to the spots. This structure seems to point to the existence of currents in the solar atmosphere, directed either towards the interior of a spot, or outwards from it.

It is stated that an explosion taking place over a sun-spot would accord well with the appearances usually seen in the great prominences which have been observed at Kalocsa, but it is by no means asserted that actual explosions take place.

THE MEASUREMENT OF DOUBLE-STARS BY INTERFERENCE.

AN interesting form of micrometer is described by Herr Karl Schwarzschild in *Astronomischen Nachrichten*, No. 3335. The idea is gathered from the instrument which Michelson suggested and used for measuring small diameters and distances, an account of which appeared in the *Memoirs* of the National Academy of Science, Washington, 1891. Michelson, it may be remembered, placed before the object-glass of his refractor a disc in which were two parallel movable slits that set up interference phenomena; and an observation consisted in noting simply the disappearance and reappearance of the interference bands. Schwarzschild's disc, or more accurately oblong framework, on the other hand, contains several slits cut out at equal distances from one another, which cause several images to be visible at the eye-end of the telescope, forming a true multiple-image micrometer.

If one considers the case of the ordinary glass grating as used in spectroscopic work, it is well known that with a bright point as the source of light, we obtain a series of images, the angular distances of which from the unrefracted central image, for a certain wave-length, are given by the formula $\sin \alpha = \lambda . n/d$, when λ is the wave-length, d the distance between the lines on the grating, and n their number. In the case of daylight the centre image becomes sharp and white, while the others become broader and broader, in fact small spectra. By exaggerating this idea of the grating, and cutting out of a card slits three millimetres broad and ten millimetres distant from one another, the angular distances of the images for wave-length $\lambda = 570 \mu\mu$ become very small, and can hardly be separated with the unaided eye. Such a grating as this placed before the object-glass of a telescope directed to a star would show, in the field of view, one colourless image accompanied on its right and left sides by several other images, the first of which would differ only slightly in sharpness and colour from the middle image. It is only to these three images that Schwarzschild pays attention. Of course it is necessary that some means should be at hand by which these images may be moved with respect to one another, and this he accomplishes very simply.

To the object-glass ring, and in a plane parallel to it, he fixes a framework capable of rotation in this plane. Two circular rods, at opposite ends of a diameter of the object-glass, and perpendicular to the framework, are rigidly fixed to the latter, and to these rods is connected the apex of two inclined smaller frameworks containing the slits, the other two extremities of which slide in the grooves of the large frame. Since the distance of this apex from the object-glass can, by means of a rack and pinion movement, be increased or decreased, and since also the distances of the different slits vary consequently in a simple known manner, the displacement of the images in the field of view can be easily calculated.

In bringing a double star into the field of view, two parallel series of images would thus be seen, one series from the primary, the other from the companion. The whole framework containing the grating was then rotated in position-angle until the two lines of images coincided; the position of this line was then determined by means of a micrometer eyepiece, and the position-angle read off. To measure the distance between the stars, the rack and pinion motion connected with the apex of the two frames containing the grating was then used, until the image of he companion appeared exactly between the two images of the primary. The position of the grating was then read off, and a brief calculation gave the distance required. From a series of observations of several binaries, the total mean gave as a probable error of the mean for each evening:

Distance	Probable error in Distance	Probable error in Position angle
2″·3	0″·050	0″·052

The numbers show, as Herr Schwarzschild points out, that greater accuracy can be obtained by this means than by the thread micrometer. He is not, however, very confident about the usefulness of the method, for when the distances to be measured exceed 5″, the colour of the first images becomes very apparent, and thus destroys the accuracy in measuring. Further, the nature of the method stops it from being useful for measuring pairs dimmer than the 7th magnitude, because the aperture of the object-glass is cut down very considerably when the grating is much inclined and the light is distributed over several images. The simplicity of the method has, however, much to recommend itself to many, more especially to those who possess large apertures, and can therefore afford to spare a little light.

D.

FLORA OF ZERAFSHAN.

IN a communication to the St. Petersburg Society of Naturalist (*Proceedings*, 1895, i.), M. Komaroff thus sketches the flora of the Zerafshan region of Russian Turkestan. The Aral-Caspian flora covers the lowlands up to the 1000 to 1500 feet level. Next comes the prairie, or Steppe, zone, which spreads up to about 3500 feet of altitude. In its upper parts it is characterised by Steppe-bushes, of which the almond-tree (*Amygdalus spinosissimus*, Bunge) is the most characteristic representative. Higher up, from 3500 to 6000, or 6200 feet, comes the zone of deciduous trees, which may be subdivided into a lower sub-zone of Mediterranean trees (*Pistacia vera*, *Celtis australis*, *Amygdalus communis*, *Acer monspessulanum*, &c.), with a prevalence of fragrant Labiatæ, which attains approximately the 4500 feet level; and an upper sub-zone characterised by maple-trees (*Acer lactum*). The zone between 6000 feet and nearly 8500 feet is taken by the Juniperus-trees which correspond in Zerafshan to the coniferous trees of other regions. It is covered at its upper limits with rampant bushes of *Juniperus nana* and *pseudosabina*, *Comarum*, *Cotoneaster*, *Lonicera*, *Astragalus*, and so on. The Alpine zone attains the levels of 11,000 and 12,000 feet—the morainic plants, *Didymophysa fedtschenkoana*, *Corydalis fedtschenkoana*, *Cerastium lithospermifolium*, *Saxifraga axillaris* and *Allardia tomentosa* reaching the highest altitudes. On the Zerafshan glacier, at a spot where it was covered with some gravel, the author found specimens of *Saxifraga axillaris*, *Epilobium latifolium*, *Arabis tibetica*, *Poa karatavica*, and one *Carex*—a fact which shows how careful one must be in interpreting the real sense of plant-bearing strata imbedded amidst morainic deposits. It is also worthy of note, that the botanic zones of Zerafshan very much correspond to the zonal geological structure of the highlands. The Aral-Caspian flora covers the æolic deposits of the great desiccated inner sea of Central Asia; the Steppe flora covers the Loess girdle; the Mediterranean trees and shrubs occupy the limestones and the marls, while the Juniperus zone spreads over the crystalline slates and limestones, and the Alpine flora covers the higher granitic massives of the highlands. Man evidently alters to a great extent the character of the vegetation—pistachio-tree groves and the *Juniperus excelsa* trees being rapidly destroyed; while the hundreds of thousands of sheep which are brought every year to the Zerafshan mountains from the lowlands, entirely destroy the Alpine prairies—thickets of *Artemisia dracunculus* taking the place of the grasses.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—One of the arguments which are brought forward for granting the degree of B.A. to students from Newnham and Girton Colleges is that, when they apply for educational positions, they are at a disadvantage as compared with students from other universities which do grant the degree of B.A. Dr. W. H. Besant points out in a circular, which he had addressed to the members of the Senate, that this difficulty would be entirely removed if a charter were granted to Newnham and Girton Colleges, creating a Women's University, which should have the power of granting degrees. This need not interfere with the present arrangements for the teaching and for the examination of the students in the various subjects, the study of which they now undertake. Mr. J. L. Strachan-Davidson has suggested that Oxford, Cambridge, and Dublin—the three universities which have not as yet conferred degrees on women—should join in a petition to the Crown to grant a charter for a university whose sole function it shall be to give degrees to women. A scheme similar to that supported by Dr. Besant has been practically adopted by the University of Harvard.

THE members of the Skinners' Company visited Tonbridge on Saturday last, for the purpose of opening a new second-grade school which they have just built at a cost of upwards of £10,000

THE following are among recent appointments:—Dr. C. A. Strong to be lecturer on psychology in Columbia University; Mr. H. C. Warren to be assistant professor of experimental psychology in Princeton University; Herr H. Hinterberger to be professor of photography in the University of Vienna; Prof. James Holm, of University College, Nottingham, has arrived at Cape Town, to succeed Prof. Smith as professor of applied mathematics and physics in the South African College; Prof. G. F. Atkinson to be full professor and head of the department of botany in Cornell University; Mr. Arnold Philip to be professor of electrical engineering and applied physics in the Merchant Venturers' Technical College, Bristol, in place of Prof. W. Wilson, who will shortly vacate the chair in consequence of his appointment to the post of principal of the Salford Municipal Technical School.

THE plans and drawings of the Women's Medical Institute, the new Russian college for granting medical diplomas to women, are, says the *Lancet*, completed. The building operations will begin next month, and it is hoped that they may be finished in time to open the new institution in August of next year. It has been liberally subsidised by Government and by the municipality of St. Petersburg, and private subscriptions and donations have been neither few nor small. At present the whole capital amounts to about 600,000 roubles (nearly £64,000). But of this at least 450,000 or 475,000 roubles will be required for building and furnishing the institute. The late Prof. Tchudnofski, whose recent death has created a vacancy in the chair of General Therapeutics in the Army Medical Academy, has left to the Women's Medical Institute his entire medical library, containing over 4000 volumes. The number of students who will be admitted to the courses at first has been fixed at 125. Already over 100 applications have been received.

