THURSDAY, JANUARY 26, 1882

THE RECENT WEATHER

THE weather of the winter months of 1881–82 bids fair to leave its mark on the annals of meteorology in an unmistakable manner. The abnormalities which are distinguishing it may be considered as having begun with the great storm of October 14, which was so disastrous to life and property, particularly among our seafaring population. During the last week of that month temperature fell low enough to produce frost on the ground, a circumstance here referred to from the significance attached to it by Sir Robert Christison, who has been so long one of our best and shrewdest observers of weather. Sir Robert's opinion is that when the temperature in Scotland during either the last week of October or the first week of November falls low enough to freeze the ground, an open winter will most probably follow, an opinion which the prevailing weather since has fully borne out.

The November which followed was, as we have already shown (NATURE, vol. xxv. p. 131), the warmest November in North Britain for the past 118 years, or since thermometers began to be employed to record the temperature. On the 27th of the same month the barometer, reduced to 32° and sea-level, fell at the Butt of Lewis to 27·865 inches, remaining at this low point from 4.30 to 7 a.m., this reading being probably the lowest barometer ever recorded in the British Islands; and over a wide area in the north-west and north of Scotland, and for a considerable time pressure was less than 28·000 inches. December was, generally speaking, as regards its meteorology, an average month, temperature being about a degree and a half above the mean in the north of the Shetlands, and as much below it in the south-west of Ireland; but over the greater portion of these islands the deviation from the normal temperature did not, either way, amount to a degree. Some frost occurred about the middle of the month, but so slight as scarcely to offer any serious check to the growth of grass, and many late and early flowering plants, which at this early season present an appearance and a bloom it would be difficult to parallel in the experiences of the past. The open season has culminated in the really fine weather of the last fortnight, marked by a temperature a long way above the average of January over nearly the whole of the British Islands and the greater portion of Northern Europe.

The outstanding feature of this singular weather is the extraordinarily high barometer which has accompanied it, an anticyclone of a very pronounced character and of great extent having overspread the Continent during this time. Starting from January 10, it is seen that the centre of highest pressure on that day was over Eastern France and Switzerland, in the centre of which pressure rose to 30·512 inches. On the 11th the area of high pressure increased and extended to eastward, retreating again on the 12th to the position it had occupied on the 10th, barometers remaining substantially at the same heights. On the 13th the centre of the anticyclone moved eastward to Prussia, pressure rising in the centre at Berlin to 30·903 inches; and on the following day the centre had advanced to Cracow with a pressure of 30·843 inches, whilst over well nigh the half of Europe pressure exceeded 30·700 inches. On the 15th the centre was found in the same position, but pressure had risen at Lemberg to 31·024 inches. On the 16th the anticyclone again retreated somewhat to westward, and at Wilna the pressure rose to 31·071 inches which is unquestionably one of the highest readings of the barometer ever recorded in this part of the earth's surface. On the 17th the centre occupied the region of the Alps, where at Berne, pressure was 31·012 inches; on the 18th it had retreated to westward so that the southern parts of England and Ireland were covered by it, pressure there being all but 31·000 inches. On the three following days, the anticyclone retained very much the same position, but the highest pressure in the centre fell successively to 30·093 inches at Oxford, 30·079 inches at Nottingham, and 30·076 inches near the Isle of Wight.

In vols. xxi., xxii., and xxiii., we took occasion, in reviewing the splendid series of International Weather Maps issued by the Meteorological Department at Washington, to point out and enforce attention to the important relations thereby disclosed between the distribution of atmospheric pressure, and that of temperature. The same relations have been observed during the past fortnight. Let our Daily Weather Reports be looked at from the 11th to the 16th, and it will be seen that the British Islands lay between the anticyclone which overspread the Continent with its high pressures, and a system, or systems, of low pressures out in the Atlantic; and that the barometric gradient was considerable during the time. With this arrangement of the pressure, southerly winds set in, characterised by a remarkable volume and persistency, and since owing to the great extension southwards of the anticyclonic area, they had come from a great distance, these winds were further characterised by a mildness and a warmth reminding one rather of the weather often experienced towards the end of September. The mean temperature of London for these days was 5°·6 above the normal, and in the Scilly Isles 6°·3.

On the other hand, as the anticyclonic area advanced on the south of England, the southerly winds gave way and were replaced with light winds and calms. The effects of terrestrial radiation now manifested themselves in a pronounced manner over the comparatively calm area, and the temperature of London markedly fell, and fogs began to prevail, as frequently happens under these conditions. On the 18th and 19th it was 5°·8 below the normal. At the same time our western and northern coasts were outside the calm anticyclonic centre, and within the outer region where moderate barometric gradients prevailed, and there, accordingly, southerly and south-westerly winds and high temperatures prevailed. Thus while in London the temperature was 5°·8 below the normal, it was 5°·2 above the normal at Mullaghmore, 6°·4 at Leith, 9°·2 at Wick, and 9°·6 at Stornoway. We have seen that the centre of the anticyclone advanced sooner on Lyons than on London, and there accordingly temperature fell sooner below the normal. Colder weather set in at Lyons on the 12th, at Paris on the 14th, London on the 17th, and the Isle of Wight on the 18th.

Over regions situated to the south of the anticyclonic

area, particularly to the south-east, northerly winds ruled, and as a consequence temperatures fell below the normal. Thus at Algiers during these days temperature was constantly under the mean, varying from 2°·9 to 6°·5, the whole period showing a mean deficiency of 5°·0; and from the 13th the mean deficiency was 3°·8 at Malta, and 5°·6 at Constantinople. On the other hand, over the north of Europe, which was during this time outside the calm anticyclonic centre, and marked with moderate barometric gradients, westerly and southerly winds prevailed, in some cases in considerable force, as on the occasion when a storm appeared in the Arctic Sea to the north. This region was therefore characterised almost throughout by abnormally high temperatures, the mean excess at Haparanda, at the head of the Gulf of Bothnia, being 21°·9 for the week ending Saturday last.

Thus, with barometers equally, or all but equally high the most diverse temperatures prevailed, the conditions determining the temperature in any locality not being the height of the barometer but the position of the locality with reference to the areas of high and of low pressure which prevailed over Europe at the time; or putting the result into the simplest words, it was not the height of the barometer, but the direction and force of the wind, which determined the temperature.

The highest barometer noted in the Weather Charts as having occurred in the British Islands during this time was 30·970 inches at 8 a.m. of the 18th at Oxford. Higher barometers than this even were recorded in 1808, at Gordon Castle, Banffshire, by Mr. James Hoy, he having noted 31·007 inches at 9 p.m. of February 24 of that year; and again 31·046 inches at 11 p.m. of January 8, 1820, this last reading being in all probability the highest reading yet recorded in these islands.

MR. MIVART ON THE CAT

The Cat. An Introduction to the Study of Backboned Animals, especially Mammals. By St. George Mivart, Ph.D., F.R.S. With 200 Illustrations. (London: John Murray, 1881.)

THE author of the present volume tells us in his preface that it "is expressly intended to be an introduction to the natural history of the whole group of *backboned animals*; but the subject has been so treated as to fit it also to serve as an introduction to Zoology generally, and even to Biology itself." By serving as a guide to the structure, as ascertained by dissection, and natural history of the cat, it will, it is hoped, "give the earnest student of biology the knowledge of anatomy, physiology, and kindred sciences which is necessary to enable him to study profitably the whole class" of Mammals, the natural history of these generally being, we are told, to be treated of in a companion volume.

After a somewhat careful study of the bulky volume of 550 pages before us, it is with some regret that we doubt if Prof. Mivart's intentions are likely to be realised, as, trying to attain two very desirable ends, it is not evident that he has succeeded in either.

The student of anatomy will, we think, find that much of the descriptive part of the present work is too sketchy to be of real service as a text-book of Mammalian anatomy, and the almost complete absence of references—even to Strauss-Durckheim's elaborate "Anatomie descriptive et comparative du Chat," published, with excellent illustrations, at Paris so long ago as 1845—also seriously detracts from its value in this respect. On the other hand, any one taking it up with a view to understanding the main principles and objects of [biological science will, even if he succeed in his endeavour, be liable we fear to be disgusted by the large amount of "dry" and quite unreadable detail contained in it. Nor can we always speak very highly of the accuracy and style displayed in the volume in question.

After an introductory chapter, eight chapters are devoted to the consideration of the various organs of the cat, the anatomical structure of each system being accompanied by an account of its histology and functions. As already indicated, the descriptions of many of the parts concerned strike us as rather too brief and wanting in preciseness, whilst in some parts that we have tested we find considerable omissions. Thus in the account of the cranial nerves in Chapter IX. we find no mention of such interesting nerves as the vidian and recurrent laryngeal; in the myological portion, no account at all is given of the important subject of the nerve-supply of the various muscles described, which is only indicated later on when considering the distribution of the nerves themselves.

With regard to the histology of the various tissues, it would be more satisfactory as convincing the reader that it *is* the cat, and not some other mammal the structure of which is being described, if the illustrations were not so frequently taken from the pig or the well-known figures of Quain's Anatomy.

Chapter X. is devoted to the "Development of the Cat," and here it would have been still more desirable that the author should have stated explicitly how much, or how little, of its contents apply to the cat, or at least have given references to the authorities for some of his statements. The account given seems, as far as we can judge, intended to be a *résumé* of the principal facts ascertained as regards the development of *Mammalia* generally, but if so some of the views put forward are rather startling.

Thus on p. 320 we are told that "the first indication of the embryo is the appearance of a longitudinal depression or furrow, termed the *medullary groove*." Fig. 145, to which reference is made, pretty clearly shows that what is meant is, in reality, the *primitive streak* (in fact it is called, in the explanation, though *not* in the description, of that figure the "primitive groove")—a structure of quite a different order and significance, as surely Prof. Mivart must know, from the real medullary groove. The heart is said to be formed by "*one* vessel, tubular and rhythmically contractile"; in fact, in Mammals, as in Birds, it always arises from *two* tubes, which only unite subsequently (Cf. Balfour's "Embryology," vol. ii. pp. 522, 523). In the account of the development of the nervous system the statement made that "the white matter of the spinal cord is formed by transformation of the cells of the adjacent MESOBLAST" (p. 356), is quite opposed to all that we know of the development of that system in Vertebrates, and we are left to infer that the "mass of the nerves" are also derived from mesoblast, in contradiction to the observation and views of our most distinguished embryologists. The account of the deve-

lopment of the urinary organs and suprarenal bodies (pp. 350, 351) also leaves much to be desired.

After a chapter on the "Psychology of the Cat," Prof. Mivart devotes one to the different kinds of cats, living and extinct. Of the living species he recognises fifty, forty-eight of which are included in *Felis*, the other two being the two species of Cheetah (*Cynælurus*). We are glad to see that Prof. Mivart does not recognise the various genera *Leo*, *Tigris*, *Uncia*, &c., proposed by the late Dr. Gray, which have been adopted by some recent naturalists. The Ounce (*F. uncia*) is stated (p. 396) to occur near Smyrna; but we believe the sole authority for this is the identification by the late Mr. Blyth, who was followed by Gray, Jerdon, and others, of the *Felis tulliana* of Valenciennes with the true *F. uncia* of the central tablelands of Asia. According to the latest authorities *F. tulliana* is certainly *not* the Ounce, and is, in all probability, only a long-haired and pale-coloured Leopard (*F. pardus*).

Chapter XIII. is devoted to the "Cat's Place in Nature," a consideration of the relationships of the *Felidæ* to other Carnivora, and organic forms generally. In the enumeration of the characters of the three great groups of Fissiped Carnivora, we miss any allusion to their well-marked cerebral differences, clearly pointed out by Prof. Flower, and on which the late Prof. Garrod laid so much stress. "Aard-vark," we may mention, is the Dutch name for the *Orycteropus*, not for *Proteles*, as stated on p. 483. The cat's hexicology (or its relations to its environment) occupies the next chapter, and the concluding one deals with the problems of the origin and pedigree of the animal. In treating of the main zoological regions of the globe (pp. 497-500) it is not clear by what exact criterion Prof. Mivart has been guided in selecting forms representative of those regions. Neither mules (why introduce such artificial products as hybrids at all in such a connection?) nor chameleons can be considered as specially characteristic of the "Palæarctic" region, nor should we have noted the absence of "true grouse" or the presence of "the mocking-bird" as peculiarities of the "Ne-arctic" one. Why, too, call *Hyomoschus* the "aquatic musk-deer" (p. 498), when on p. 467 Prof. Mivart has correctly characterised the chevrotains as "very small animals, commonly called *in error* musk-deer"?

The book, we must add, is on the whole got up in very good style, both as regards type, paper, and illustrations. Of the latter there are over 200 woodcuts, many of them original, and including a nice series of figures of some of the less known species of *Felidæ*, as well as of skulls of some of the more remarkable North American extinct *Æluroidea*. It is to be regretted, however, that the volume should be disfigured by numerous misprints, most of them of well-known names. Thus we have *Potamagale* and *Potomogale*, *Arctitis*, *Mustilidæ*, *Amphinama*, "Horned-senamer" (for -screamer), *Teniada*, *Gregorinidæ*, &c. Fort Bridger, a locality in Wyoming Territory, well known for its vertebrate remains, appears as Fort Bridges (p. 512) and also as "Fire Bridge" (p. 506)! Prof. Mivart, too, is not consistent in his spelling; thus we have Bali and Bally, and *Ai*lurus, *Ai*luropus, &c., succeeded almost immediately by *Ae*luroidea, Pseudælurus, &c. Lastly, it is a pity that the author does not always give his references in full, or even get the titles of the journals quoted correctly: thus on p. 331 we notice the "Quarterly Journal of Microscop*ic* Science, and Schäfer's Proceedings of the Royal Society" (*sic*).