YALE UNIVERSITY is having a run of good fortune. The widow of Thomas G. Sloane will remarry soon after Easter, thereby forfeiting to Yale the sum of 200,000 dols. left by her first husband on condition of her remaining unmarried. She will let the money go without a contest. The will of the late George Bliss, of the great banking house of Morton, Bliss, and Co., was admitted to probate in New York on March 11. Among the bequests is one of 50,000 dols. to Yale, to be disposed of as the President of the University shall direct. A new dormitory is to be erected on the college *campus* this season, at a cost of nearly 100,000 dols. Ground was broken on March 9, at Washington, for the new American University, the Hall of History being the first building to be erected. This is a university of the Methodist Church, and Bishop Hurst of that Church presided. About 1,000,000 dols. has been secured towards the University fund. This should not be confounded with the proposed University of the United States. Nothing has yet been done regarding the latter, except the introduction of a Bill in Congress; and the fate of the measure is still problematical.

WHEN shall we be able to chronicle so many gifts from private persons to science and education in England as the following, which *Science* announces in a single number?—The will of the late Mr. Hart A. Massey, of Toronto, leaves about 650,000 dols. to educational and charitable institutions, including the following bequests: Victoria College, Toronto, 200,000 dols.; Wesley College, Winnipeg, Man., 100,000 dols.; Mount Allison College, Slackville, N.B., 100,000 dols.; Wesleyan Theological College, Montreal, 50,000 dols.; American University, Washington, D.C., 50,000 dols.—The Finance Committee of the Senate of the State of Virginia has presented a Bill appropriating 50,000 dols. annually, instead of 40,000 dols. as heretofore, to the University of Virginia.—The will of the late Mr. Charles L. Colby, of New York, bequeaths 20,000 dols. to Brown University.—Morris M. White and Francis T. White have given to Earlham College, a Quaker institution in Richmond, Ind., 25,000 dols., to be added to the endowment fund and to be known as the John T. White memorial fund, in honour of their father.—Mrs. Josiah Fiske, of New York City, has given 5000 dols. to Radcliffe College, in memory of her late husband. The College has also received 6568 dols., the balance of a bequest by the late Caroline B. Perkins.—Mr. T. E. Bondurant, of De Land, Ill., has offered to give 20,000 dols. to the endowment fund of Eureka College, Illinois, provided the Board of Trustees will secure 100,000 dols. additional by March 1, 1897. Mr. T. J. Underwood, of Sangamon County, Ill., has donated 10,000 dols. towards the fund.

A RETURN made to the Department of Science and Art, showing the extent to which, and the manner in which local authorities are applying funds to the purposes of technical education (including science, art, technical and manual instruction), has been published as a Parliamentary Paper. The return shows that the total expended on technical education during the year 1893–94 in England, Wales, Scotland, and Ireland was £647,632; and that the estimated total expenditure on technical education for the year 1894–95 was £737,421. These amounts are exclusive of the sums devoted to intermediate and technical education under the Welsh Intermediate Education Act. In England, 41 out of the 49 County Councils (excepting the County of Monmouth) are applying the whole of the residue received under the Local Taxation (Customs and Excise) Act to technical education, and 8 County Councils a part of it to the same purpose. Of the Councils of the 61 County Boroughs, 55 are devoting the whole of the residue to technical education, and 8 a part of it; while in one case only, the County Borough of Preston, the residue is not being applied to educational purposes, but to relief of rates. Further, the Councils of 11 County Boroughs, 51 Boroughs, and 86 urban districts are making grants out of the rates under the Technical Instruction Acts; and 8 local authorities are devoting funds to technical education out of the rate levied under the Public Libraries' Act. In Wales and Monmouth, the 13 County Councils and the Councils of the 3 County Boroughs are devoting practically the whole of the residue grant to intermediate and technical education, and several Councils are making grants out of the rates. As regards Scotland, 21 out of the 33 County Councils are applying the whole of the residue to technical education, and 9 a part of it, while 3 use it for the relief of rates. Of the 195 Burghs and Police Burghs, more than half (101) apply the whole of the grant to the relief of rates.

DESPITE Prussia's open secret of a Treasury exhausted for the Army vote, and the consequent amenities between the Ministers of Education and Finance, the necessity of maintaining the trade schools in some degree of efficiency is present to the German official mind. The want of funds applicable to educational purposes in Prussia, is among the causes making for the spread of social democracy, and this is particularly the case in the straitened salaries of the teachers of the *Volksschulen*. A review of the Technical Education item in the Prussian Budget for the last five years shows, however, a healthy growth. For altogether, apart from the continuation schools in West Prussia and Posen, for which special provision is made, the grant for 1895–96 was 1,947,257 marks (£97,362 17*s.*), which was an increase in the total State subvention of £22,304 14*s.*, or nearly 30 per cent. of the entire grant. To take the trade schools (*Fachschulen*) alone, these were especially well treated. The State's expenditure on them rose from 896,993 marks (about £44,850) in 1891–92, to 1,263,157 marks (about £63,158) in 1895–96, or by more than 40 per cent., while their internal history shows an equally satisfactory development. In 1891–92 there were forty-four trade schools subsidised by the Treasury. Of these, four of the least significant have since been closed, while, on the other hand, no less than eight new ones have been started, involving a vote for the current year of more than £10,500. Three of these new schools are for building, two for weaving, one for pottery, one for engineering, and one for art industries. Similarly, the contribution to the continuation schools (*Fortvildungsschulen*) reveals an increase by more than 20 per cent., from £22,000 in 1891–92 to £26,500 in 1895–96. These figures are at least reassuring, and give hope that during the present year the Treasury will not look askance on the Education Office when it begs for money for the growth of its good work.

SCIENTIFIC SERIALS.

American Meteorological Journal, February.—The rainfall of the Malay Archipelago, by Dr. A. Woeikof. This article is chiefly based upon the observations which have been for fifteen years published in considerable detail by the Observatory of Batavia. It is generally considered that near the equator the rains are everywhere heavy and of nearly daily occurrence. Dr. Woeikof shows that in many localities, *e.g.* on the open sea, this is not the case. In the region in question, some of the wettest and some of the dryest stations lie within 1½° N. and 1° S. of the equator. The most rain falls on the west coast of Sumatra; the more level Eastern Sumatra and Western Borneo

have less rain, and less contrasts also. On the north-east of the peninsula of Celebes the rains are comparatively light, and there is a well-marked dry season. In Java, the rainfall is lightest in the east, and the dry season is longer and more sharply defined, so that vegetation has a time of arrest corresponding to our winter.—Psychrometer studies, by Prof. H. A. Hazen. This is a continuation of a discussion between Prof. Hazen and Dr. Ekholm, of Stockholm, on the behaviour of the psychrometer with respect to water vapour and ice vapour.

Bulletin of the American Mathematical Society, vol. ii. No. 5, February.—"Remarks on the progress of celestial mechanics since the middle of the century" is the presidential address delivered before the Society on December 27, 1895, by Dr. G. W. Hill. The address opens with the statement that a thoroughly satisfactory history of the subject has yet to be written, and then the author rapidly analyses some of the books that touch upon it, as Gautier's "Essai historique sur le problème du troîs corps" (1817), Laplace's historical chapters in the last volume of the "Mécanique Céleste," Todhunter's "History of the Theories of Attraction and the Figure of the Earth," and Tisserand's "Traité de Mécanique Céleste." The scarcity of memoirs and books on the same subject accessible to American students, unless they work abroad, is dwelt upon, and then Dr. Hill opens with a consideration of Delaunay's method (*cf.* his "Théorie du Mouvement de la Lune"). Pointing out that Delaunay's method has not yet received all the developments and applications it is susceptible of, he next merely mentions Hansen's treatise on the perturbations of the small planets, and then confines his attention to a careful examination of the labours of Prof. Gyldén and M. Poincaré. He here enters into considerable detail, and closes with the remark that we owe much to M. Poincaré for his attack, "but the mist is not altogether dispelled; there is room for further investigation." This last remark is made with reference to the Lindstedt series, which "if convergent, would establish the non-existence of asymptotic solutions" (*cf.* a paper by the same author in the January number of the *Bulletin*, noticed in NATURE, No. 1373, p. 382).—A short note follows on Kronecker's linear relation among minors of a symmetric determinant, by Prof. H. S. White.—Dr. G. A. Miller's note on the lists of all the substitution groups that can be formed with a given number of elements, is a valuable historical *résumé* of recent and past work in this subject.—On Cauchy's theorem concerning complex integrals, by Prof. M. Bôcher, closes the mathematical papers.—From the Notes we learn that Prof. White's paper was read before the Society.

In the December number of the *Botanical Gazette* (vol. xx.), Mr. Frederick V. Coville, the Botanist of the U.S. Department of Agriculture, contributes a very interesting account of the botanical explorations of Dr. Thomas Coulter in Mexico and California, between the years 1824 and 1834. Among the chief botanical explorers in North America during the first half of the present century was Coulter. His collections were the basis of important contributions to the descriptive botany of Mexico and California. Born near Dundalk, Ireland, in 1793, he graduated in the Dublin University in 1817, studied under De Candolle at Geneva, and published his monograph of Dipsaceæ in 1824. He was Keeper of the Herbarium of Trinity College, Dublin, from 1834 to 1843. This account is accompanied by a copy of the principal part of the map published with Coulter's "Notes on Upper California," and Mr. Coville adds that he hopes in the near future to publish the letters of Coulter to A. Pyramus and Alphonse De Candolle, of which, through the courtesy of Dr. Casimir De Candolle, he has had copies. He further earnestly begs for any additional facts relating to Coulter, which should be sent to hlm to the Agricultural Department, Washington, U.S.

L'Anthropologie, Tome vi. No. 6.—Researches on the weight of the brain among the lunatics at St. John's Hospital, Copenhagen, by F. Meyer and P. Heiberg. In these investigations, which have extended over more than ten years, the authors have excluded brains that have suffered great loss of substance, those that have been the subjects of considerable cerebral hæmorrhage, and those that presented large tumours; on the other hand, brains suffering from œdema, anæmia, hyperæmia, atrophy, or periencephalitis have been included. The mean weight of 398 brains of men was found to be 1320 grammes; the greatest weight was 1866 grammes, and the least 995 grammes. 292 brains of women were examined; the mean weight was 1177 grammes, the heaviest weighed 1509 grammes, and the lightest 780 grammes. It appears that the brain gradually diminishes in weight after about fifty years of age.—On marriage amongst the Polynesians of the Marquesas Islands, by Dr. Tautain. Some of the marriage ceremonies described by the author clearly point to a time, not very remote, when all the women were common property, and marriage was unknown. A man on his marriage acquires the right of a husband over all his wife's sisters, and at the same time his brothers are entitled to exercise similar privileges with respect to the newly-made bride. In the author's opinion the Marquesans are a degraded people, and do not deserve the least sympathy.—Prehistoric stations in the neighbourhood of Marseilles, by E. Fournier. In this paper are recorded the results of digging operations at 110 stations, 45 of which have yielded evidence of the fauna and of prehistoric industry. They may be arranged in four groups: (1) The Magdalenian, (2) those belonging to the transition period, (3) the Lower Neolithic, (4) the Upper Neolithic.—Sculpture in Europe before Græco-Roman influence, by Salomon Reinach. The author enters upon the last part of his inquiry, viz. the representation of animals in primitive art, and the association of the human form with the forms of animals.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 5.—"On the Diurnal Periodicity of Earthquakes." By Charles Davison, M.A.

Reference is made to the previous work of De Montessus and Omori, the former endeavouring to show that the diurnal periodicity of earthquakes is apparent rather than real, and the latter pointing out that a marked diurnal periodicity characterises the after-shocks of great earthquakes in Japan.

The results of twenty-six registers obtained by means of continuously recording instruments in Japan, the Philippine Islands, and Italy are subjected to harmonic analysis with the following conclusions:—

(1) The reality of the diurnal variation of earthquake-frequency seems to be proved by the approximate agreement in epoch (mean local time) of the first four components (24, 12, 8, and 6 hours) for the whole year at Tōkiō and Manila, and for the winter and summer halves of the year at Tōkiō.

(2) In ordinary earthquakes, there is in nearly every case a marked diurnal period, the maximum generally occurring between 10 a.m. and noon. The semi-diurnal period, though less prominent, is also clearly marked, the maximum occurring as a rule between 9 a.m. and noon and between 9 p.m. and midnight. Other minor harmonic components are also occasionally important, the first maximum of the eight-hour component probably occurring about 6.30 a.m., and that of the six-hour component about 3 or 4 a.m.; but for these two epochs the results are not always concordant.

(3) Though the materials are insufficient for any general conclusion, the weaker shocks seem to be subject to a more marked diurnal periodicity.

(4) In the case of after-shocks of great earthquakes, the diurnal periodicity is as a rule strongly pronounced. The maximum of the diurnal period occurs within a few hours after midnight, but the epochs of the other components are subject to wide variation, possibly on account of the short intervals over which the records extend. A special feature of after-shocks is the prominence of the eight-hour and four-hour components.

The epochs of the first four components representing the diurnal variation of seismic frequency are compared in several cases with those for barometric pressure and wind velocity. While the variation of the former cannot be attributed exclusively to either of the latter phenomena, it seems not improbable that the diurnal periodicity of ordinary earthquakes may be due chiefly to that of wind velocity, and the diurnal periodicity of after-shocks chiefly to that of barometric pressure.

Geological Society, February 26.—Dr. Henry Hicks, F.R.S., President, in the chair.—On the structure of the Plesiosaurian skull, by Charles W. Andrews. Owing to the imperfection of the specimens described, various previous accounts of the Plesiosaurian skull were incomplete, and differed from one another in important particulars. There was in the National Collection a fine skull of *Plesiosaurus macrocephalus* which had lately been cleared from the matrix, with a description of which the author was mainly occupied, though other specimens, which were of assistance in clearing up some

difficulties, were also noticed. The author particularly considered the structure of the palate, and only such points in the structure of the rest of the skull as added to or were at variance with previous descriptions were considered.—On certain Granophyres, modified by the incorporation of Gabbro fragments, in Strath (Skye), by Alfred Harker. The rocks described formed a group of irregular intrusions, the largest less than a mile in length, situated in the tract of volcanic agglomerate north and west of Loch Kilchrist. They differed from the normal Granophyres, abundantly developed in the neighbourhood, in being darker, denser, and manifestly richer in the iron-bearing minerals, while in places were seen numerous small rock-fragments evidently of extraneous origin. In the discussion that followed, Sir Archibald Geikie pointed out that the paper had a double value. In the first place, it was important in regard to the local geology of the Western Isles, for it demonstrated by new evidence the posteriority of the Granophyres to the Gabbros; and in the second place, it had a suggestive bearing upon questions of theoretical interest regarding the possible modification of eruptive rocks by the incorporation of foreign material into their substance.—Observations on the geology of the Nile Valley, and on the evidence of the greater volume of that river at a former period, by Prof. E. Hull, F.R.S. The author drew attention to the two great periods of erosion of the Nile Valley, the first during the Miocene period, after the elevation of the Libyan region at the close of Eocene times, and the second during a "pluvial" period extending from late Pliocene times into and including the Pleistocene. In the second part of the paper the terraces of the Nile Valley were described, and full details given of the characters of a second terrace, at a height varying from 50 to 100 feet above the lower one, which is flooded at the present day. This second terrace was traceable at intervals for a distance of between 600 and 700 miles above Cairo. Two old river channels were also described, one at Koru Ombo, and the other at Assuan itself. The author discussed the mode of origin of the second terrace and the old river valleys, and believed them to be due to the former greater volume of the river, and not to subsequent erosion of the valley. He gave further evidence of the existence of meteorological conditions sufficient to give rise to a "pluvial" period, and pointed out that other authors had also considered that the volume of the Nile was greater in former times.—The fauna of the Keisley limestone, part i., by F. R. Cowper Reed. The author had examined a very full series of fossils from the Keisley limestone of Westmoreland, and proposed to describe the fauna of the limestone. In this (first) part of the paper a description of the Trilobites was given.

Zoological Society, March 3.—Sir W. H. Flower, K.C.B., F.R.S., President, in the chair.—Mr. G. E. H. Barrett-Hamilton exhibited two skeletons and other bones of the Norway lemming (*Myodes lemmus*), obtained by Dr. H. Gadow from caves in South Portugal. This discovery had increased our knowledge of the distribution of the Norway lemming in past times. In present times the Norway lemming was, roughly speaking, only to be found in Norway and Lapland, its southern range extending to about 58½° N. lat.; but its remains had been met with in England, and in Quedlinburg in Saxony. Dr. H. Gadow, F.R.S., gave an account of the caves in Southern Portugal in which he had procured these lemmings' bones along with those of other animals.—Mr. Sclater opened a discussion on the rules of zoological nomenclature by reading a paper on the divergences between the rules for naming animals of the German Zoological Society and the Stricklandian code usually followed by British naturalists (see NATURE, March 5, p. 427).—A communication was read, from Graf Hans von Berlepsch and M. J. Stolzmann, on the ornithological researches of M. J. Kalinowsky in Central Peru. The collections made in the years 1890-93 had been transmitted to the Branicky Museum of Warsaw, and contained examples of 295 species and sub-species, of which an account was given in the present paper. Five species and twenty-two sub-species were described as new.—Dr. David Sharp, F.R.S., on behalf of the Committee for investigating the flora and fauna of the West India Islands, communicated a paper on West Indian terrestrial Isopod Crustaceans prepared by M. Adrien Dollfus. The paper contained an account of the Armadilloidian Isopods, of which specimens had been obtained by Mr. H. H. Smith in the islands of Grenada and St. Vincent and the adjacent islets. These were referred to thirteen species, all but one of which were described as new to science.