W. A. FORBES

CRYSTALLOGRAPHY

Rammelsberg's Handbuch der Krystallographisch-Physikalischen Chemie. Vol. I. (Leipzig: W. Engelmann, 1881.)

THIS volume may to a certain extent be regarded as the first part of a new edition of Prof. Rammelsberg's two previous works on the same branch of science ("Handbuch d. Kryst.-Chemie, 1855; and "Die Neuesten Forschungen im Gebiete der Kryst.-Chemie," 1857). The development of its plan and the wealth of material entitle it, however, to rank as a new work, and has necessitated its division into two parts, of which the present one deals with the elements and inorganic compounds. Of late years much work has been done in the investigation of the physical properties of the artificial substances obtained in our chemical laboratories, the account of which is dispersed through the various scientific periodicals often in such a way as to render it all but impossible to find out whether any investigations have been made of the physical properties of a particular substance. The present work will therefore be highly welcome to both chemists and physicists who are interested in this their common province, and as a book of ready and easy reference will be a great boon to all researchers. The aim of the book is to give in as condensed a form as possible all the physical properties of artificial substances as far as they have been determined, in addition to the crystallographic characters which are often the only ones known. Thus the optical constants, the dilatation under change of temperature as determined by Fizeau, the electrical, magnetic, and other properties of each substance are given wherever known. In fact it aims at doing for artificial substances what has been already done for minerals in Miller's and Des Cloizeaux's "Treatises on Mineralogy." In addition the references to the original memoirs on each property are placed directly after the account of this property. Prof. Rammelsberg's reputation for the thoroughness of his work has been so long established that it seems almost impertinent to praise the excellent way in which he has here carried out his intention. He has produced a book which will not only be in every chemist's and physicist's library, but one which will be continually consulted by them. After dipping into the book in numerous places only one substance has been met with which seems inadequately treated, and this is antimony iodide, than which few substances are more interesting to the crystallographer. The account of the modifications and their relations is in this case scanty and imperfect, and the reference to Prof. Cooke's elegant research on them is wanting in precision.

Prof. Rammelsberg adopts the Weissian system of notation in his Crystallography, but this not in its entirety, as he uses sub-multiple—and not multiple—indices, as was done by Weiss. In the last paragraph of his introduction he states his opinion that the Weissian system is superior to those both of Naumann and of Miller, and he ends by declaring that crystallography would have been

much more studied by chemists had crystallographers avoided following the two latter distinguished men. It is difficult to understand such a view for, as far as descriptive crystallography is concerned, the Weissian and Millerian notations are practically identical except in the rhombohedral system, where different axial systems are adopted. The advantages of Miller's trigonometrical methods of calculation are acknowledged by many who, through long familiarity, invariably use the geometrical methods, and no one who is acquainted with both can hesitate as to the one he will employ.

The work is a fresh monument of Prof. Rammelsberg's indefatigable industry and skill in arranging and condensing a vast amount of material, and is a worthy addition to the long list of works on chemistry and crystallography with which science has been enriched by him.

OUR BOOK SHELF

The Encyclopædic Dictionary: A New and Original Work of Reference to all the Words in the English Language. By Robert Hunter, M.A., F.G.S. Illustrations. Vol. I.: A—Cab. (London: Cassell, Petter, and Galpin. No date.)

The Imperial Dictionary of the English Language: A complete Encyclopædic Lexicon, Literary, Scientific, and Technological. By John Ogilvie, LL.D. New Edition, carefully revised and greatly augmented. Edited by Charles Annandale, M.A. 3000 Engravings. Vol. I.: A—Depascent. (London: Blackie and Son., 1882.)

No better evidence could be adduced of the extent to which science has permeated modern life and literature than the prominence given to scientific terms in these two dictionaries. Words which a few years ago were confined only to technical vocabularies and were known only by specialists, are in these reference-books for general use found side by side with the vocabularies of Chaucer, Shakespeare, Tennyson, and Dickens. The many illustrations, too, are to a large extent derived from science, while the great advances recently made by a scientific study of language are shown in the etymologies. Mr. Hunter's undertaking is one of great magnitude, a combination of the dictionary and encyclopædia, an account of things as well as words. To judge from the first volume, it is likely to turn out a work of great practical utility. The vocabulary is as complete as could be desired, and the treatment of the various terms full, concise, accurate, and methodical. Mr. Hunter includes terms in the oldest English, and the scientific vocabulary is so full that it will be found of service even to specialists. The special terminology of botany, zoology, and chemistry is included, and, so far as we have tested, all those terms which have originated in the recent rapid advances of science. The numerous illustrations are carefully and nicely executed, and the etymologies give evidence of the study of the best authorities; though sufficient care is not always taken to distinguish between cognates and derivatives. Mr. Hunter has been "assisted in special departments by various eminent authorities"; indeed he could never have adequately carried out his undertaking without such assistance. We wonder, however, who his botanical assistant is. Under Botany we have a short history of the science, in which its classifications by various authorities are given; in Modern Botany, for example, we have first Lindley, then Thomé, and finally—"Robert Brown, jun."!

Ogilvie's Imperial Dictionary has held its place for about forty years, in spite of certain failings, especially in its etymology. It quite deserved the great reputation and popularity it had for so long, for it was really the most thorough and complete and practically useful dictionary in the language. It really, like Mr. Hunter's book, was a combination of dictionary and encyclopædia. It, however, greatly needed to be brought up to date, and this is what Mr. Annandale has attempted to do in the new edition, and the attempt has been successful. It is more concise than Mr. Hunter's book, both in vocabulary and definition, but on this very account may be preferred by many. It ranges over the whole of English and Scotch literature, and its scientific department is as full as the most exacting reader could require. The definitions are given with care and accuracy; the etymology is up to the latest research, and is concise and clear; the illustrative quotations show extensive reading, and the illustrations are thoroughly intelligible and neat. In its new form the "Imperial" is likely to meet with as wide acceptance as it did when originally published. Both dictionaries are excellently printed.

First Steps to a New Selenography; in which it will be recognised that the Moon was once an Inhabited World. By John Jones. (Dundee: J. Leng and Co., 1881.)

THE title of this little book is hardly in accordance with its contents. For it is not *selenography*—the description of the features of our satellite—but *selenology*, the theory of the mode of their formation, that the author has taken in hand; and the inhabitants to whom he proposes to introduce us will be found to be by no means, as we might have expected, "men in the moon," but creatures of one of the lowest types of existence. We will not, however, quarrel with this. But we are obliged to add that the writer has attacked his subject in rather a peculiar way. Having come into possession of a good telescope, he has satisfied himself, from three nights' inspection of the Moon, that all former observers are in the dark, and that the real cause of her crateriform aspect is the building up of *atolls* of coral reef in oceans of volcanic mud, while the mysterious brilliant streaks are due to the friction and polishing of a glacial period. Various theories, as our readers may be aware, have been proposed to account for the wonderful aspect which our satellite presents in a telescope, and which is not unencumbered with difficulty; and the discussion, which has been going on for half a century, has by no means reached an uncontroverted solution. Nor can it be any disadvantage to the cause of truth that it should be thoroughly ventilated, and looked at from every point of view. But we must be forgiven for doubting whether the publication before us will advance the inquiry. We are loth to bear hard on any ingenious speculator, but we cannot persuade ourselves that the "crater-craze," be it right or wrong, will be "exploded" by the observations of three nights. And as to the possibility, alleged in the "Epilogue," that a meteor, "colliding with the extremities of projecting pinnacles of the lunar structures," might demonstrate the theory to our senses by transferring a fragment of coral reef to the surface of our globe, the author we hope will excuse us for preferring to wait for the messenger before we acquiesce in the theory.

The First Book of Knowledge. By Fredk. Guthrie, F.R.S. (London: Marcus Ward and Co., 1881.)

FROM the style of this little book we should judge that it is intended for the use of School Board teachers in giving Object Lessons. It gives in simple language an idea of the nature of common objects, and also of the mode of their composition. Of course from a man of such well-known ability as Prof. Guthrie we may be quite sure that the book will be perfectly accurate and thoroughly good so far as its subject-matter is concerned. The manner, however, in which the knowledge to be communicated is arranged is by no means to be unreservedly praised. In endeavouring to be simple Prof. Guthrie has adopted a

style which, to say the least of it, is clumsy, and which in many places is so unique as to be almost ludicrous. Prof. Guthrie calls every thing either a *stuff* or a *thing*, for instance, clay is a stuff and a brick is a thing, so then he goes on to tell what stuffs are and how they are made into things. The different subjects are very carefully arranged in chapters and paragraphs, and questions are given which would prove very useful for a class. Some of the descriptions of common objects are graphic, in other cases there is rather too much brevity employed.

A Lady's Cruise in a French Man-of-War. By C. F. Gordon Cumming. Two vols. Map and Illustrations. (Edinburgh and London: Blackwood, 1882.)

THOSE who have read Miss Gordon Cumming's "At Home in Fiji," recently reviewed in these pages, will be glad to meet with her again. The present work is more slight and sketchy than the former, but no less interesting. It consists of a series of letters written from day to day during a cruise on board a French man-of-war, in the autumn of 1877. Miss Cumming was the guest of the French Bishop of Samoa, and accompanied him on his visits to the churches on various South Sea Islands. In this way she visited the Tonga, Samoa, and the Society Islands, making a specially long stay in Tahiti, and everywhere received with the warmest hospitality. Besides the genuine interest of Miss Cumming's narrative, it is valuable as giving a very full idea of the present condition of the islands visited. She has also a naturalist's eye for geology and botany, and has occasional interesting notes on the products of the islands. The cover of her book is a novelty, and its delicate colours make one afraid to handle it. It bears a coloured illustration of the beautiful climbing fern, which twines round trees and shrubs in the Pacific Islands, and is called by the natives "Wa Kalou" (God's Own Fern).

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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Mid-day Darkness of Sunday, January 22

IT is to be hoped that you will receive many and good accounts of the wonderful, perhaps unprecedented darkness which obscured London for some three hours on Sunday last, in order that its range may be localized.

It appears to have commenced about 10½ A.M., though I cannot vouch for it, as I had been up till near dawn, and was not roused till near noon. Then truly it was hard to believe the clock! To all practical intents and purposes it was night; only the street lamps remained unlit. This however enabled one to realize more fully the wonderful absence of all ordinary daylight in the streets. After the first surprise, it occurred to me to note such facts as would hereafter constitute evidence. In the first place I sought to establish that the phenomenon was not an ordinary thick London fog; secondly, to find some striking measure of the darkness, in one's immediate vicinity. A third observation offered itself in corroboration of both. These I will give in detail.

Looking out of a first-floor window, eastwards, I had on the right towards the south the sharp tall spire of Langham Church, clearly visible (at a distance of 65 yards) against the darkly lurid background afforded by the distant fog behind, which must have been the sun, then near the meridian and at about the proper elevation, but of course quite invisible. The clearness of the outline showed how slight was the fog—at any rate below the level of its apex. Next, looking across the street, fourteen yards from wall to wall, the gas-lit interiors opposite were all plainly visible—blinds not being down, nor curtains drawn, in London, during the daytime, even if the gas is lit. It was *obvious* that there was no fog to speak of. Next, as to the darkness: I say that the street lamps were not lit; consequently this observation was easy. I remarked that though one could *hear* the passers-by on the opposite pavement, they were *quite invisible*. I could only see the lower limbs as they crossed the dim lights in the opposite basement windows. Lastly, looking northwards, where a turn of the street brings a line of four-storied houses across the line of sight, at forty-five yards distance, many of the windows where the occupants were not at church, being lighted from within, were easily seen; but there was *not the faintest sky-line:* the sky, or rather background of foggy air, was utterly devoid of illumination. The windows alone stood in evidence that there were houses there, *not* obscured by fog.

Finally, so strong was the impression of *mere darkness* that, having sat down to write, I started up and went again to the window, with the ejaculation—"Why, one ought to see the stars!" and I should hardly have been otherwise than satisfied if I *had* seen some.

Others may have seen this kind of thing in London before. Certainly I have not; and I have a strong impression that if it had happened on a week day, instead of on a Sunday during the morning service, we should have had a storm of complaints from the City, which even the *Times* would have noticed!

1, Langham Street, January 24 J. HERSCHEL

Earth-Currents

A REMARKABLE and unusual sudden appearance of earth currents occurred between 10.15 and 10.20 p.m. Greenwich time on the evening of January 19, on lines running east and west. They disappeared as rapidly as they arrived. They were weak, measuring, when at a maximum, 3.3 milliamperes. Traces remained until 10.50. It will be interesting to learn if simultaneous disturbances occurred in our magnetic observatories. I have not heard of any aurora being visible that night.