Entomological Society, March 4.—Mr. Walter F. H. Blandford, Vice-President, in the chair.—Mr. Percy H. Grimshaw exhibited specimens of *Cephenomyia rufibarbis*, Meigen, a new British bot-fly parasitic on the red deer. The specimens were collected in Ross-shire, in June and July 1894, and in the Cairngorm Mountains in 1895.—Mr. C. G. Barrett exhibited, for Mr. Porritt, a black variety of *Polia flavicincta*, taken at sugar in his garden at Huddersfield.—Mr. A. H. Jones exhibited specimens of the butterflies captured at Coomassie by Major Henry P. Northcott during the recent expedition.—Sir John T. D. Llewelyn, Bart., M.P., exhibited specimens of a small species of Diptera which he believed to be parasitic on *Trochilium sphegiforme*, as he had bred a number from that species. He remarked that *T. sphegiforme*, although one of the most local moths in this country, had occurred last year on the estate of Sir J. Hills-Johnes, K.C.B., in Carmarthenshire, in such numbers in the larval state as almost to destroy the whole of the alders growing there. Mr. G. H. Verrall said that the insects belong to a species of *Phora*, possibly *Phora rufipes*, which fed on almost everything.—Mr. Hampson exhibited an exotic species of Locustidæ which Lord Walsingham, F.R.S., had found in his conservatory at Merton Hall, Norfolk.—Dr. Sharp, F.R.S., exhibited specimens of the pupæ of *Micropteryx* (probably *semipurpurella*) and drawings to illustrate their structure. The pupæ were sent to him by Dr. Chapman, who had described their peculiarities in the *Transactions* of the Society in 1893. Dr. Sharp considered the pupa to be that of a Trichopterous insect; most of its structures were those of Trichoptera, and the account given by Dr. Chapman of its emergence showed that this was essentially the same as that of Trichoptera. Mr. McLachlan said that so long ago as 1865 he had suggested the close affinity of *Micropteryx* to the *Trichoptera*. Mr. Hampson, Mr. Barrett, and Mr. Blandford also took part in the discussion which ensued.—Mr. McLachlan exhibited a singular instance of monstrosity in a dragon-fly. The insect was a male of *Heterina occisa*, Hag., from Venezuela.—Mr. E. E. Green exhibited a larva of an Homopterous insect—one of the *Cicadinæ*—from Ceylon, having what appeared to be a head at its caudal extremity.—M. Louis Péringuey contributed a paper, entitled "Descriptions of New Species of South African Coleoptera, chiefly from Zambesia."—Dr. Sharp read a paper, by Prof. Williston, entitled "On the Diptera of St. Vincent, West Indies. Part I."

Chemical Society, March 5.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—The explosion of cyanogen, by H. B. Dixon, E. H. Strange, and E. Graham. When cyanogen, mixed with an equal volume of oxygen, is fired in a long tube, it burns directly to carbonic oxide, and by the use of a photographic method of recording the explosion wave, it is seen that the wave-front is followed by only a very short luminous tail; when a mixture of one volume of cyanogen and two of oxygen is fired, the sharply defined wave-front in which combustion to carbonic oxide occurs, is followed by a long highly luminous tail in which combustion to carbon dioxide occurs.—On the mode of formation of carbon dioxide in the burning of carbon compounds, by H. B. Dixon. The author discusses the various current views respecting the function of water vapour in making a mixture of carbonic oxide and oxygen inflammable; in connection with the dissociation theory of the action, it is shown that the Röntgen rays do not cause the dry mixture to become inflammable.—On the explosion of chlorine peroxide, by H. B. Dixon and J. A. Harker. When cyanogen, acetylene, or carbon disulphide vapour is detonated at one end of a long tube in which it is contained, the explosion wave is not propagated far along the tube; mixtures of chlorine peroxide and oxygen when similarly treated, however, decompose regularly, a true explosion wave being propagated through the gas at about 1100 metres per second.—Note on the use of certain phosphorescent substances in making X-rays visible, by H. Jackson. The most suitable form of vacuum tube for examining the Röntgen rays is one containing a concave aluminium kathode and an inclined platinum anode; the latter spreads the rays from the kathode in all directions, apparently by scattered reflection. A high vacuum is necessary for good results. The most brilliantly phosphorescent substance out of three hundred examined by the author is potassium platinicyanide; it crystallises with $3H_2O$, and since it is most active in its fully hydrated state, should be painted on to black cardboard or vulcanite for use as a screen, in such a way that it can be kept moist. The other

platinicyanides and the platosamine salts are less fluorescent. A study of the discharge phenomena observed during the exhaustion of the tube shows that the rays proceeding from the concave kathode meet at the centre of curvature of the latter, and then diverge in a solid cone; as the vacuum becomes higher, this cone gradually narrows until it becomes at length a straight line. It is interesting to note that this latter would be the behaviour of non-elastic particles emanating normally from the concave kathode.—The union of carbon and hydrogen, by W. A. Bone and D. S. Jordan. On heating carefully purified sugar charcoal to a white heat in hydrogen, 1 to 2 per cent. of the latter is converted into methane. During the burning of an electric arc lamp in hydrogen, acetylene and another hydrocarbon, probably methane, are produced.—Note on the $\alpha\alpha_1$-dimethylglutaric acids, by W. A. Bone and W. H. Perkin, jun.—The symmetrical dimethylsuccinic acids, by W. A. Bone and W. H. Perkin, jun.—The cis- and trans-methylisopropylsuccinic acids, by W. H. Bentley, W. H. Perkin, jun., and J. F. Thorpe. In these three papers the preparation and properties of the acids named are described.

Linnean Society, March 5.—Mr. W. Percy Sladen, Vice-President, in the chair.—On behalf of Capt J. Marriott, Mr. Harting exhibited an antler of the Burmese deer (*Cervus Eldi*), and described a singular condition in another example which for eight years had continued to exude a blood-coloured liquid from a puncture on the under surface of the brow-tine. Prof. Stewart, to whom some of the substance had been submitted for examination, had found no blood-corpuscles therein, and considered it to be grease in a semi-fluid condition, the nature of the colouring matter being as yet undetermined. Mr. Druce thought the substance exuded might be the excretion of the larvæ of some insect feeding upon the internal surface of the horn, and suggested the examination of a section, if possible.—Mr. Harting exhibited a drawing from life of a Klipspringer antelope (*Oreotragus saltator*), lately received (for the first time in this country) at the Zoological Society's Gardens.—Mr. Thomas Christy exhibited several cases of butterflies collected by Mr. Horace Billington in Old Calabar, on which remarks were made by Messrs. W. F. Kirby and H. Druce.—Mr. B. D. Jackson, in directing attention to an English translation by Mr. J. Lucas of that portion of Pehr Kalm's "Travels" which relates to England, remarked that few persons were aware that Kalm, a pupil of Linnæus, had in 1748 spent six months in this country and had diligently noted the plants which he met with. Thus he had recorded no less than sixty plants for Hertfordshire alone, deriving some of his information from an examination of the contents of two haystacks in that county—in this way anticipating by more than a century one of the methods employed by Sir John Lawes and Sir J. H. Gilbert, and by Prof. Fream.—On behalf of Prof. Gustav Gilson, of Louvain, two papers, entitled "Studies in insect morphology," were communicated by Prof. Howes. In the first of these, on segmentally disposed thoracic glands in the larvæ of *Trichoptera*, the author found that in *Limnophilus flavicornis* the prothoracic prominence gives exit to an underlying tubular gland. In *Phryganea grandis* each thoracic sternum gives exit to a glandular apparatus of the same category, the prothorax alone developing a prominence.—In the second paper by Prof. Gilson and M. J. Sadones, on the larval gills of *Odonata*, the authors described in each branchial lamella of *Libellula depressa* three conical processes which are functional in preventing adherence of the lamella to its fellows, and in maintaining full exposure to the surrounding medium.

Mathematical Society, March 12.—Major MacMahon, R.A., F.R.S., President, in the chair.—The President read the following abstract of a paper by Prof. Lloyd Tanner, on the enumeration of groups of totitives. The paper explains a method of determining how many groups of given order can be formed with the totitives of any integer, n. In the investigation use is made of a function formed from a binomial coefficient by replacing each factor, say r, of the numerator or denominator by $p^r - 1$, so that the binomial coefficient is in fact the limiting value of the function as p approaches 1. There are indications of the existence of a reciprocity theorem (viz. that the number of groups of order ν is equal to the number of groups of order $\tau(n)/\nu$), but this theorem is not proved. The attempt to establish the theorem has led to the discovery of some notable properties of the functions—a Van der Monde-theorem, for instance. The functions in question are well known. They were used by Euler as generating functions for the number of partitions, and by Cayley ("Researches on the Partition of Numbers," *Phil. Trans.*, cxlv.). Jacobi in a memoir (*Crelle*, xxxii., 1846), starting with a more general function, obtained a number of formulæ which appear to be different from those used in this paper. Gauss, in the *Summatio serierum quarundam singularium*, used these functions, the base being a complex number of modulus 1. They have been used too (in Schellbach's treatise) as a means of forming the theta-functions. The present application is of a different kind. As in Euler's theory, they are used for enumeration; but the number sought is given by the actual value of the function when the base p is a prime factor of τn.—Prof. Greenhill, F.R.S., next read a paper on the associated dynamics of a Top, and of a Body under no Forces. Jacobi's theorems (*Werke*, ii. p. 480) flow naturally from Darboux's representation by means of the deformable hyperboloid (Despeyrous, *Mécanique*, ii. Note xx.). The hyperboloid is constructed, in Henrici's manner, flattened in the plane of the focal ellipse, by placing the generating lines tangential to the focal ellipse, and knotting together at the points of crossing the generators of opposite systems. Planes are drawn through any point H perpendicular to the generators HP_1, HP_2, through H (the tangents to the focal ellipse through H), the perpendiculars OG, OC are drawn from the centre O upon these planes, and the perpendiculars OY_1, OY_2 on the generators HP_1, HP_2. Then, during the deformation of the hyperboloid, the lengths OG, OC, or HY_1, HY_2 remain constant, and the points V, T, P in which a generator meets the principal planes are fixed points on the generators; so that the planes through H perpendicular to the generators are tangent planes at H to two fixed coaxial quadrics, the squares of whose semi-axes are numerically equal to the rectangles HV.HV, HV.HT, HV.HP, the sign being taken positive or negative according as V and V, or T, or P are on the same or opposite sides of H. These quadrics are the momental quadrics of Jacobi's two associated bodies moving under no forces; but as the quadrics are unrestricted in shape, the bodies must be composed of matter which is capable of having a negative density, as is the two-fluid theory of electricity. The curve described by H is a polhode curve common to the two momental quadrics; it is also a line of curvature formed by the intersection of a confocal ellipsoid and a hyperboloid of two sheets; thus any such line of curvature may be taken as a polhode on either of two momental quadrics, the generating lines of the confocal hyperboloid of one sheet through any point being the normals of the quadrics. If OG is held in a vertical position, OC will imitate the associated motion of the axis of a top, if H is moved always in a direction perpendicular to the plane OGC, and OH will represent the resultant angular momentum. If the momental spheroid of the top at the fixed point O is a sphere, then OH will also represent the resultant angular velocity; but in the general case the resultant angular velocity is represented by the vector OI to a point I fixed in the generator HP_2. In constructing *pseudo-elliptic* cases of motion, the ratio of the axes of the focal ellipse is taken as the modulus of the elliptic functions, and the position of P corresponding to a parameter one-nth part of a period will be determined geometrically by means of the poristic relation of a polygon of n or $2n$ sides, circumscribed to the focal ellipse and inscribed in a confocal. The secular term, associated in general with the azimuth, can be cancelled by placing H in the tangent at P_1 in a position given by a simple relation; and now the cone described by OC is algebraical, as also the herpolhode described by H in the plane perpendicular to OG. Thus for Halphen's algebraical herpolhode, P_1 is at Fagnano's point, and H is the mid-point of P_1Y_1. If P_2 is at the end of the minor axis of the focal ellipse, the axis OC of the top describes cusps. If H is placed at Y_2, then OC represents the motion of the thread of a spherical pendulum. After a brief discussion, in which the President and Mr. Love, F.R.S., took part, Prof. Greenhill made a communication on the Catenary on the Paraboloid and Cone. Clebsch's equations for the form of a chain wrapped on a sphere, which is revolving about a vertical axis with sufficient rapidity for the attraction of gravity to be negligible, are here shown to be immediately applicable to the case of a chain on a vertical paraboloid, when gravity is again taken into account. An elliptic integral of the third kind is required, with a pole at the vertex of the paraboloid, and this integral can be compared immediately with the standard form of the pseudo-elliptic integral, by the solution of a certain Jacobian quartic. The arc of the catenary is also directly reducible to the form employed by Abel (*Œuvres*, ii.). The motion of a little ball, rolling on the paraboloid, is re-

ducible to integrals of a similar nature; but in no case does it appear that its path, nor the catenary, can become of a purely algebraical nature. In the catenary on the vertical cone, as well as in the motion of a sphere rolling on the cone, the integrals are more directly reducible to the Jacobian form. In each case the developed catenary or trajectory is the form assumed for a constant central attraction or repulsion.—Lieut.-Colonel Allan Cunningham, R.E., gave a proof that $\frac{1}{4}(5^{11}-1) = 12,207,031$, and $\frac{1}{8}.\frac{1}{2^3}(7^{11}+1) = 10,746,341$, are both prime numbers.

Royal Meteorological Society, March 18.—Mr. E. Mawley, President, in the chair.—Mr. Frederic Gaster, of the Meteorological Office, delivered a lecture on weather forecasts and storm warnings, how they are prepared and made known, which he illustrated by numerous instruments, diagrams, and lantern slides. Mr. Gaster said that in the preparation of forecasts the position held by the barometer was so much more important than that of any other instrument, that its action must be fully comprehended if the rest of the work was to be at all clearly understood. The lecturer having fully explained this, referred to the use of a single isolated instrument, and showed how new light was thrown on the observer who could have telegraphed to him simultaneous observations from a large number of places scattered over a considerable area of the earth's surface. The kind of variation in the distribution was dealt with, isobars were drawn, and the phenomena which they exhibit in the way of high and low pressure areas described. An explanation was given of the terms "cyclonic" and "anticyclonic," and the generally opposite characteristics of these two systems were referred to. Mr. Gaster next drew attention to the obvious importance of the variation in the weather over a given area caused by alterations in the position of the cyclonic and anticyclonic systems, and the importance of the fact that the former tended to move round the latter from left to right. This led to some remarks on the indications observed when disturbances were advancing towards our islands from different points. Attention was drawn to secondary systems, both of high and low pressure, the forms they assume, and their effect on the weather which, but for their presence, would probably have accompanied their primaries; and the necessity for allowing for such systems in sending warnings to our coasts. The lecturer then remarked on the value of auxiliary information, such as is to be obtained from decided changes in the direction of the wind, sudden changes of temperature, the movements of clouds at different levels, observations made at high-level stations, and telegrams from the United States. Mr. Gaster next explained how the information is made known to the public. Forecasts are issued by the Meteorological Office in the *Daily Weather Report*, and also communicated to the press, &c. Hay harvest forecasts are issued to certain selected authorities, who circulate them as much as possible in their neighbourhood. Storm warnings are telegraphed to our coasts with instructions to hoist the cone-point up when the gale is probable from northerly to easterly points, and point down when from southerly to westerly points. In conclusion the lecturer drew attention to the marked improvement which had occurred in these warnings in recent years, and to some of the occurrences which from time to time caused failures.

EDINBURGH.

Royal Society, March 2.—Prof. Geikie in the chair.—A paper was read by Mr. C. A. Fawsitt, on peroxide of hydrogen in reference to its use as an antiseptic. Since its introduction into surgery by Sir Benjamin Richardson, peroxide of hydrogen had not become so popular as was expected. It possessed undeniable advantages—*e.g.* when its oxygen was given off only water remained. But it had the disadvantages of irritability and instability. The former was due to the presence of acids, usually HCl, and solid matter. This was to be avoided by exercising great care in its preparation. The instability of H_2O_2 varied with the method of preparation adopted. Mr. Fawsitt recommended that whenever it was procured, it be diluted to the strength required in practice, and kept in a dark place.—Dr. D. Fraser Harris communicated the results of experiments he had been conducting on some points in the physiological chemistry and coagulation of milk. He found that the small globules, as well as the large, contained fat in direct, and "caseinogen" in indirect proportion to their size. Milk that was heated nearly to boiling point gave the best results with artificial digestion.—Mr. R. C. Mossman read a paper on the seasonal death-rate from certain diseases in Edinburgh during the period 1878-94, with remarks on the relation between weather and mortality. He exhibited the curves of the mortality from various diseases plotted above those denoting temperature, variability of temperature, and rainfall. The most marked result was that bronchitis, pleurisy, and pneumonia, while only very slightly influenced by low temperature, were very directly associated with variability of temperature.