January 24 W. H. PREECE

The Storage of Electricity

WE have heard a great deal of late in reference to what is called the storing of electricity, and not long since we had a long account in the *Times* of the journey from Paris to Scotland of a gentleman who carried with him a number of cells "filled with electricity," and representing "hundreds of thousands of foot-pounds of force." The daily papers and the scientific serials have vied with each other in telling how electricity can be stored, or bottled up and transported from place to place, to be drawn upon as circumstances may demand. The result is that the majority of those practically unacquainted with the subject have very false ideas as to the nature of the Planté, the Faure, or the Sutton accumulators. In no sense of the word can these beautiful forms of batteries be called stores of electricity. A man who should carry with him a piece of copper, a piece of zinc, and a little sulphuric acid, and should then boast that he was transporting electricity from place to place, or carrying half-a-dozen thunderstorms in his pocket, would be rightly regarded as committing an abuse of language. A man who carries a box of lucifer matches in his pocket has no right to say he is transporting fire from place to place, or to speak of them as storers or accumulators of fire. In like manner it is an abuse of language, to speak of electricity being carried from place to place, or stored up for future use in the Faure secondary battery. Nor is it less incorrect, or less misleading to speak of "charging" such batteries with electricity. The dynamo machine may render the amalgamated lead and copper of a Sutton battery capable of being unequally acted upon by sulphuric acid, and of thus giving rise to an energetic current of electricity, and the reversing action of such batteries is undoubtedly very beautiful and certain to be of the greatest possible practical convenience, but there is nothing in the principle of their action to justify the very misleading language used in reference to them, not only by writers to the provincial press but by scientific men in high-class journals. Practical electricians understand generally perfectly well what they mean by the figurative language they use, but it would be well, if in lectures and articles of a didactic nature, or intended for the information of the general public, they were to use language of a less metaphysical character and to describe a thing as it really is. It is because as a teacher I know how apt people are to give a concrete significance to abstract or figurative expres-

sions that I ask you to find room in your pages for this short protest. EDMUND P. TOY

Middle Class Schools, Littlehampton, January 13

A Solar Halo

A PHENOMENON quite unusual in these parts was witnessed here this morning in the form of a solar halo of surpassing brilliancy. The outer ring was dazzling white; the next pale lemon, the inner orange, and the inclosed space grayish brown, uniform throughout. The display was brightest at sunrise. The sky was clear with the exception of a few light clouds along the eastern horizon. The air was still. The temperature was ten degrees below freezing point. As the sun climbed higher the colours gradually faded out, until at 10.30 the last traces had disappeared. J. T. BROWNELL

Mansfield, Pa., U.S.A., January 10

Coltsfoot

THERE is an interesting article on "Coltsfoot" in the *Pall Mall* for January 21, in which mention is made of fifty-two species of wild flowers being in bloom at Lyme Regis; "and at Hastings nearly one hundred have been counted within a semi-circular radius of 10 miles." Coltsfoot is amongst the flowers already in blossom on the south coast; and it is instanced as a very remarkable proof of the mildness of this winter. I think it is nearly as wonderful that *Corylus avellana*, the common nut, should be in blossom on a sheltered bank in North Wiltshire. Not only are the catkins fully in blow, but the fertile flowers are also in blossom, and that not only on one, but on many bushes. A wood full of primroses such as we often wait for till March or April is another instance of absence of frost.

T. S. MASKELYNE

Salthrop, Wroughton, Wilts., January 23

The Absolute Sine Electrometer

IN my paper in last week's NATURE (p. 278), read "$\frac{1}{60}$ inch pitch" instead of "$\frac{1}{10}$ inch pitch" for the micrometer screw. The diagram has been turned round counterclockwise.

Cooper's Hill, January 21 GEORGE M. MINCHIN

PEDICULI.—A correspondent asks if any one can inform him whether in experimental researches on spontaneous generation pediculi have ever been the subjects of observation, and if so, with what results? Further, is it likely that the density of their dermal structures affords them a means of resistance to heat applied through a liquid medium?

PHYSICAL NOTES

DR. R. KÖNIG has recently described a method of investigating the nodes in the vibrating column of air in an organ-pipe. The pipe—a large one—is laid horizontally on its back, and a long slit is made the whole length of the pipe. The slit is closed by water, the pipe lying in a trough. A small curved tube, open at the end, passes down through the water and up through the slit into the pipe. Its other end is joined to a manometric capsule in conjunction with a flame apparatus of the usual type. The nodal surfaces can be determined to within two millimetres. The introduction of the tube interferes less with the conditions of vibration than the introduction of a tissue-paper disk or other explorer hitherto u ed.

A NEW barometer, automatically recording the variations on an enlarged scale, has been invented by Marshall Delaey (*Bull. Belg. Acad.*, No. 8). It has the following arrangement:—The barometric tube, having a capacious reservoir at top, is fixedly suspended. The cistern is a tube slightly wider and nearly as long; it bears on one side an index, and on the other a pencil working on a moving cylindrical surface, and it forms the upper part of a kind of areometer, having a downward extension in the form of a closed tube floating in mercury in a wider tube, which communicates below, through a U-tube, with a wide and shallow covered cistern, the level in which is approximately constant. The variation of pressure is marked by the variation of the height of mercury in the reservoir, and this latter is to that of the total height in the barometric cistern (or to the path of the float or of the pencil) in the ratio of the section of the cistern to that of the reservoir (a sixth in the instrument the author represents). Thus an amplification is realised.

THE colourless fluorspar of Switzerland, according to M. Cornu (*Jour. de Phys.*, October), is a substance at least as transparent for ultra-violet rays as quartz, and its law of dispersion is so much in harmony with that of quartz that with the two a system of lenses of nearly perfect achromatism may be had. To give an idea of this achromatism M. Cornu states that he obtains on one *cliché*, with very satisfactory distinctness, the spectrum of all the photographic lines of metals, from the three blue lines of zinc to the lines No. 32 of aluminium. With such objectives a determination of the wave-lengths of very refrangible radiations becomes possible. The author describes measurements of t is kind (along with details of method) in the case of magnesium, cadmium, zinc, and aluminium.

A RHEOMETER, for measuring currents at different depths in water, is described by Signor Scardona in the *Rivista Scientifico-Industriale* (September 30). It acts by pulses generated at intervals (according to the speed of the current) in a tube, and affecting a bell. The water-current acts on two screw-vanes on a horizontal shaft in a case attached to a vertical rod. This shaft (which a flat vane keeps in a line with the current) actuates, at intervals, through an endless screw and a reducing system of wheels, a lever applied to a caoutchouc capsule at the end of a metallic tube, through which, and a flexible tube attached, the resulting pulses pass to the bell-arrangement (which is in a portable case). The rod and the metallic tube are each made up of several pieces screwed together, and the vane case and tube can be fixed at any part of the rod. The advantages claimed over Amsler's rheometer are simplicity (in dispensing with electrical action), and a better kind of signal (one stroke of the bell for each turn of a wheel).

AN experimental inquiry by Herr Graetz (*Wied. Ann.* No. 10) into the heat-conductivity of gases and its relation to temperature results as follows:—1. Heat-conduction in the gases air, hydrogen, and (with low temperatures) carbonic acid, consists in transference of progressive energy only; intramolecular energy contributes immeasurably little. The molecules thus behave like material points. 2. The relation of heat conduction to temperature is found by experiment to be such (approximately) as Clausius' theory requires. 3. All results for gases and vapours, showing divergences from the values calculated from theory, are without evidential force, for they only gave the apparent heat-conducting power, in consequence of absorption of radiant heat. 4. The divergence of the temperature-coefficient of friction from that calculated from theory cannot have for cause (or not alone) the decrease of the molecular diameter with rising temperature; some other explanation must be sought.

A USEFUL comparison of the numerous determinations of the expansion of water by heat is made by Herr Volkmann in a paper contributed to Königsberg Institute (*Wied. Ann.* No. 10). Experimenters, it is known, have used two methods—the hydrostatic and the dilatometric. The author gives in a table the average values for volume and density of water (deduced from the observations of Hagen, Matthiessen, Pierre, Kopp, and Jolly) for all temperatures from zero to 25°; also the volumes every 5° from 25° up to 100°. The temperature of greatest density of water is, according to the best data, +3·94° C. Herr Volkmann thinks there is no occasion to study the subject anew on the lines hitherto adopted; but it might be well (in his opinion) to observe the absolute expansion of water in the same way as Regnault determined that of mercury (with communicating tubes).

IN view of assertions that the band-spectrum attributed to hydrogen by Herr Wüllner is really that of a hydrocarbon—acetylene according to Herr Ciamician—the former physicist has made a careful examination of the acetylene spectrum (*Wied. Ann.* No. 10), and finds that, as might be expected from the higher proportion of carbon in acetylene, its spectrum differs from that of hydrogen much more than do the spectra of ethylene and marsh gas. While in these latter the characteristic carbon bands indicate the spectrum to be that of a carbon-containing gas, the whole of the red, orange, and yellow part, in the other, resembles much more the spectrum of carbonic acid than it does that of hydrogen.

THE physical properties of indium have been very little known hitherto. A recent contribution on the subject by Herr Erhard (*Wied. Ann.* No. 11) treats of some of its electric properties. As regards resistance, he finds that indium is like some other metals in not coming under the often-accepted rule that pure metals have a change of coefficient of resistance with tempera-

ture corresponding to the absolute temperature. The thermo-electric position of iridium among seven other metals for temperature-differences 0° and 98°·6 is thus indicated—

− Al, Sn, In, Zn, Ag, Au, Cu, Fe +

with smaller differences (0° and 5° or 10°) it comes after Au Zn. Once more, elements were constituted of indium in its chloride with zinc, copper, and iron in their chlorides, and examined. In the element indium-zinc, the indium is the positive pole; in the two others the negative. The electromotive force of In/Zn was found equal to 0·331 Daniell; of Fe/In = 0·160 D., and of Cu/In = 0·584 D.

In a paper communicated to the American Association for the Advancement of Science Dr. E. L. Nichols discusses the relation between the electric resistance of platinum and its coefficient of expansion by heat. He has made careful experiments by an ingenious method at temperatures rising up to 3000° C., and finds that all the empirical formulæ given previously by Siemens, Matthiesen, and Benoit are unreliable, and, from certain anomalies in the behaviour of the metal he concludes that it is safer to infer the temperature from its expansion than from its electric resistance.

TORNADOES, WHIRLWINDS, WATERSPOUTS, AND HAILSTORMS[1]

II.

THE *Dust Storm* of India and other dry, hot climates, is another well-marked type of the whirlwind. The observations and illustrations of these meteors, which have been made by Baddeley and others, are in a high degree instructive from the light they throw on the actual movements of the whirlwind which the dust-laden air-currents of the storm present in a visible form to the eye.

Previous to the outbreak of a dust storm, the atmosphere is unusually calm and sultry, thus essentially resembling the conditions of weather under which the tornado and whirlwind originate and which point to a vertical disturbance in the equilibrium of the atmosphere. The simplest form of the dust storm is that of a tall aërial column of sand moving onwards, and drawing into itself as it whirls round in its course, dust and other light bodies within the sweep of the strong air-currents which blow along the surface and converge vorticosely round the base of the column. A frequent form is shown in Fig. 4, which represents several dust columns grouped together, each whirling independently round its own axis with incurving air-currents at the base, whilst the group is bodily borne forward, presenting remarkably striking aspects as the forms and relative positions of the columns are changed. While engaged early in 1851 in the investigation of dust storms, Dr. Baddeley followed one on horseback, and was fortunate to note several of the important phenomena of these storms. As the dust storm passed various objects in its course, such as tents, horses, &c., it gradually diminished in size, till instead of a whirling circle of five or six feet in diameter, composed of several rotating eddies, or spirals of dust, such as are seen in Fig. 4, it terminated in a single cone, the apex of which in contact with the ground, rotated briskly from left to right, just as the whirling composite circle had done. From the cone of dust, a long ribbon-like band about a foot across, of equal dimensions throughout, extended into the atmosphere as far as the eye could see, but as its sides presented a greater opacity than the central portion it was really of a cylindrical form. This column was rendered visible by the dust it had whirled aloft, and was further observed to exhibit by the light of the sun which shone through it, a kind of vermicular spiral motion. Aloft the column extended forwards in advance of the whirling cone. Suddenly the lower portion of the column which continued to rotate to the last vanished, and the upper portion then slowly receded upwards and onwards till it passed out of sight.

The important character of the evidence adduced by the observations of dust storms towards a correct understanding of the whirlwind consists in the circumstance that it affords conclusive evidence that there is a strong inflow of the air along the surface of the ground all round vorticosely towards the base of the whirlwind, and that these same inflowing air-currents thereafter ascend through the air along the centre of the whirlwind, carrying with them the evidence of their ascent in the visible solid particles of dust, sand, and other light objects they whirl up with them in their upward course.

The most marked difference between the dust storm and the waterspout or tornado lies in the essential difference, as regards moisture, of the masses of air which are drawn into and ascend the columns of the whirlwinds. In the waterspout, certainly in all waterspouts that reach down to the surface of the earth, the earth is at, or not far from, the point of saturation, and in these cases the whirlwind is accompanied with heavy rains. In some instances the rainfall has been so excessive that it can fittingly be described as only an aërial torrent of solid water, that from the velocity with which it falls from the clouds digs

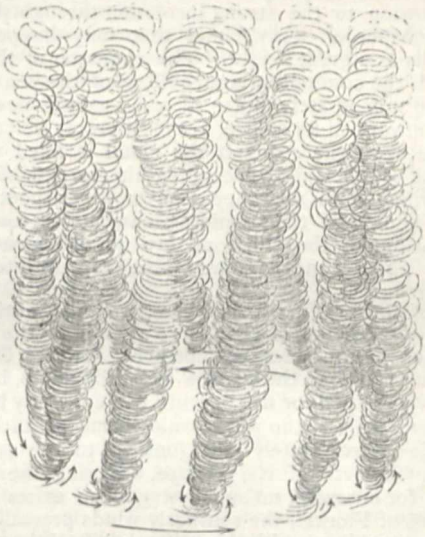

Fig. 4.

deep openings in the soil at the points where it strikes the ground. Thus immediately after the great tornado which occurred in Pennsylvania in June, 1838, Espy visited the spot and carefully examined the sides of the ridges and mountains on which its chief force was spent. He found many holes dug out by the torrents of water shot down by that tornado, which measured about thirty feet in diameter and from three to six feet deep, according to the nature of the soil and depth of the rock; the sides of the holes being in most cases cut down almost perpendicularly on their upper side, but entirely washed out on their lower side, so as to form the commencement of a ravine.

On the other hand, the air-currents which enter into and rise through the columns of the dust storm are very dry, and far removed from the point of saturation. Hence a large number of dust storms are neither accompanied nor followed by rain or any aqueous precipitation. Not a few, however, are observed to be followed towards the close of the storm with a sudden fall of rain, occasionally little more than a sprinkling, which may be due either to the condensation caused by the extreme rarefaction resulting from the rapidity of movement of the gyrations of the ascending air-currents, or to the great height in the atmosphere to which the air-currents are carried by the storm.

[1] Continued from p. 157.

Certain tracts of the ocean are known by the absence, or comparative absence, of rain, such rainless regions of the ocean being included within what may be called permanent anti-cyclones; that is, tracts of sea over which atmospheric pressure is higher than it is all round. Such regions are also remarkable for peculiarly bright clear skies and strong sunheat. Similarly the anti-cyclones which occur between, or in the immediate neighbourhood of cyclones are characterised by dry air and clear skies; and it is under such conditions that the strongest direct sun-heat is experienced. When in the warmer months of the year these anti-cyclones remain practically stationary for some time, which at that season of the year not unfrequently happens, it follows that the lowermost strata of the atmosphere become abnormally heated; thus bringing about a vertical disturbance of the equilibrium of the atmosphere, out of which whirlwinds originate. It is under these conditions, in all probability, that *white squalls*, or *fair-weather whirlwinds* occur, the originating cause of this special form of the whirlwind being the great dryness of the air due to its place in the anti-cylone, and the abnormally rapid diminution of temperature with height owing to the strong insolation through the clear, dry atmosphere. Any cloud that may happen to be formed is at a great height. The character of the cloud, also, and the commotion and boiling of the sea which is observed immediately under it, and accompanies it as it moves onward in its course, are clear proofs that the interspace between the sea and the cloud is filled with the gyrations of the rapidly-ascending air-currents of a whirlwind, which does not appear as a water-spout simply because the air of the ascending currents is too dry or the gyrations of the whirlwind are not sufficiently rapid to bring about condensation of the vapour into visible cloud.

One of the best marked of the permanent anticyclonic regions of the globe is that large region of the Atlantic which lies to the west of Northern Africa. Over this wide tract of ocean the portion most liable to be struck by the white squall or the tornado will evidently be where the general drift of the wind issuing from the anticyclonic region is approximately antagonistic to the prevailing wind as observed at the surface. During the summer months, for example, no such antagonism exists between the winds of Florida, the southerly winds prevailing there being in accordance with the general drift of the winds for that side of the anticyclonic region of the Atlantic on the one hand, and on the other in equal accordance with the monsoonal wind of that coast towards the heated interior of the Southern United States. Quite otherwise, however, is it with the ocean off the west coast of Northern Africa. There the general drift of the winds over that part of the region overspread by the Atlantic anticyclone is north-easterly; and that this wind prevails at no very great height is abundantly shown by the quantity of African dust which falls on this part of the sea; whereas the surface wind is from the south-west, being strictly monsoonal in its character, or is an inflow towards the heated interior of North Africa. This is the region of the *Bull's-eye Squalls* of the African coast—a form of the whirlwind which deserves to be more accurately described and investigated than it has yet been, from its evident relations to the two great wind-systems referred to above, and to the very different states of atmosphere, which these imply over the restricted region where the bull's-eye squalls occur.

The white squall accompanies fine weather, and is preceded immediately, and for a space of time more or less extended, by a clear sky and calm, or all but calm, weather. Its appearance is sudden, its duration brief, but its destructive power is occasionally so dreadful, that it has been known to strip a ship of every sail and mast in a few seconds, and leave it lying a helpless log amidst the tremendous seas which follow it. It is not possible, when sailing through a region overspread by the anticyclone, to make the outlook too close and sharp, particularly when the weather looks singularly fine, the skies beautifully clear, the air calm or all but calm, and *the temperature and moisture of the air noticeably high.*

On May 17, 1763, Cook saw six waterspouts on Queen Charlotte Sound, in one of which a bird was seen, and in arising was drawn in by force and turned round like a spit; an important observation, as Prof. Ferrel remarks, as showing that there is draught and an inflowing of air from all sides to supply the ascending current. In other words, the behaviour of the air-currents of a waterspout is precisely that of the air-currents of a duststorm, as actually seen in its dust-laden currents.

Another observation of great importance was made by Prof. F. E. Nipher, near Schell City, Missouri, and published in NATURE, vol. xx. p. 456, which, from its great importance in the study of whirlwinds, we here quote:—

"While making magnetic determinations at Schell City, Mo., a whirlwind of some violence passed near our tent, moving with the characteristic swaying and halting motions of the tornado. Its base was quite pointed, and about 2 feet in diameter.

"Unlike those seen last year, and described in NATURE about a year ago, there were no surface-winds strong enough to bear dust along the surface of the ground, but the dust carried up in the vortex was collected only at the vertex of the whirl. The dust-column was about 200 feet high, and perhaps 30 or 40 feet in diameter at the top. The direction of rotation was the same as that of storms in the northern hemisphere. Leaving the road the whirl passed out on the prairie, immediately filling the air with hay, which was carried up in somewhat wider spirals, the diameter of the cone thus filled with hay being about 150 feet at the top. It was then observed, also, that the dust-column was hollow. Standing nearly under it the bottom of the dust-column appeared like an annulus of dust surrounding a circular area of perfectly clear air. This area grew larger as the dust was raised higher, being about 15 or 20 feet wide when it was last observed. This whirl could be observed half a mile, finally disappearing over a hill."

Hence in this whirlwind the behaviour of the wind was exactly what is seen to obtain in the dust-storm. The light objects on the surface of the earth were lifted and carried up in whirling gyrations with a velocity so considerable that the hay and dust were driven outward by the centrifugal force of these gyrations to some distance from the axis of the whirlwind, leaving round the axis a shaft of perfectly clear air, the diameter of which gradually increased as the gyrating air-currents ascended, and friction was thereby diminished. An increase in the velocity of the ascending gyrations would, if sufficiently great to produce the required rarefaction, have filled the clear axial shaft of the whirlwind with cloudy vapour.

ELECTRICITY AT THE CRYSTAL PALACE

I.

THE work of installing the apparatus and machines at the Crystal Palace Electrical Exhibition is progressing very slowly, owing perhaps to the absence of any formal day of opening to hasten it. Before everything is fairly in its place, at least another fortnight will have elapsed, for a great deal of time is necessarily consumed in making electrical connections. Enough has been done, however, to give a fair idea of what the exhibition will be like. The official catalogue has been published in advance, and there are about five hundred exhibitors enumerated in its pages. Of these only about a hundred are from abroad, including America, so that the exhibition is rather an English than an "international" one. At the Paris International Exhibition of Electricity there were over two thousand exhibitors, and of these only one-half were French, the remainder being from every other civilised country, including Japan, which offered the first fruits of its electrical science in the shape

of some porcelain telegraph insulators, and battery pots of porous clay. Comparison with the famous show at Paris is naturally provoked by the public statements which have been made, to the effect that the Sydenham exhibition will be equal, if not superior to that in the Champs Elysées, but there is really no comparison between the two displays. It is not merely in the number and variety of the exhibits that the difference is so marked; but in the arrangement of the whole, and the intrinsic value, ingenuity, and workmanship of the articles exposed. The Paris exhibition was a compendium of all that electricity had achieved since it became a science, and the visitor could there see within the compass of a single building the rough experimental apparatus with which all the great discoveries in electricity had been made, and the most powerful and magnificent effects which modern invention has elicited from them. Everything had been done by the exercise of French taste to make the exhibition as interesting and attractive as possible. A lighthouse, a model theatre, a picture-gallery, had been erected to show the capabilities of the electric light; the powers of the telephone were exemplified by means of a "salle d'audition," where visitors could hear the music of the Grand Opera and the elocution of the Comédie Française; an electric boat plied on the waters of an ornamental basin; an electric balloon was propelled through the air; and a great diversity of machines were put in motion by the electric current from sewing-machines and fans, up to hammers, pumps, and printing-presses.

There is no good reason why the English exhibition should not have been equally interesting and instructive if it had been carried out under happier auspices. To begin with, the time was ill-chosen, following, as it did, hard on the back of the Paris one, when foreign exhibitors had grown tired of exhibitions, and were eager to return to their homes. A year hence would have been a better time; and the response of foreign electricians would doubtless have been heartier. Moreover, the Crystal Palace is not well adapted for such a purpose. It is too far out of London, and being above all a place of entertainment, is out of keeping with a scientific exhibition. The truth is that there is a clear need of a large building in London for exhibition purposes. We have no Palais de l'Industrie as yet, and hence we are obliged to hold our industrial exhibitions in such places as the Agricultural Hall, which has by no means a central site, or the narrow galleries surrounding the Horticultural Society's Gardens, where the apparatus of the Smoke Abatement Exhibition is now very inconveniently crowded. We require for London a commodious and elegant glass and iron structure, of a permanent kind, situated somewhere in the West End, either in Hyde Park or the Green Park, where it would be readily accessible to all. Until we have such a building, our exhibitions, in this age of exhibitions, will never show to good advantage.

Taking the Crystal Palace Electrical Exhibition for what it is, and not for what it might have been, we shall still find plenty to interest us there. The four great divisions of applied electricity, telegraphy, telephony, electric lighting, and the transmission of motive power by electricity, will be represented, and in telegraphy and electric lighting very worthily represented on the whole. Great Britain has played a leading part in the development of the telegraph, and the fruits of her enterprise and ingenuity are visible on the Post Office stall, and the exhibits of the great submarine cable companies. The Wheatstone automatic instrument, which is the most rapid telegraph for overland lines, is shown at work by the Post Office, and the Eastern Telegraph Company exhibit Sir William Thomson's beautiful Siphon Recorder, which is the finest apparatus yet invented for receiving messages through deep-sea cables. The stalls we have mentioned, together with that of the War Office, are situated in the great nave of the Palace; and the galleries at the west end are also set apart for various exhibits. Fully one-half of these are in their places, and a number of interesting objects are on view. We shall have occasion to refer to some of these stalls at greater length in subsequent articles, but at present they are incomplete.

The display of electric lamps promises to be very good, partly owing to the magnificent vista offered by the grand aisle of the Palace, and the varied objects below, such as ferns, flowers, statuary, and gaily-coloured wares. Visitors will have a rare opportunity of seeing how brightly the various tints appear in the electric light, more especially the green of foliage, owing to the prevalence of actinic rays in the electric arc. It is for this reason that landscape paintings appear doubly natural when lighted by the rays of a "lampe soleil" or Werderman lamp; and on the other hand that flesh tints are apt to seem too purplish. The purely incandescent light such as that of Swan or Edison has a yellowish tinge, which produces a scenic effect more resembling the deadening of gas light, and it is therefore not so well adapted to light a picture-gallery, or the tableau of the stage, as the electric arc or Drummond limelight.

The entire nave will be lighted in sections by arc lights, of different kinds, such as the Siemens', Brush, Jablochkoff, Pilsen, Gravier, and Crompton lamps. The incandescent lights of Swan, Lane-Fox, and Edison will be shown in the courts and enclosures within the Palace; for example, the Alhambra Court, which will be lighted by a crystal chandelier of Lane-Fox lamps hung over the fountain, and the Entertainment Court, which is now being fitted up with a splendid chandelier of a hundred Edison lamps of sixteen candle-power. This brilliant fount of light resembles an enormous basket of flowers, tulips and convolvuli, each arching over towards the observer and displaying between the coloured petals a luminous globe as if it were an enlarged pistil. The stems of the flowers are of gilt brass, the petals are of pearl and opalescent glass; while the pistil is of course the pear-shaped bulb of the incandescent lamp. The Concert Room has been lighted every evening for some time past by Edison lamps swung in festoons from the pillars, or suspended in stars under the galleries, and clustered in two chandeliers hung from the roof. One of these is a small copy of the larger flower basket in the Entertainment Court, and the other is a sac of crystal lustres gleaming here and there with lamps. Altogether the designs of these fittings reflect great credit on Messrs. Verity and Co. of Covent Garden.

EDWARD WILLIAM BINNEY, F.R.S., F.G.S.