March 16.—Prof. Copeland in the chair.—Mr. J. Y. Buchanan read a paper on the action of water on monochloracetic acid.—Dr. David Hepburn communicated a revised description of the dorsal interosseous muscles of the human hand, with suggestions for a new momenclature of the palmar interosseous muscles, and some observations on the corresponding muscles in the anthropoid apes. The shaft of each metacarpal bone, with the exception of the first, presents two triangular areas, a larger in the dorsal aspect and a smaller in the palmar aspect, neither of which affords origin to muscular fibres. It follows, therefore, that the palmar aspect of the various metacarpal bones are more fully occupied by muscles than the dorsal aspects. The dorsal interosseous muscles, which are abductor in function, are smaller than current descriptions lead us to believe. This is quite in accordance with the comparatively feeble nature of the abductor movements. Each digit is provided with a short flexor muscle presenting radial and ulnar heads, which are capable of acting *independently*, and thereby producing a certain amount of abduction and adduction according to their position with regard to the middle line of the hand. Every muscle of the dorsal or abductor series is inserted in common with *one of the heads* of a short flexor muscle, and in consequence of their close fusion the line of separation between them is somewhat obscured and has been overlooked. The members of the palmar or true adductor stratum have all disappeared from the human hand with the exception of the adductor *Pollicis obliquus et transversus*; hence the action has been thrown upon certain heads of the short flexors, and in consequence these heads stand out more distinctly, especially as their presence is not marked by fusion with any other muscle. Whenever true adductor muscles are found, as in certain of the apes, they are inserted in conjunction with those heads of the short flexors which are capable of supplementing this action. In the case of the human pollex, which possesses the one true adductor muscle, not only is this muscle inserted in common with one head (the ulnar) of the *Flexor brevis pollicis*, but in consequence that that head is always obscured, and in many cases extinguished.—Mr. A. T. Masterman communicated a note on the structure and affinities of Phoronis. He suggested that Phoronis should take its place amongst the Hemichordata, since it showed various points of resemblance to Balanoglossus, to Cephalodiscus, and to Rhabdopleura.—Dr. W. Peddie communicated the second part of a paper on the torsional oscillations of wires. In the first part it was proved that the formula $y^n(x+a) = b$—where y represents the range of oscillation, k represents the number of oscillations which have taken place, and n, a, b are constants—expresses the law of decrease of the oscillations with great accuracy in any one experiment. The value of n is increased by increase of the initial range, and also by fatigue. A theoretical deduction of the formula was also given, it being assumed that the loss of energy per oscillation was proportional to a power of the range. When n is zero the curve changes form and becomes logarithmic. Thus the well-known law for small oscillations is accounted for. In the second part of the paper, additional proof of the great accuracy of the formula is given. The relation $nb = BK^n$ is established between the quantities n and b, B and K being absolute constants. And it is further shown that K is, in terms of the particular angular unit employed, the value of a *critical angle* for the given wire. This critical angle is such that, when the range is equal to it, the loss of energy per oscillation is totally independent of the magnitude of the initial range or of fatigue. When the range exceeds the critical angle, the loss of energy per oscillation is increased by fatigue; when the range is less, the loss of energy is decreased by fatigue. A theoretical explanation of the existence of a critical angle was given. In the particular wire employed, the critical angle corresponds to a twist of about 0·1° per centimetre of length.

CAMBRIDGE.

Philosophical Society, March 9.—Prof. J. J. Thomson, President in the chair.—Notes on the geological history of Monocotyledons, by Mr. A. C. Seward.—A description of the

skulls found at Girton in 1881, by R. Horton-Smith.—On some scratched stones from the Permo-Carboniferous rocks of South-east Australia and the bearing of the evidence on the question of recurring Ice Ages, by Prof. Hughes. Prof. Hughes exhibited some specimens and photographs given to him by Prof. David of the University of Sydney, pointing out that the glaciation of South Australia as generally understood had been entirely disproved; that there had been no glaciers in the district in question, but that the traces of glaciation were due to ice floating from the south over a subsiding area, with, as he inferred, a compensating elevation elsewhere. He gave a *résumé* of the new evidence which he had collected in favour of the view that the recurrence of local glacial conditions was always connected with movements of elevation and depression, and appealed to physicists to explain the overthrusts and contortions of the surface of the earth, not solely by shrinkage of the nucleus nor by deformation of the whole mass, but by some conditions affecting regions limited in extent and depth, with perhaps a certain amount of periodicity determined by some more general cosmical causes.—On some chipped flints from the higher plateau gravel of Salisbury, by Prof. Hughes. Prof. Hughes criticised the evidence which had been adduced in favour of the discovery of man older than the Palæolithic Age, exhibiting in illustration a collection of so-called Palæotoliths from the plateau gravels near Salisbury, from the stony surface between Six-Mile Bottom and Balsham, and from Kent. As far as he had seen, no satisfactory evidence had been adduced in favour of the higher antiquity assigned, in the case of any of the flints which could be said to bear marks of design.—On the leakage of electricity through dielectrics traversed by Röntgen rays, by Prof. J. J. Thomson and Mr. J. A. McClelland. This paper contains an account of a series of experiments made with the object of investigating the laws regulating the passage of electricity through dielectrics transmitting Röntgen rays. This phenomenon has been discussed by one of the authors in a paper read before the Philosophical Society on January 27, and also in one read before the Royal Society on February 13. The first experiments relate to the rate of leak through different gases under similar conditions as to pressure and potential gradient. The gases used were hydrogen, ammonia, carbonic acid, air, coal gas, sulphuretted hydrogen, chloroform, chlorine, bromine, iodine, sulphur chloride and mercury vapour. Numbers showing the rate of leakage in these gases relatively to that in air are given. In general, though the rule is not without exceptions, the greater the molecular weight of the gas the more rapid the leakage. In hydrogen the leak was slowest, and in mercury vapour fastest; the rate in the vapour of boiling mercury was about twenty-eight times as fast as hydrogen. The rapid rate in mercury vapour is interesting, for this gas offers great opposition to the passage of an ordinary electric discharge. The rate of leak in the halogens is also very rapid, and a tube containing a charged plate in chlorine gas is a very sensitive and convenient method of measuring the intensity of these rays. The rates of leakage in air at different pressures were investigated; it was found that the rate of leak was slower at a low pressure than at a high one, and was over a considerable range of pressure approximately proportional to the square root of the pressure. The effect of temperature was also investigated, and it was found that through air the rate of leak was slower at a very high temperature than at the temperature of the room, but there was an intermediate temperature at which the rate was a maximum. The most remarkable thing about this leakage under the influence of these rays is that the rate is almost independent of the potential difference. Thus when the high potential plate was 5 volts above that of the low, the rate of leak was appreciably greater than when the potential difference was 1 volt, but the rate was no greater when the potential difference was 500 volts than when it was 5. A series of experiments were made to find how the rate of leakage varied with the distance from the bulb; the bulb was placed behind a metal plate with a hole in it: it was found that in the neighbourhood of the phosphorescent glass the reciprocal of the rate of leakage was a linear function of the distance from the phosphorescent patch, but at greater distances it diminished more rapidly than is indicated by this law. The measurements are not inconsistent with the view that the rate varies inversely as the square of the distance from a place in the neighbourhood of the *negative electrode*. Some experiments on the rate of leakage produced by the rays after passing through a varying number of strips of tinfoil seem to indicate that these rays are not all of one kind.

DUBLIN.

Royal Dublin Society, January 24.—Prof. George F. Fitzgerald, F.R.S., in the chair.—The following papers were read:—On carborundum, a substitute for emery, by Dr. Charles E. Fitzgerald; some remarks on difficulties of meridian circle work, by Mr. Arthur E. Lyster; a method of using common petroleum as the illuminant for beacons and buoys, by which a continuous light for weeks or months may be maintained day and night, without the necessity for the attendance of a light-keeper, by Mr. John R. Wigham At this meeting, Prof. D. J. Cunningham, F.R.S., exhibited and described puppies of the Cape hunting dog (*Lycaon pictus*), preserved in spirit. The animals were born in the Royal Zoological Gardens, Dublin.—Mr. Richard J. Moss described acetylene, the new illuminant.

February 19.—Prof. G. F. Fitzgerald in the chair.—The following two papers were read:—On Hamilton's singular points and planes on Fresnel's wave-surface, by Prof. William Booth, of Hoogley College, Bengal, communicated by Prof. Thomas Preston; on the continuity of transformation from the liquid to the gaseous state, by Prof. Thomas Preston.—There were exhibited at this meeting the Lenard-Röntgen X-rays, and their properties were described by Dr. J. Joly, F.R.S., photographic results being exhibited by Dr. Joly, Mr. W. E. Wilson, and Mr. Richard J. Moss.

PHILADELPHIA.