THIS eminent geologist was born in 1812 at Morton, in Nottinghamshire. He was descended from a long-lived and robust stock of men, very few generations taking the family back long before the times of the Great Rebellion One of the American branch, the Hon. Horace Binney, with an interest in strange contrast with the indifference commonly felt about such matters in this country, has taken much pains in tracing the origin of his ancestry. Perhaps it will satisfy most persons to know that the father, Thomas Binney, born in the year 1762, was a much respected gentleman, diligent in business, and of the strictest integrity. He was a maltster, often travelling to Manchester, where one of his principal customers was the grandfather of the writer of this article. He died in 1836. Young Binney received his education in a grammar school, conducted on principles of severe discipline, so different from the modern *régime*. He then served his apprenticeship to a solicitor in Chesterfield. Other pursuits soon occupied his attention, but his legal knowledge was afterwards of the greatest service to him in the commercial portion of his career.

From an early age he was a keen observer of the

operations of nature, and took great interest in philosophical pursuits generally; hence soon after settling in Manchester he sought admission into the Literary and Philosophical Society; his election, on January 25, 1842, taking place by a singular chance on the same day with Dr. Joule's and Dr. Schunck's, subsequently sharers with him in the honours of the presidency. In this Society, so congenial to his tastes, he was a leading spirit. It was mainly owing to his energy that the Society was maintained in its position as a publishing institution, and to it many of his more important papers were addressed.

One of the earliest of these was in 1843, when he read a paper entitled "An Account of the Petroleum found in Downholland Moss," showing that petroleum could be produced from the decomposition, or rather distillation of peat at a low temperature. Little was before known of the origin or utility of this product. In the inquiry he was associated with Mr. W. H. Talbot, who assisted him in making the bores and obtaining information respecting the moss. The following is extracted from Mr. Binney's statement to the Philosophical Society (*Proceedings* of the Society, vol. viii. p. 136). "On the 26th November, 1848, I went to Downholland and showed the deposit to Mr. James Young, and explained to him how the petroleum was there formed. This was before I accompanied that gentleman to Riddings, at Easter, 1849, and went down Mr. Oakes's pit, where the deep coal was wrought, and petroleum flowed from the roof. At both those places the supply of petroleum was not sufficient for commercial purposes on an extensive scale. The Bathgate works were the cause of the petroleum trade in America. In Scotland paraffin oil was first made on a large scale and introduced as an article of commerce. In the suit of Young *v.* White and others, tried at Westminster in 1854, the circumstances under which Mr. Young first became acquainted with the petroleum at Riddings were given to the public. Of course when the Americans saw the report of that trial they ceased to import high-priced Boghead coal from Scotland, upon which they had to pay a patent right for the manufacture of paraffin oil, and immediately resorted to petroleum, which had been running to waste for ages."

The name "paraffin," adopted by Mr. Binney, was a principal means by which the patent was established.

The successful commercial enterprise thus commenced did not alienate Mr. Binney from the pursuit of science. Besides his paper "On the Origin of Coal," December 1, 1846, he made elaborate investigations on Permian and Triassic Strata; on building stones, of which he made the collection in the geological museum which he was mainly concerned in establishing, and filling with specimens of his own collecting; the drift deposits of Manchester and its neighbourhood," &c., &c. From the last-named paper I extract a paragraph indicating his love of the subject :—"The examination of the older fossiliferous rocks, rich with the remains of organic life, has generally attracted the attention of geologists, to the exclusion of the drift, which has been but too often considered as a dry and uninteresting study. My intention is to attempt to dispel this delusion. However delightful it may be to the human mind to examine the 'medals of creation,' as Cuvier aptly denominated fossil organic remains, and to trace back through countless ages the successive races of beings that have formerly peopled this globe—performed the parts for which they were designed, and then ceased to exist; to investigate the various forms of vegetable life that deprived the atmosphere of its surplus carbon, for the double purpose of forming our invaluable beds of coal, and at the same time fitting the air for the respiration of animals of a higher order; and to examine the wonderful chemical agencies that have been in operation in the great laboratory of nature, in order to prepare our metallic and mineral treasures; still, the last great physical causes which have operated on the face of the globe, and adapted it for the habitation of man, deserve our attention in an equal, if not more pre-eminent degree.

"It is to this last and finishing stroke of the Creator that the earth chiefly owes its present arrangement of land and water, its beautiful variety of hill and dale, and its different kinds of soils for the support and nourishment of the vegetable kingdom—that wondrous agent for the conversion of brute into organic matter, which fits it for food for the use of the animal creation, and man himself." ("Manchester Memoirs," vol. viii. N. Ser. p. 196).

Mr. Binney had great sympathy with all earnest intellectual labourers, particularly with those of straitened means, and it did not matter much with him in what field their energies were displayed. Thus among those he helped with his counsel and assistance, Sturgeon, to whom we owe so many first steps in theoretical and practical electricity, is a striking example. It was through Mr. Binney's exertions that this singularly gifted man was rescued from poverty and received Government recognition of his discoveries. Then there were Butterworth the geometrician, Bamford the poet, Richard Buxton the botanist, and many others, whom he cared for with almost a paternal solicitude.

Sixteen years ago he purchased Ravenscliff, in the Isle of Man, and there he spent a large portion of his time, showing much hospitality to men of kindred tastes to his own. There he took pleasure in botany and such geological investigation as the island afforded. He desired nothing more ardently than that nature should flourish around him, and his place was fragrant with myrtles, escallonia, and roses. He took much interest in a *Eucalyptus globulus*, which, planted close to the sea, grew to the height of twenty feet in a few years.

I do not recollect any one whose heart seemed as it were to go out to all living things with the warmth of affection shown by him. I cannot in this regard help recalling a circumstance which occurred in a walk with him on Langness. A bird's nest containing two eggs being found on the ground, he flung himself down beside it and contemplated it with the greatest delight, but without touching or disturbing it in the least.

He was an enemy to all the so-called "sports" in which cruelty to animals and gambling are the principal features, such as pigeon-shooting, horse-racing, &c. To one who asked him to subscribe 5*l.* for the establishment of a race-course his characteristic reply was: "I will gladly subscribe 5*l.* to prevent it." He even possessed a kind of sympathy, known only to poetic minds, for vegetable life, fully concurring with a remark I made to him, that a man who could take pleasure in felling a noble tree must be destitute of the finer feelings of humanity.

Mr. Binney had a large, muscular frame, and his countenance in profile resembled that of Cato the censor, with whose character he had many points of strong resemblance.

Long time a sufferer in health without fatiguing his friends with complaints, "the silver cord was loosed" on December 8. The paralysis terminated fatally on the 19th, and on the 23rd he was buried in the family grave at Worksop.

He has left a widow, daughter of the Rev. David Jones, Rector of Hope Bagot, near Ludlow, and six children.

J. P. JOULE

THE LATE CHANGES IN THE VESUVIAN CONE

NOVEMBER, 1881.—The condition of the crater of Vesuvius is at present exceedingly interesting. This is especially so after the continuous active state that the mountain has been in for nearly three years. The old crater of 1872 is now completely filled, and has in fact been so for some time. About three-quarters of the edge

has been overflown by lava at various times, but especially by the eruptions of the last two years. Last June, arising from the plain or platform of lava formed by the filling of the crater, was the cone of eruption. This was situated east-north-east of the axis of the mountain. It formed a small steep-sided cone till the eruption of July destroyed the northern portion, forming a large low crater. Its condition on November 5, when I visited the crater or craters, was most instructive, and reminds one of a figure and description given by Sir W. Hamilton in his "Campi Phlegrei."

Arriving at the edge of the 1872 crater from the west one crosses the crater plain, and arrives at a low semi-circular ridge with an average height of about twenty feet. Ascending this rim-like heap of scoria, one observes occupying its irregular bottom fumaroles and yellow patches of decomposing lava. The complete crater of July is formed of this ridge, together with the southern portion of the former cone of eruption. Within this space rose another cone of eruption whose centre was occupied by the main vent. On this occasion it was possible to approach within a few yards of the great mouth, from which issued the column of vapour and momentary puffs of fluid lava fragments. Thus it will be seen that there are at present three cones and craters one within the other.

This, however, was not the most interesting point. In the lava of the great plain we discovered a large cone or lava tunnel about eight feet high, twenty or thirty feet long, and fifteen feet broad, but with a general slope downwards. The roof was composed of lava about eight months old, but much decomposed. The whole cave presented one glistening forest of stalactites, some three hundred about were counted; also stalagmites. Most of these were from two to three feet long, and a few twice that length; many, however, with a uniform diameter of less than an inch throughout and tubular, divided by septa, reminding one of an Orthoceras in structure. The colours most various and beautiful: bird's-egg blue, acqua marine, salmon white, yellow, and reddish brown, and many variegated in these colours. The effect after the eyes quitting the rugged and fierce scenes around seemed to rest on some fairy cave.

On attempting to approach the entrance the gust of hot air, redundant with hydrochloric acid vapour, almost prevented one from making an attempt at an entrance. However, these beautiful and interesting prizes determined me to make an endeavour. Nose and mouth muffled, and having placed my friends on each side of the entrance with a strap, I made a dive down some steps. The effect was at first almost suffocation, stinging of the conjunctiva, and a profuse perspiration. To grab a few of those stalactites near at hand and return was the work of a minute, then the hearty pull-up by my friends, a fit of coughing and a little fresh air restored me. This was repeated eight times, during which I was able to obtain all the best specimens, some thirty examples, and reach the extremity of the cavity. These prizes were carried carefully to Naples, where they have been placed under glass in a dry atmosphere, since they were highly deliquescent. A qualitative analysis gives the chief component as chloride of sodium, with chlorides of potassium, iron, manganese; sulphates of soda, potash, iron, and copper.

They were undoubtedly formed in the following manner:—The heavy rains we have had here lately dissolved out the materials from the decomposing lava above. The solution as it descended was evaporated by the current of hot air continually circulating through the cave, thus driving off the water and depositing the salt. Many showed within their cavities crystals of Halite Sylvine, and a few also Molysite.

December.—In the early part of this month lava commenced to flow down the eastern or Pompei side; this, although not seen from Naples, gave a brilliant reflection at night which could be observed from the city. This aurora continued with variable intensity until December 25, 1881, when it reached its climax. The lava had commenced to issue by a fissure nearly north of the base of the cone of eruption. During the three weeks that it flowed this fissure had become widened and opened up. On Christmas and the following day the quantity of lava increased much in quantity, and altogether Vesuvius was much more active. The rent at this time had extended down the slope about one-third the distance of the Vesuvian cone and formed at its upper or wider part, an opening of about 120 feet in breadth by the same in depth. The floor which I visited and walked up on December 29 was covered by the scoria and lava blocks continually falling from its edges. This floor sloped downwards to the end of the fissure at a small inclination. From its termination issued the larva already spoken of.

This was a good example of the opening up of a dyke to the surface of a volcanic cone, so lucidly described by Mallet ("Mechanism of Production of Volcanic Dykes, and on those of Mount Somma," *Quart. Journ. Geol. Soc.* vol. xxxii. p. 472).

The lava that issued at first descended the cone, crossed the Valle dell' Inferno, following the course of the 1834 stream, and threatening Otajano. It stopped, however, and followed a course across the Atrio in a north-east direction, where it can do no harm.

An important fact was brought out by this eruption, small as it was. When the level of the lava in the vent had been lowered by exclusion of the fissure downwards an entire change of ejectamenta took place. The soft masses of pasty lava as ejected generally was replaced by rounded fragments of solid and old lava and volcanic ashes. The cone of eruption having no longer the column of lava to support it internally had crumbled in and was being ejected piecemeal by the explosions in the form of stones and ash. This we had practical experience of. At one time approaching somewhat incautiously through the mist we were practically warned to beat a hasty retreat by hearing the rattle around us of small, and the heavy thud of larger stones. The beautiful yellow crater plane of 1872 had been covered by the dull grey ash, only relieved by numerous green-coloured saline crusts rich in copper. This was made evident on looking at our boot-soles, where we found the nails thickly plated with metallic copper.

Near the end of the above-mentioned fissure the lavas were flowing down the mountain in a tunnel. The roof had broken through at one place, and standing a few yards above this a fine sight presented itself. Figure a long fairly regular arched passage of about a metre and a half wide by the same in depth, along which one could see for one or two hundred yards.

This was bright red-hot, and flowing along its floor with considerable rapidity was a stream of bright orange-coloured lava with the liquidity almost of water. In this we were able to carry on some experiments on the specific gravity of molten and cold lava, which reverse the results obtained on former occasions by Palmieri and others, and which will prove that cold is of higher specific gravity than molten rock, as theoretically should be the case. These facts, however, will be described elsewhere.

H. J. JOHNSTON-LAVIS

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

V.

11. THE Beatrix Antelope (*Oryx Beatrix*).—The antelopes of the genus Oryx constitute a well-defined and most beautiful group of the Bovine Family. Although not amongst the largest of the antelopes, they are animals of above the average size in the group. The males are

[1] Continued from vol. xxiv. p. 534.

furnished with very long straight or slightly recurved horns, which are also present, though not quite so highly developed, in the females. These organs are more or less ringed at the base, and are placed in a line with the anterior surface of the face, or nearly so. They constitute a formidable weapon of attack and defence, and on this account be-

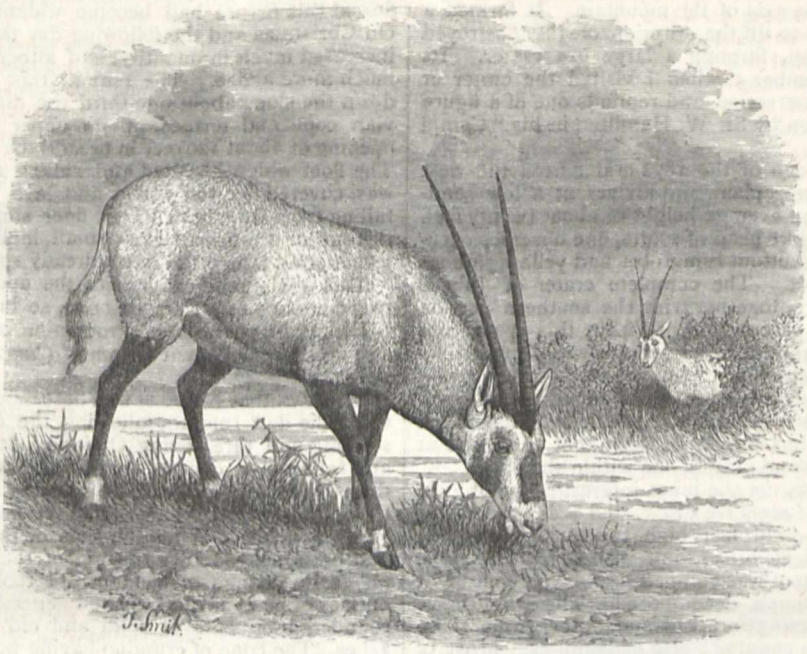

FIG. 11.—The Beatrix Antelope.

come frequently broken in the case of captive specimens. The colour of the Oryxes is generally of a brilliant white, ornamented by black streaks, and occasionally clouded with shades of grey and rufous.

The best known member of the genus Oryx is the Leucoryx (*Oryx leucoryx*), a native of Senegal, but also met with in Sennaar and Nubia. Of this antelope, examples have been for many years in the Zoo-

FIG. 12.—The Thar.

logical Society's Menagerie, and have bred young ones on several occasions. Besides this species the Society's Collection contains at present several specimens of the still more beautiful Beisa Antelope (*Oryx beisa*), of Abyssinia. This antelope bred in the Society's Gardens last year, and the young animal has been figured in a re-

cent number of the *Proceedings* (see *Proc. Zool. Soc.*, 1881, p. 626, pl. liv.). Of the allied Gemsbuck of South Africa, well-known to the sportsmen of the Cape, though, according to Mr. Selous, now entirely confined to the arid deserts of the south-west, the Zoological Society have not, of late years at least, been able to exhibit living specimens. But the celebrated collection of the late Lord Derby formerly contained examples of both sexes, and the young, bred at Knowsley, is figured in the volume entitled "Gleanings from the Knowsley Menagerie."

To the three species above-mentioned of the genus *Oryx*, which have long been known to naturalists, a fourth was added some twenty years ago by the late Dr. Gray, who, in 1857, at one of the Zoological Society's meetings (see *Proc. Zool. Soc.*, 1857, p. 157, pl. lv.), described a new species based upon an animal received from Bombay, but supposed to have been originally brought from some part on the Red Sea. This species, as Dr. Gray pointed out, is in some respects intermediate between the Gemsbuck and the Leucoryx, having the straight horns of the former and the plain colour of the latter, but the dark legs and peculiar white feet at once separate it from both of them.

The Beatrix Antelope (*Oryx Beatrix*), as it was named by Dr. Gray after the Royal Princess of that name, although thus clearly defined, and excellently figured by Mr. Wolf, remained a somewhat obscure species until 1872, when, singularly enough, a second living example was received by Mr. Gwyn Jeffreys, F.R.S., from Colonel Pelly, H.B.M. Resident at Bushire, and deposited in the Society's collection. In 1878 a third example of the same antelope was received by the Society from Commander Burke, of the SS. *Arcot*. This animal was obtained at Jedda, but was stated to have been originally captured in the Hedjez passes, some 150 miles in the interior of Arabia.

The fourth example of this antelope, lately presented to the Society by Lord Lilford, from which the present figure is taken (Fig. 11), comes from a still more definite locality. It was shipped to Lord Lilford by Lieut.-Col. S. B. Miles, British Consul at Muscat, with the information that it came from the great desert behind the mountainous district of Oman. It is now therefore abundantly evident from these four examples, which agree in all material points, that the Beatrix Antelope is a good and well-defined species, and that its native home is the interior of the Arabian peninsula, where it replaces the Beisa of the Abyssinian plateau.

12. The Thar (*Capra jemlaica*).—The peculiar Himalayan Goat, known to the Indian sportsmen as the Téhr, Thar, or Tahir, was first described in 1828 by Hamilton Smith, and named *Capra jemlaica*, from the district of Jemlah, to the north of Nepaul, in which his specimen was procured. It is found, however, as Dr. Jerden tells us, throughout "the whole extent of the Himalayas at great elevations, generally above the limits of forest and not far from the snow. It frequents rocky valleys and very steep and precipitous ground, and is often seen perched on what appear to be inaccessible crags. It feeds on the grassy spots among rocks, and though not unfrequently solitary, is more generally seen in flocks, sometimes as numerous as twenty, thirty, or even forty. If alarmed whilst feeding, these animals all go off at full speed with a clattering sound, but soon halt and turn to gaze on the intruder. They generally follow the guidance of an old male, and will make their way up almost perpendicular precipices if there be but a few rough edges or crevices. In the north they are said to be sometimes seen in company with the *Markkor* (*Capra megaceros*)."

The Thar also extends into Cashmere, and was found by Dr. A. Leith Adams to be common on the Pir Pinjal ranges, and still more so on the mountains on the banks of the Chenab, near Kistewar.

The first example of this wild goat received by the Zoological Society was obtained in 1852, and lived some years in the Menagerie (see Wolf and Sclater, *Zool. Sketches*, ser. i. t. xxv.). After the death of this animal the species remained unrepresented in the collection until 1880, when the examples now in the Gardens were presented to the Zoological Society by the Prince of Wales. His Royal Highness, on his return from India in 1876, brought home with him a pair of these animals, from which a young one was produced. The male unfortunately died at Sandringham, so that only the mother and young (also of the female sex) were transferred to the Society. Fig. 12 represents the adult female, in which the horns, although nearly of the same character as in the male, are not so large or so well developed.

Fig. 13.—The Indian Darter.

13. The Indian Darter (*Plotus melanogaster*).—The Darters form a very peculiar type of birds of the order Steganopodes, allied to the Cormorants in structure, but very Heron-like in gait and gesture. For several years the Zoological Society's fish-house has not failed to contain one or more specimens of these birds, which have given us abundant opportunities of observing their peculiar mode of fishing. The Darter in its normal position sits erect upon a branch or stump overlooking the water. When proceeding to fish it dives head foremost into the stream, and swimming entirely under water, transfixes its finny prey with the rapidity of lightning. Emerging from the water with the fish speared upon its long slender beak, the Darter chucks the fish into the air, and catching it head foremost with unerring aim, swallows it whole. This peculiar and interesting mode of fish-catching may be witnessed every day when the Darters in the Zoo-

logical Gardens are fed with their usual meal of small fishes.

The Darters usually exhibited in the Society's Gardens are of the South American species (*Plotus anhinga*), which, it seem, is the most easily obtained alive. But in 1878 an example of the African form Le Vaillant's Darter (*Plotus levaillanti*)[1] was received, and lived for some time in the Gardens, where it exhibited the characteristic mode of feeding previously observed in its American brother. In April last an example of a third species of this genus—the Indian Darter (*Plotus melangaster*) was obtained in exchange from the Zoological Gardens of Calcutta. After living for many months in excellent health this bird died suddenly on the 21st of December last, apparently from a sudden shock produced by feeding too rapidly.

In captivity the Indian Darter does not deviate as regards habits from the species previously received. "In a state of nature," as Dr. Jerden tells us, "this beautiful diver is found throughout all India, Ceylon, Burmah, and Malayana. It is exceedingly numerous in some parts of the country, especially in Bengal; hundreds are often to be seen on a single jheel. They hunt singly in general, or in scattered parties, but often roost in company, both at night and in the middle of the day, when numbers may be seen perched on the trees overhanging some tank or river. They float low on the water, often with nothing but the head and neck visible, and swim and dive with rapidity. After feeding for some time they perch on the bough of a tree or on a pole or stone, and spread their wings out to dry as the Cormorants do."

The Darters present some very abnormal features in the structure of the stomach and in the mechanism of the vertebræ of the neck. These have been elaborately described by the late Prof. Garrod from the specimens that have lived in the Society's Collection (*Proc. Zool. Soc.*, 1876, p. 335, and 1878, p. 679.

THE LICK OBSERVATORY

AN esteemed American correspondent has sent us the following information on this remarkable observatory:—

In December, 1874, Mr. James Lick determined to erect "the most powerful telescope in the world," somewhere within the boundaries of California, his adopted State. Various sites were proposed and considered, the first being Observatory Point on Lake Tahoe, which was soon abandoned on account of the severity of the winters at this place, and especially on account of the great snowfall. Mr. Lick's original idea was somewhat crude and unformed, but it took shape after consultation by letter and otherwise with various men of science in the East and elsewhere, and also with gentlemen of scientific tastes in California. Monte Diablo (3856 feet high), Mount Helena (4343 feet high), and other points, were successively proposed and, after examination, rejected. Finally, Mr. Lick sent Capt. Fraser, his man of business, to examine Mount Hamilton (4440 feet), an easily accessible peak some thirteen miles east of San José, in Santa Clara County. The first examination was made by Capt. Fraser, in August, 1875.

In most respects this site was found to be satisfactory, but the chief objections to it were found to be important, if not vital. The cost of constructing a road to the summit would certainly be very great, and the summit itself was a sharp point of very hard trap rock. To make a level space here for the reception of the necessary buildings would be a serious matter. Finally, no water was known anywhere near the summit. The last objection was disposed of by the discovery of two springs, only 4300 feet distant from the summit and 300 feet below it. Mr. Lick then announced that if Santa Clara County would build a suitable road connecting San José with the top of the mountain, he would establish and suitably endow an observatory on Mount Hamilton. After various changes in his plans Mr. Lick made a deed of trust (dated September 21, 1875), which gave a very large amount of real and personal property to five trustees to be by them expended for various purposes. The observatory was provided for as follows:—The trustees were authorised to expend the sum of 700,000 dollars for the purchase of the necessary land and for putting up on that land "a powerful telescope, superior to and more powerful than any telescope ever yet made," with the necessary machinery, &c., "and also a suitable observatory connected therewith." As soon as these objects are satisfactorily accomplished the observatory is to be turned over to the Regents of the University of California, to become a department of the University, and any surplus left over after paying for the land and observatory is to be invested in safe bonds. The income from these bonds is to be devoted to "the maintenance of the said telescope and of the observatory connected therewith, and shall be made useful in promoting science."

A grant of land was obtained from the United States; the proposition of Mr. Lick to Santa Clara county was accepted, and the road to the top of Mount Hamilton was built during 1876. It was formally accepted by the Trustees in January 1877. It is now maintained by Santa Clara county as a county road, and it is quite likely that it will soon be extended by Alameda county over the range into the San Joaquin valley. Probably no more magnificent mountain road exists in the United States, when one considers all the circumstances of fine surrounding scenery, excellent road-bed, and commanding views. Some idea of the engineering difficulties overcome can be had from the cost of constructing this highway twenty-six miles into the heart of the mountains, and with a rise of 4000 feet in twenty-two miles. Such a project would appal the average county surveyor of New England, but it was here accomplished at the large cost of 78,000 dols.

The maximum grade is 6 feet 6 inches in 100 feet, or about 343 feet in the mile. Most of the road, however, is materially less steep than this. The first four miles is a fine level avenue, laid out in a perfectly straight line in the Santa Clara valley. The ascent of the foothills is then commenced, and the road begins a series of turnings and twistings which are of course necessary to keep the gradient low. Toward the end of the route the road winds round and round the mountain itself and overlooks one of the most picturesque of scenes: the valley of Santa Clara and the coast range to the west, a bit of the Pacific to the south-west, the Sierra Nevadas with countless ranges between, to the south-east the San Joaquin valley, and the Sierras beyond to the east, while to the north on clear days you plainly see Mount Shasta (14,000 feet) 175 miles away. The bay of San Francisco lies open before you, like a child's dissecting map, and at the end of it Tamalpais, the mountain near the entrance to the Golden Gate.

Mount Hamilton has, properly speaking, three summits. The east peak is 4440 feet, the middle peak is 4350 feet, and the third, the observatory peak (originally 4256 feet), has been cut down to a level surface just large enough to contain the neeessary buildings for the instruments. The dwelling-house and workshops are on a narrow saddle some 50 feet below the summit. To gain the level surface some 29 feet of rock has been removed from the peak; in all about 40,000 tons. A level site is thus provided, and this is perfectly accessible from San José. With a light waggon one may trot the horses all the way. The springs have also been connected with "the hill," as it is called by the inhabitants, by a good

[1] The discovery recently made by Canon Tristram of the occurrence of this Darter breeding in large colonies on the Lake of Antioch is very remarkable, he species not having been previously known to occur north of Sennaar.

road along which a water-pipe is laid. These springs yield 850 gallons per day in the dryest time, and in the wet season as much as 5000 gallons per day. Thus a very serious problem is solved.