Academy of Natural Sciences, February 25.—Papers under the following titles were presented for publication: "The Colouring Matter of the Axil of *Celastrus scandens*," by Ida A. Killer; "The Crystallisation of Molybdenite," by Amos P. Brown. The Anthropological Section having precedence, Dr. D. G. Brinton made a communication on the use of the craniofacial line in determining racial and individual characters on the living subject. The relation of the diameters of the cranium formerly relied on had been found unsatisfactory. He specially recommended a line closely resembling that suggested by the sculptor Charles Rochet. It connects the two auditory foramina, forming a slight curve, the superior border of which connects the internal commissures of the eyes. This line, it is claimed, divides the ideal, normal head into two perfectly equal parts, although in nature, of course, this proportion is not maintained, but varies as a racial character and in individuals. The relations of the lines may also indicate the cranial capacity, as the plane of the curve continued posteriorly is approximately the base of the skull. He further pointed out that the distance between the distal extremities of the curve gives the width of the head and the face; and that a series of curves, described from the fixed points indicated, offers, probably, the simplest and most accurate method of obtaining significant head-measures on the living subject.—Dr. Harrison Allen commented on the difficulty of obtaining satisfactory cranial measurements, and referred to Oldfield Thomas's, taken from the outer margin of the orbits to determine the projection of the nose. He did not think the true horizontal plane of the skull could be fixed. The so-called Frankfurt plane is the one most commonly accepted.—Dr. Seneca Egbert stated that he had demonstrated the action of the X-rays through plates of platinum from ordinary sunlight. Illustrative pictures were exhibited, and the published results of other experimenters were discussed.—Prof. Maxwell Summerville exhibited beautiful specimens of chipped arrow-heads made from common green bottle-glass by the natives of North-western Australia. He also called attention to a stone carved to resemble a miniature grotesque head, from the valley of the Delaware, opposite Milford, and an object used in phallic worship by the natives of Poonah, India.—Dr. D. G. Brinton called attention to the importance of obtaining systematic data for the study of American anthropology, and suggested the wide distribution, under the auspices of the Anthropological Section of the Academy, of circulars of inquiry, similar to those in use by the Committee appointed by the British Association for the Advancement of Science for the study of the ethnography of Great Britain.

March 3.—Messrs. Morris E. Leeds and J. S. Stokes, on behalf of Messrs. Queen and Co., made communications on the historical development of studies in connection with Röntgen photography, presented the most advanced views as to the nature of the X-rays as published by various investigators. They also exhibited a series of fine pictures illustrating the application of the process to the study of biology, and the results obtained by the use of quick and slow plates and various developers. Dr. Egbert having alluded to

the results obtained by him from the direct rays of the sun through platinum plates, Mr. Leeds called attention to the desirability of experimenting with the sun's rays reflected from a mirror. If a positive result be obtained, it would demonstrate either that Röntgen rays can be reflected, or that those producing Dr. Egbert's effects are not Röntgen rays.—Mr. J. Willcox presented a collection of 308 recent and fossil Fulgurs from various localities and geological horizons, illustrating with extraordinary completeness the evolution of the forms.—A preliminary announcement was made of the presentation by Mr. A. Donaldson Smith of fine collections of mammals, birds, reptiles and insects, made by him during his recent exploration of Western Somaliland, Africa.

PARIS.

Academy of Sciences, March 6.—M. A. Cornu in the chair.—The President announced to the Academy the death of M. Sappey, Member of the Section of Anatomy and Zoology.—On the underground pendulum of the Paris Observatory, by M. F. Tisserand. The pendulum is buried to a depth of twenty-seven metres, where its temperature does not vary by more than '01° to '02° during the year. Although an attempt was made to keep the pressure of the air round the pendulum constant, the variations in rate were found to follow the variations in the atmospheric pressure.—On a new carbide of zirconium, by MM. H. Moissan and Lengfeld. An account of a second zirconium carbide, ZrC ; distinguished from the carbides of allied metals by not reacting with water either at 0° or 100° C.—Actinometric observations made at the Observatory of Montpelier in 1895, by M. A. Crova.—On a log with instantaneous readings, by H. A. Coret.—On the errors in astronomical instruments caused by variations of temperature, by M. Hamy.—On uniform functions defined by the inversion of total differentials, by M. P. Painlevé.—On the principle of an accumulator for light, by M. C. Henry.—On lunar barometric waves and the secular variation of the climate of Paris, by M. P. Garrigou-Lagrange.—Cryoscopic researches, by M. A. Ponsot. Data are given for the limiting values of the molecular lowering of the freezing point of water for ten salts.—On the structure and constitution of the alloys of copper and zinc, by M. G. Charpy.—On the *rôle* of alumina in the composition of glass, by M. L. Appert. The introduction of alumina into glass tends to prevent devitrification, and allows of a considerable quantity of lime to be present.—The constitution of rhodinol, by MM. P. Barbier and L. Souveault. From a study of its oxidation products rhodinol is shown to be a primary unsaturated alcohol.—Explanation of the cruciferous flower from its anatomy, by M. O. Lignier.—On the geological constitution of the strata in the vicinity of Heraclea (Asia Minor), by M. H. Douville.—On a meteorite that fell near Fisher (Minnesota) on April 9, 1894, by M. N. H. Winchell. This meteorite consists chiefly of olivine and enstatite, together with small quantities of iron, troïlite, tridymite, and maskelynite.—On the meteor of February 10, 1896 (Madrid), by M. Miguel Merino.—On a meteor represented by Raphaël in his "Madone de Foligno," by M. P. Masson.—A confirmation of the results of M. Le Bon on dark light, by M. Ellinger.—On some experiments demonstrating the action of the Röntgen rays on fluorescent bodies, by M. G. Campos.—On a point in the kinetic theory of gases, by M. Chapel.

BERLIN.

Meteorological Society, February 4.—Prof. Börnstein, President, in the chair.—Prof. Zuntz spoke on mountain-sickness, and gave an account of the experiments on respiration he had carried out, in conjunction with Dr. Schumburg, at great altitudes on Monte Rosa. He found that when resting the consumption of oxygen was greater than at lower levels, but not very markedly so, and differed with different individuals. During work, which consisted in climbing a steep incline, the amount of oxygen consumed was per kilogramme-metre of work nearly three times as great, indicating a correspondingly increased expenditure of energy. In accordance with the above, the so-called mountain-sickness cannot be due chiefly, if at all, to the diminished partial pressure of oxygen at the higher level. He considered that it is rather the outcome of a lessened cardiac activity brought about by the powerful stimuli of insolation acting on the eyes and skin, by the action of cold, of increased air-currents, and of psychical excitement united to the antecedent fatigue. The deleterious effects of these abnormal stimulations can be lessened, or even done away with, by practice ; and the effect of the diminished partial pressure of oxygen, which is observed in the case of some persons, may be prevented by mixing a little (about 2 per cent.) carbon dioxide with the inspired air, since this gas induces somewhat deeper inspirations.

Physiological Society, February 7.—Prof. Zuntz, President, in the chair.—Prof. Goldstein exhibited a series of photographs taken with Röntgen X-rays.—Dr. Abelsdorff spoke on the visual purple of fishes, which shows a maximum in its absorption spectrum differing from that in the similar spectrum obtained from amphibia, birds and mammals. He exhibited a solution of visual purple obtained from fish ; it was at first of an obvious violet colour, became speedily yellow under the action of light, and then finally and very slowly colourless. By treating fish-eyes with alcohol and formalin he had obtained preparations which showed the retina of a brilliant purple colour as looked at anteriorly.—Dr. Benda spoke on the regeneration of blood corpuscles in man, and on the structure of the organs therein concerned, as based on serial sections through lymphatic nodules, the spleen, and the marrow of bones. He came to the conclusion that in the nodules the germinal centre, the germinal layer, and the more peripherally placed leucocytes form part of one developmental series. He found similar structures in the spleen, and also that in the marrow of bones the red corpuscles exhibit a similar series.

February 21.—Prof. du Bois Reymond, President, in the chair.—Dr. Frenzel exhibited photographs taken on bromide of silver-paper with Röntgen X-rays. Of these the most interesting was that of a frog taken on twelve sheets of the paper laid one upon the other ; the photograph came out equally well defined on each sheet.—Dr. Schulz spoke on the influence of temperature on the working-power of unstriated muscles. He had studied the isotonic and isometric contractions of strips from the muscular layer of a frog's stomach in response to maximal electrical stimuli at temperatures between − 6° and + 45° C. From the temperature of the room onwards the height of circulation increased up to 35°, the tension up to 32°, while at the same time, and up to the same temperatures, the latent period and duration of the contraction diminished. Above these maxima all the phenomena were exactly reversed. At 45° the muscles gave no further reaction, and a temperature of 60° to 65° caused a permanent shortening. On cooling below the temperature of the room, both the height of contraction and the tension diminished progressively, whereas the latent period and duration of contraction increased down to a lower limit of − 5° to − 6° C., at which temperature there was no further reaction. When slowly rewarmed contractions again made their appearance. Between − 8° and − 10° the muscle contracted suddenly and permanently ; but this contraction disappeared on slow warming, the muscle now being inert even at higher temperatures. Comparing the striated with the unstriated muscles, Dr. Schulz laid stress on the fact that with a rise of temperature the latter exhibit a gradually increasing efficiency up to the maximal, whereas the former, according to Gad and Heymans, show a secondary minimum at 19°.