The decision of the general plans for the Observatory has fallen largely to the President of the Lick Trustees, Capt. R. S. Floyd. He has given to these questions an amount of time which few persons could possibly bestow on a matter outside of ordinary professional life. Since 1876 he has personally visited most of the observatories of Europe and America and has corresponded with astronomers all over the world. In 1879 he visited Washington, and together with Profs. Newcomb and Holden, of the Naval Observatory, he prepared a series of drawings from which the Observatory was to be built, and ordered the first of the instruments. The general plan of the Observatory is to give the place of honour to the large dome (some seventy-five feet in diameter). This is to contain a refracting telescope by Alvan Clark and Sons, of Cambridgeport, who have made not only the largest, but the best telescopes in the world. Their first telescopes were six inches in aperture and of exquisite definition. Without losing in precision, they have successively made object glasses of 8¼, 9¼, 12, 15½, 18½, 23, and 26 inches. They are now engaged on an objective of 30 inches for the Russian Government, and will soon commence the Lick telescope of 36 inches aperture, for which they have served so magnificent an apprenticeship. This is to occupy the whole of the south end of the plateau of the summit. At the northwest corner stands a dome (completed in November, 1881) which contains a 12-inch telescope by Alvan Clark, one of his very finest. Connecting the two domes is to be a one-story building containing a clock room, workshops, a library, offices and bedrooms for observers. A transit house of iron (completed in 1881) stands a few feet east of the smaller dome, and just south of this is the photo-heliograph, with its house. A few feet east of this the six-inch meridian circle (by Repsold of Hamburg) is to stand, which, with the four-inch transit (by Fauth of Washington) completes the list of meridian instruments. A four-inch comet-seeker, by Clark, occupies a small dome. The main building will be built of brick. The bricks of clay, found close to the Observatory, are made under a contract which saves the Observatory some fifty per cent. of the usual cost. About 2,000,000 bricks are now made and ready to deliver, and these will just about suffice for the constructions agreed upon.

It will be seen that an observing station of importance is already established on the mountain, containing an equipment of which many European observatories would be proud. It may be said that the whole of the fund expended to date is less than the cost of the road to the summit, and this includes all expenses. This equipment has recently been utilised in the observation of the transit of Mercury on November 7, 1881, by Prof. Holden and Mr. Burnham, who were invited by the trustees to set up their first instruments. In 1879 Mr. Burnham spent three of the summer months on the mountain, and used his six-inch telescope in regular observations, the object being to compare the conditions of vision at this high altitude with those at lower levels. His conclusions were extremely favourable to the Mount Hamilton site, and from his report there is little doubt that during the summer months this site is more favourable than that of any observatory now established. During the winter, storms prevail, but the snow is not very deep, and does not lie long, and the temperature is not very low. When it is clear, in the rainy season, it is perfectly so, and the vision compares favourably with the average conditions at Eastern observatories. It is obvious that if the management of the Observatory affairs remains in the same able control, we shall have in a few years one of the most admirably equipped observatories in the world, on a site far superior to any; and without being too sanguine, it will be safe to expect much from such an institution in proper hands.

NOTES

MR. MACLEOD (Assistant Secretary, Education Department, Whitehall) having resigned, will be succeeded by Col. Donnelly, R.E., now Director of the Science Division, who, while retaining his present post, will, as Assistant Secretary of the Education Department, be the chief officer of the Science and Art Department at South Kensington.

THE death is announced of Prof. Theodore Schwann of Liége, the eminent biologist, at the age of seventy-two years. We hope to refer to Prof. Schwann at length next week. We also learn of the death of Hermann Schlagintweit, well known as a naturalist, and in conjunction with his brother Emil, as an explorer of the Himalayas.

THE death is announced of Signor Carlo Piaggia, who has done some good exploring work in the region to the south of Abyssinia. Signor Piaggia was proceeding from Khartoum to Fadassi to join Herr Shuver, to whose journey we referred last week.

WE regret to learn that Mr. Joseph Thomson is daily expected home. It may be remembered that he was engaged for two years by the Sultan of Zanzibar to geologise along the Rovuma, and in other districts of the Sultan's dominions. We give elsewhere some of the results of his great excursion along the Rovuma, where he failed to find coal, which the Sultan was anxious he should do. We are informed that the Sultan is so disappointed at the result that he has abruptly broken the engagement, and sent Mr. Thomson home with payment only for the time he has been out. This is disappointing, as much good work would certainly have been done by Mr. Thomson had he been allowed to pursue his explorations. Evidently the Sultan has much to learn. We trust Mr. Thomson will soon find suitable employment for his exceptional ability as an explorer.

SOME very important experiments have recently been carried out at the Conservatoire des Arts et Métiers, upon the accumulating power of Faure's secondary battery. A committee consisting of MM. Tresca, Potier, Joubert, and Allard conducted operations. Thirty-five accumulators of the spiral form, each set in a cylindrical stoneware pot about 35 centims. high and 25 centims. diameter, were charged in series by the current from a Siemens' dynamo-electric generator worked by a steam-engine. The working electromotive force of an accumulator was found to be from 2·15 to 2·5 volts. For twenty-two hours the battery was charged with a current whose average strength was 8·5 ampères, the total work expended in charging being 6,020,000 kilogrammetres. The total work of the steam-engine was also measured by a dynamometer, the Siemens' generator having, as it appeared, an efficiency of 71 per cent. The battery was then discharged through eleven Maxim lamps, the potential and current being accurately measured from time to time, and although the discharge lasted eleven hours there appeared to be 70 per cent. of the original energy given out in the discharge. A complete report is promised by the committee.

THE umbrella trade (according to the *Scientific American*) threatens the existence of the pimento (pepper) plantations of Jamaica. It was shown by an official estimate made at Kingston last autumn, that more than half a million umbrella sticks were then awaiting export to England and the United States. These sticks were almost without exception pimento, and it is not surprising that owners and lessees of pimento walks are becoming alarmed at the growth of a trade which threatens to uproot, in a

few years, all the young trees. The export returns for the last five years show an average of 2000 bundles of sticks sent out from Jamaica annually, and the returns for the first three-quarters of 1881 show an export of over 4500 bundles, valued at 15,000 dollars. Each bundle contains from 500 to 800 sticks, each of which represents a young bearing pimento tree.

THE results of a third year's observation of spirit-levels at Secheron, for elucidation of periodic movements of the ground, are given by M. Plantamour in the December issue of *Archive des Sciences*, and Col. von Orff also communicates results obtained at the Observatory of Bogenhausen (3 to 4 km. from Munich). M. Plantamour shows that the oscillations, both in the east-west and the north-south direction, present anomalies, or differences from year to year, which cannot be explained by mere variations of the temperature of the air. The earth's surface he supposes to be in a state of constant gentle undulation, the direction and amplitude of which varies in each locality according to the nature of the ground and the forces in action; and the effect may strengthen, or neutralise that of the air temperature on the ground, or even produce a movement in an opposite direction. Col. von Orff's observations afford ground for supposing that the spirit-level variations are, partly at least, caused by variations of heat in the formation on which the Observatory rests.

"RHOPALOCERA MALAYANA: a Description of the Butterflies of the Malay Peninsula," is the title of a work which will shortly be published by Mr. W. L. Distant. It is proposed in this work to give a monographic revision and synonymic catalogue of the butterflies of the Malay Peninsula, including the islands of Penang and Singapore. The fauna of the western side of the Peninsula is at present best known, and will be here principally treated. This area will extend from Quedah to Johore, and thus comprises the Straits Settlements of Province Wellesley, Perak, and Malacca. Each species (and variety where considered necessary) will be represented by a coloured figure, and the details of its habits, variation, and geographical distribution will be given as far as our present knowledge will allow. An introduction to the classification will also be added, with a tabular arrangement of the genera. The Malayan butterfly fauna is very rich in species, and very typical of the Oriental region. It includes numbers of species which are found in Continental India, and many others which are common to Sumatra, Java, and Borneo. It is therefore anticipated that the work may prove useful to others than Malayan entomologists alone. It is to the scientific enterprise of Mr. D. Logan of Penang that the inception of this work is due, and an important part of the material on which it is based will be derived from that gentleman's collectors, who have been despatched to Quedah, Malacca, and Johore. Beside the collections made by the author, when in Penang and Province Wellesley, many others have been examined, and much information acquired, during the last ten years. The work will be comprised in six or seven royal quarto parts, each containing four coloured plates, and about twenty-eight pages of letterpress.

CONTINUING his researches on the Hydroids and Medusæ of the White Sea, and giving a *résumé* of his three years' exploration in Solovetzky Bay, Prof. Wagner states that ten different species of Medusæ inhabit the waters of this lake: *Lizzia rota*, *Bougainvillia superciliaris*, *Circe kamtschatica*, *Sarsia tubulosa*, *Plankayon hyalinus* (n. sp. et g.), *Ægionopsis Laurentii*, *Tiara pileata*, *Staurophora laciniata*, *Cyanea Arctica*, and *Aurelia aurita*. Each of these forms show some special adaptation to the medium they live in. The two first are the simplest, the primary ones, so to say, and their most important feature is the great development of the generative organs. The elegant form of the bell of the *Circe* is adapted to a rapid and ingenious motion, and its long tentacles are perfectly developed for warning it against any danger. The voracious *Sarsia* is adapted for continually searching for and catching prey at different depths, by means of its very long tentacles. The *Tiara* is characterised by a perfect development of its great stomach and mouth-ciliæ, and the large vessels are adapted for the circulation of a great amount of nutritive liquids. The *Ægionopsis* is distinguished by its large bell, which affords great room for the sexual sinuses of the stomach, whilst four tentacles inclosing the bell are protective of this great sexual laboratory. The *Staurophora* has the same characters, with some modifications for the enlargement of the nutritive and sexual organs. The flat and flexible bell of the *Cyanea* is an immense nutritive organ, to which large tentacles and a great catching-bag supply plenty of food. And the *Aurelia* is, so to say, a *résumé* of all these adaptations. Altogether they afford a fine illustration of the Etienne Geoffroy St. Hilaire's law of "organic equilibrium, or compensation of organs." All are equally well-armed for the struggle for existence and for the life in common in the waters of the White Sea. If the lazy and badly-armed *Lizzia* and *Bougainvillia* are often subject to starvation, a few individuals on the other hand suffice for producing millions of progeny. Prof. Wagner also makes some interesting remarks with regard to Milne Edwards's law as to the tendency of Nature towards diversity and economy of means.

WE have repeatedly had occasion to refer to the excellent work now in course of publication—"Anatomisch-physiologischer Atlas der Botanik," by Dr. Arnold Dodel Port, of Zürich University, and have pleasure in announcing that the 5th part of this remarkable work has just left the press. It is a specially interesting one, and contains the following subjects:—(1) *Marchantia polymorpha*, a cosmopolitan liverwort-moss, with its characteristic fruit receptacles and sporanges, of which the whole development is illustrated; (2) *Taxus baccata*, yew, with the simplest possible female flower, showing the anatomy of the ripe seed and the first germination stages of the latter; (3) *Oedogonium diplandrum Juranyi*, one of the oospore-forming filamentous Algæ, showing the green asexual zoospores, the yellowish androspores, the yellow spermatozoids, and the dwarfed males. The whole process of fertilisation and the development of oospores is also represented, this being one of the most interesting Oedogonieæ; (4) *Chara fragilis*, showing the rotation of the cell contents in the tubular cells and the female organs; (5) *Cydonia vulgaris*, Quince, showing the development of the flower and its fertilisation by the honey-bee; (6) *Centaurea cyanus*, Blue Cornflower, with the development of the protandrous flowers, showing the sensitiveness and functions of the contractile stamens facilitating the fertilisation by insects carrying pollen from other flowers. The author hopes to publish Part 6 early in April next, and Part 7 in the autumn, thus completing the work.

THE Danish Society for the Protection of Animals (under the patronage of His Majesty the King of Denmark) offers two prizes, of 2000 and 1000 francs respectively, for the best and second best scientific essay on that part of the Vivisection question, which concerns the possibility of replacing *living* by *recently killed animals* for the sake of physiological investigations. The essay should sufficiently indicate previously unknown cases, in which such a substitution of dead material may be applicable. In these essays the possibility and desirability of replacing painful experiments on animals by some *other methods of research*, may also be a subject of inquiry. The essays may be written in the Danish, Swedish, English, French, or German languages, and forwarded before September 1, 1882, to His Excellency Mr. A. de Haxthausen, President of the Danish Society for the Protection of Animals, at the office of the Society, Copenhagen. "Our Society is only too well aware that the claims of humanity are not to be satisfied by these means, as extensively as it could wish. It will however feel itself richly rewarded, if its efforts

result in diminishing the number of experiments in which animals are subjected to great and lingering agony. In this earnest hope we respectfully request all humanely disposed scientific men of every country in the world, kindly to comply with our invitation."

THE Russian representative at Peking is said to be urging on the Chinese Government the construction of a line of telegraph across Mongolia, to connect the Shanghai line with the Russian land-lines of Siberia. Should this line be carried out Peking will be in telegraphic communication by two separate routes with Europe; but it is said that the Chinese do not view the project with very favourable eyes. The new Chinese telegraphs seem to be doing their work very well. The people living along the route have abandoned their hostility, which has given way before feelings of wonder and admiration. The common people call the telegraphs "letter-poles," and think that the letters are despatched through the wires, which are believed to be hollow.