Physical Society, February 14.—Prof. du Bois Reymond, President, in the chair.—Prof. Börnstein exhibited photographs of a hand taken directly on to paper by means of Röntgen X-rays.—Prof. von Bezold spoke on balloon voyages from their scientific point of view. Starting with the fundamental physical principles which underlie the events taking place in cyclones and anticyclones as also in the general atmospheric circulation, he proceeded to show the necessity for more exact measurements of temperature and humidity in the upper strata of the air, and of ascertaining the height at which air passes over from a cyclone into an anticyclone. In conclusion, he gave the values of this height as far as they have so far been determined by means of balloon ascents made from Berlin.—Prof. Neesen exhibited specimens of the photographic effects he had obtained by means of kathode rays which were reflected by means of a mirror in the vacuum tube into a lateral tube, and then passed out of the tube through an animal membrane. It was found that a thin glass plate materially weakened the action of the rays, whereas they passed just as readily through the animal membrane as do the Röntgen rays through the fleshy parts of the hand. Prof. Goldstein stated that the Röntgen rays may be concentrated, and hence sharply-defined images obtained, by using as kathode an aluminium disc backed with a glass plate, and nearly filling the vacuum tube.

—Dr. Koehne announced that he had succeeded in obtaining an electrolytic solution of carbon. Using pure carbon as anode, hot sulphuric acid as electrolyte, and platinum as kathode, he observed that the fluid became yellow and then dark brown or black, while at the same time a thin layer of graphite was deposited on the kathode. By means of carbon, hot sulphuric acid, and peroxide of lead, he obtained a galvanic cell, with a resistance of 100 ohms, which gave a current of one volt.

February 28.—Prof. du Bois Reymond, President, in the chair.—Dr. Martens spoke on the magnetisation of horizontal discs rotating in the terrestrial field, and made of various samples of iron, steel, and nickel, explaining how he had measured their magnetism by means of an astatic needle, and giving the values he had obtained.—Mr. Goode exhibited a vacuum tube for the production of Röntgen rays, on to which a system of bulbs and tubes had been fused and partially filled with mercury, so as to admit of the removal of any gases which had collected in the tube.—Mr. H. Starke explained a simple method of determining the electrical constants of solid bodies. It is based on the introduction into one arm of a Wheatstone bridge of a condenser between whose plates fluid mixtures of various dielectrics with varying electrical constants can be placed, and on the finding of a mixture such that when the given solid is immersed in it the constants of the mixture are not altered.—Prof. Lampe exhibited a series of Röntgen photographs taken by Prof. König in Frankfurt a-M., which were remarkable for their sharpness and the shortness of the exposure necessary for their production.—Prof. Rubens demonstrated Hertzian vibrations whose wave-length was 4½ cm., and which, after being made parallel by means of a glass lens, were then polarised by the use of a set of three glass discs.

NEW SOUTH WALES.

Linnean Society, November 27, 1895.—Mr. Henry Deane, President, in the chair.—On some developments of the mammalian prenasal cartilage, by R. Broom.—On a small fossil diprotodont marsupial, with large grooved premolars, by R. Broom. A more complete description from more perfect specimens of the little fossil marsupial described under the name *Burramys parvus* at the June meeting.—On a small fossil *Petaurus*-like marsupial, by R. Broom. Under the provisional name *Palæopetaurus elegans* was described a small fossil marsupial from a bone-breccia deposit in the neighbourhood of Taralga.—On the organ of Jacobson in an Australian bat (*Miniopterus*), by R. Broom.—Observations on a gravid echidna, by R. Broom.—Stray notes on Papuan ethnology, by C. Hedley. An interesting carved figure-head, of the bird and crocodile design, "geroma," from a village in Bentley Bay, British New Guinea, was described. It was interesting as setting at rest the identity of the bird, a cassowary, which Prof. Haddon had in his monograph been unable to determine. He also described an ingenious palm-leaf basket "porha" in common use among the natives of Eastern British New Guinea.—On an undescribed structure in the leaves of certain plants, by Alex. G. Hamilton. In this paper was given a detailed account, with figures, of certain structures which have been found to be present in the leaves of more than thirty species of plants referable to various natural orders, respecting which the text-books and other literature available, beyond an incidental allusion or two, seem to furnish little or no satisfactory information. In their most complete form the structures in question appear as hair-lined cavities in the leaf substance, situated in the axils of the primary or secondary veins, and opening to the exterior on the under-surface of the leaf by a small opening with a thickened rim (as in *Pennantia Cunninghamii*, Miers, and *Coprosma lucida*. Experimental evidence was adduced against the view that they are catchment hollows for water; and the author was led to think that they were structures once useful, but now no longer functional, and in course of disappearing.—Preliminary note on the occurrence of a placental connection in the bandicoot (*Perameles obesula*); and on the fœtal membranes of certain macropids, by Jas. P. Hill.—Notes on the eucalypts of New South Wales (No. 1), by Henry Deane and J. H. Maiden. The authors having for a considerable period made a special study of the eucalypts of this colony, both in the field and from dried specimens, gave the results of a series of observations in regard to the botanical structure, geographical distribution, &c., of a number of species belonging to the *Renantheræ*.—Descriptions of some new Australian plants, by J. H. Maiden and R. T. Baker.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Glaciers of the Alps: J. Tyndall, new edition (Longmans).—Proceedings of the London Mathematical Society, Vol. xxvi. (Hodgson).—The Hymenoptera Aculeata of the British Islands: E. Saunders (L. Reeve).—Moorland Idylls: Grant Allen (Chatto).—The Whence and Whither of Man: Prof. J. M. Tylor (New York, Scribner).—Statesman's Year-Book, 1896 (Macmillan).—Single-Salt Analysis: B. P. Lascelles (Sonnenschein).—Geschichte der Explosivstoffe: S. J. von Romocki. II. Die Rauchschwachen Pulver (Berlin, Oppenheim).—Fear: A. Mosso, translated by E. Lough and F. Kiesow (Longmans).—Historical and Future Eclipses: Rev. S. J. Johnson, new edition (Parker).—Elements of the Theory of Functions of a Complex Variable: Dr. H. Durège, translated by Drs. Fisher and Schwatt (Philadelphia, Fisher).—Ostwald's Klassiker der Exakten Wissenschaften, Nrs 72, 73, 74, 75 (Leipzig, Engelmann).—Lehrbuch der Anatomie des Menschen: Prof. C. Gegenbaur, 2 Vols. Sechste Verbesserte Auflage (Leipzig, Engelmann).—From the North Pole to Equator: A. E. Brehm, translated (Blackie).—Elementary Practical Chemistry: G. S. Newth (Longmans).—Researches on Mimicry on a Basis of a Natural Classification of the Papilionidae: Dr. E. Haase, translated by Dr. C. M. Child, Part 2 (Stuttgart, Nägele).—Atlas of Nerve Cells: Drs. Starr, Strong, and Leaming (Macmillan).—Handbook of Jamaica for 1896 (Stanford).—Calcul du Temps de Pose en Photographie: H. Boursault (Paris, Gauthier-Villars).—Géométrie Descriptive: A. Gouilly (Paris, Gauthier-Villars).—A Fauna of the Moray Basin: J. A. Harvie-Brown and T. E. Buckley (Edinburgh, Douglas).

PAMPHLETS.—Report for 1895 on the Lancashire Sea-Fisheries Laboratory at University College, Liverpool (Liverpool).—Démonstration de l'Axiome XI. d'Euclide: M. Frolov (Paris, Michelet).—Royal Gardens, Kew. Hand-list of Conifera grown in the Royal Gardens (Eyre).—Typhoon Highways in the Far East. No. 1. Across the South End of Formosa Strait (Zi-Ka-Wei).—On the Application of the Law of Similarity to Marine Propellers: J. D. Young (Newcastle-on-Tyne).—The San Jose Scale: L. O. Howard and C. L. Marlatt (Washington).—Observations Météorologiques, Magnétiques et Hydrométriques de l'île de Danemark dans le Scoresby Sound, 1891-92 (Copenhague).

SERIALS.—Zeitschrift für Wissenschaftliche Zoologie, lxi. Band, 2 Heft (Williams).—Académie des Sciences de l'Empereur François Joseph I. Bulletin International Classe des Sciences Mathématiques et Naturelles, II. (Prague).—American Journal of Science, March (New Haven).—Journal of the Western Society of Engineers, January, and Supplement (Chicago).—Journal of the Institution of Electrical Engineers, March (Spon).—Journal of the Franklin Institute, March (Philadelphia).—Psychological Review, March (Macmillan).—Transactions of the Astronomical and Physical Society of Toronto, 1895 (Toronto).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique, 1896, No. 2 (Bruxelles).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Vol. x. No. 1 (Manchester).—Astrophysical Journal, March (Weslev).—Royal Natural History, Part 29 (Warne).—L'Anthropologie, tome vii. No. 1 (Paris, Masson).—Economic Journal, March (Macmillan).—Timehri, December (Stanford).—Imperial University, College of Agriculture Bulletin, Vol. ii. No. 5 (Tōkyō).—Himmel und Erde, March (Berlin, Paetel).—Trans. R. S. Edin., Vol. xxxviii. Part 2 (No. 9): Specific Gravities and Oceanic Circulation: Dr. A. Buchan (Williams).—American Naturalist, March (Philadelphia).—Journal of the Anthropological Institute, February (Paul).—Das Tierreich, Probe-Liefg., Heliozoa: Dr. F. Schaudinn (Berlin, Friedländer).—Physical Review, Vol. iii. No. 5 (Macmillan).

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