THE popular belief that the present Japanese are iconoclastic in their zeal for removing the ancient monuments of the country would seem to be a mistake. We read in the *Japan Gazette* that a society, composed of the Prime Minister, the Assistant Prime Minister, and other high officials and nobles, has just been formed for the protection of old temples, shrines, and other remnants of antiquity. A sum of two millions of *yen*, or about 400,000*l*. sterling, has been collected, and it is intended to devote the interest of this amount to the purposes of the Association. Not long since we read of a large collection—the present Minister for Foreign Affairs being among the principal subscribers—being made for the maintenance and repair of the Temple of Hachiman, or the Genius of War, at Kamakura, which contains many ancient and interesting relics. Indeed the work of destruction seems to have been confined to feudal castles, fortifications, &c. The former residences, or *yashikis*, of the nobles have been dismantled and converted into schools, hospitals, barracks, public offices, &c. Many picturesque structures throughout the country have thus been removed; but the Government deemed this absolutely necessary in order to eradicate feudal feeling, as well as to destroy strongholds for possible malcontents. The beautiful temples and shrines of old Japan still remain, and are, we see, to be maintained unimpaired.

THE Chinese authorities of Shanghai recently issued a quaint decree respecting the neglect of physicians to attend at once on their patients, and the high fees which they charge. They give notice that it is the duty of all physicians to use their knowledge for the benefit of the people; when people are sick they must be ready to attend upon them whenever they are sent for, without regarding the hour of the night or day, or the state of the weather. When people are ill they long for the presence of the doctor as the grain of seed longs for the rains. Instead of doing this, however, the physicians now think that they possess great skill, and not only charge high fees, but insist on being paid full hire for their chair coolies, and they do not care what becomes of the patient so that they get their fees. If these were only charged to the wealthy it would not so much matter; but the poor have to pay them also. An evil practice (the decree goes on) also exists by which doctors will not visit their patients before one o'clock in the afternoon; some will even smoke opium and drink tea until late in the evening. These are abuses, the magistrates say, which they will on no account permit. Doctors must attend their patients at all times; they must, if necessary, visit them several times daily; they must think more of them and less of their fees. Notice, therefore, is given to all officials and people that a physician who does not attend when he is called must only receive half his fees and half his chair hire. "If you physicians delay your visits you show your wickedness, and sin against yourselves." The decree is a model one for a paternal government; argument, entreaty, objurgation, exposition, threats, are all mingled in due proportions.

WHILST smaller glaciers leave only shallow grooves and scratches on the surface of the rocks, it is easy to see that the mighty glaciers of the Glacial period must have covered all the surface of the wide track they moved upon with deeper grooves and with low elongated ridges. Finland displays at every step an illustration of this activity of glaciers, which one of the Russian explorers of that country has described as a "telescopic glacier-scratching." Now, M. Koudravtseff, the geologist of the Russian White Sea Expedition, gives, in the *Proceedings* of the St. Petersburg Society of Naturalists, a description of the same phenomenon on the Kola Peninsula and on the west coast of the White Sea. All these scratches, troughs, and elongated embossments have the direction from west to east, showing thus that in the neighbourhoods of the White Sea the great Scandinavian and Finnish ice-covering moved towards the east.

MR. PENGELLY, F.R.S., was presented with an admirable portrait of himself at Torquay on Thursday last, as a mark of the admiration, respect, and regard in which he is held by his fellow-townsmen and friends elsewhere.

PROF. ALBERT GAUDRY, the eminent palæontologist, has been elected to the place in the Paris Academy of Sciences rendered vacant by the death of the late M. H. Sainte-Claire Deville.

THE Commission appointed by the French Chamber of Deputies to deliberate on the sale of the jewels of the French Crown has interrogated the Professor of Mineralogy of the Museum, requesting him to mark those stones which it would be desirable to send to the collection of that establishment.

SIR ERASMUS WILSON has presented a sum of ten thousand pounds to found and endow a chair of Pathological Anatomy in Aberdeen, "as an expression of my regard for an institution in which my father, a native of Aberdeen, received his medical education, and as a recognition of the honour which the University has been pleased to confer on me by granting me the distinguished degree of LL.D."

THE Etna Observatory, erected on a small mount near the crater, and so placed that a current of lava would probably divide in two and avoid it, has been completed. It is 2943 metres above the sea; the Great St. Bernard Monastery is 2491, and the St. Gothard 2075 metres.

THE Thirty-fifth Annual General Meeting of the Institution of Mechanical Engineers will be held to-day and to-morrow, at 25, Great George Street, Westminster. The chair will be taken by the President at half-past seven p.m. each evening. The following papers will be read and discussed:—On meters for registering small flows of water, by Mr. J. J. Tylor, of London; on the Bazin system of dredging, by Mr. A. A. Langley, of London; on hydraulic lifts for passengers and goods, by Mr. Edward Bayzand Ellington, of London; on improved appliances for working under water, or in irrespirable gases, by Mr. W. A. Gorman, of London; on power hammers with a movable fulcrum, by Mr. Daniel Longworth, of London.

FROM the Prospectus of Lectures and Classes for the second term of the present session of University College, Nottingham, we are pleased to see that the institution is in full working order. Both day and evening classes and lectures are well provided for, science occupying a prominent place.

THREE out of the eight articles in the new number of the *Quarterly Review* are scientific:—An article on Sir Charles Lyell, *à propos* of his recently published Life and Letters;

another on Mr. Darwin's work on Earthworms; and a third on Dr. Günther's work on Fishes.

THE Austrian naturalist, Dr. Karl Helmes, has discovered a new viper in a valley of the Makattan Mountains in Central Egypt. He has named it *Ammodytes-ægyptiaca Helmesii*. It has nothing in common with *Cerastes cornutus*, the yellow horned viper. The principal difference is that the horn-points are not above the eyes but about 4 mm. behind them. The animal does not hiss like other serpents, but makes a rattling noise as when water is thrown upon red-hot iron. The discovery will be all the more interesting to zoologists as this is the first new species discovered for many years.

THE Budget Commission of the German Reichstag has again granted 75,000 marks (3750*l*.) for the investigation of Central Africa. The Berlin African Society intends to send out two expeditions during 1882, one to start from the west and another from the south-west. It is further expected that the German station at Hakoma (Lake Tanganyika) will soon be able to pay its own expenses by establishing plantations and opening commercial relations with the neighbouring tribes.

THE Academy of Meteorological Aërostation of France has sent to M. Paul Bert a report which was adopted at its last session, and which suggests that an international exhibition of "Aërial arts" should be held in Paris in 1883, to commemorate the invention of balloons by the two Montgolfiers in 1783. The first public experiment having taken place at Annonay on June 5, 1783, a local commemoration is to take place in that town. The "Aërial arts" are to include every industry, science or art, relating to gas or the atmosphere, which is supposed to have any connection directly or indirectly with aërostatic experiments.

A SUBMARINE eruption took place recently in the Gulf of Missolonghi, not far from Anatolikon. For five days a strong odour of sulphuretted hydrogen was noticed in the neighbourhood, and whole ships' cargoes of dead fish were washed ashore.

A SMART shock of earthquake occurred at Iquique on November 13, and the master of the German barque *Shakespeare*, from Liverpool, reports that he felt it when about eight miles to the westward of Punta Arenas with such severity that he imagined the vessel had struck on a rock until the lead showed that he was in deep water. On Saturday night an earthquake shock was felt at Agram, lasting three seconds, and accompanied by a rumbling noise. Intelligence reached Plymouth on Monday from Yokohama of a destructive earthquake in China. The news, which was despatched from Yokohama on December 25, coming by way of San Francisco and New York, is exceedingly meagre. It simply announces the fact that a severe earthquake had occurred in the district of "Kantcheou," and that more than 250 people had been killed.

THE additions to the Zoological Society's Gardens during the past week include a Markhoor (*Capra megaceros* ♀) from Afghanistan, presented by Lieut.-Col. St. John; a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, presented by Miss Morson; a Common Raven (*Corvus corax*), British, presented by Mr. S. J. Elyard; a Spanish Terrapin (*Clemmys leprosa*), South European, presented by Mr. H. Balfour; a collection of Sea Anemones, British Seas, presented by Mr. A. D. Bartlett; a Malayan Bear (*Ursus malayanus*) from Malacca, purchased; a Cashmere Shawl Goat (*Capra hircus*, var.), born in the Gardens.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society last week, Sir John Kirk read a paper by Mr. Joseph Thomson, on his examination of the Rovuma basin, East Africa, during his recent trip in search of the long-talked of coal-beds. These were supposed to be situated at the Mavitu village of Itule on the banks of the Lujende, some three days' march from its confluence with the Rovuma, but on investigation proved to be only some irregular layers of bituminous shale, which are of no practical use. Though disappointed in the primary object of his journey, Mr. Thomson has been able to add much to our knowledge of the geography of the Rovuma region, having traversed between 600 and 700 miles of country, besides furnishing many interesting particulars respecting the seven tribes, or remnants of tribes, which are found there. A paper by the Rev. Channey Maples, of the Universities' Mission, was afterwards read, on Makua Land between the Rivers Rovuma and Luli, a tract of country hitherto entirely unknown. Mr. Maples had hoped to have gone right through from Masasi to Mozambique, but on his arrival at Mvalixa's, the capital of the Meto Makuas, he was unable to induce his followers to proceed further. He had, therefore, to abandon his projected visit to the fierce branch of the Makua tribe, called the Walomwe; but what was more annoying, his hopes of verifying the existence of a snowy mountain, named Irati by the natives, and said to be about half way between Meto and Mozambique. In the discussion which followed the reading of these papers, Sir John Kirk made some interesting remarks on the great expansion of the india-rubber trade in East Africa during recent years, the value of the annual export having risen from *nil* to about a quarter of a million sterling.

AFTER his recent discovery of the source of the River Lujende in what he supposes to be the unexplored northern portion of Lake Shirwa, the Rev. W. P. Johnson, of the Universities' Mission, followed the course of the river with a view to returning to his station at Mataka's town, but he was met outside and informed by the chief that his house had been utterly wrecked and his very books torn to pieces and scattered to the four winds of heaven. The outrage appears to have been committed by the owners of a slave-caravan, who believed that Mr. Johnson had contrived to send down information which had enabled Capt. Foot, R.N., to stop them some fifteen miles from the coast. Mr. Johnson had consequently been obliged to go to Zanzibar to refit, and as it would be impossible to settle again at his old station for the present, he intends to establish himself at Losewa, on the eastern shore of Lake Nyassa, in about S. lat. 13°. Thence he hopes to work Mataka's town, and he ought to be able to obtain useful information about this almost unknown side of the lake.

A TELEGRAM from St. Petersburg states that a scientific expedition, consisting of members of the Russian Geographical Society, the Imperial Academy of Sciences, and others, is being equipped for the purpose of making historical and ethnographical researches in Bulgaria and Roumelia. Prince Alexander of Bulgaria has contributed 4000*l*. towards the expenses of the expedition, in the work of which it is hoped Prince Vogorides will join.

MR. CUTHBERT PEEK is to read a paper on his journey in Iceland last summer, at the Geographical Society's meeting on January 30.

MR. BARHAM, an experienced surveyor, is to start this week for West Africa, for the purpose, it is said, of surveying a line for a light railway from the Gold Coast littoral through the little-known gold-mining region of Wassaw, which will pass the property of several mining companies. The country which will be opened up by this railway, if it be constructed, is rich in palm-oil, india-rubber, &c., in addition to the precious metal.

THE first number of *Petermann's Mittheilungen* for this year contains a letter from Mr. Schuver, giving details of his journey on the Upper Nile, to which we have already referred. There is a good summary of the Arctic work of the year, with special reference to Wrangel Land, of which island an excellent map is given from recent surveys. An interesting sketch is given of convict life in Siberia, and a summary of recent work in the Congo basin. A brief but valuable sketch of the Karachis of the Caucasus, followed by the monthly notes, concludes the number. A valuable geological map of West Africa, after data furnished by Dr. Lenz accompanies the number.

THE new part (Heft i. band iii.) of the *Mittheilungen* of the German African Society contains several communications. Dr. Buchner has reached Loanda on his return journey. There is a series of interesting letters from the members of the German

station at Kakoma, in 32° 29′ E., and 5° 47′ S., in the plateau which begins at the boundary of Ugogo with the Mpwapa heights. The letters contain a good deal of information on the country and the people, the fauna, flora, and climate. Dr. Stecker gives an account of his Abyssinian journey, to which we have already referred. Herr Flegel gives a long account of his journey from Rubba, on the Niger, north to Sokoto and back, between October 1880 and April 1881. His map contains much new and useful information on the country traversed. Finally there are some letters from Herren Pogge and Wissmann, who had reached Malange in May, and hoped to be at Kimbundo in June.

FURTHER RESEARCHES ON ANIMALS CONTAINING CHLOROPHYLL[1]

IT is now nearly forty years since the presence of chlorophyll in certain species of Planarian worms was recognised by Schultze. Later observers concluded that the green colour of certain infusorians, of the common fresh-water hydra, and of the fresh water sponge was due to the same pigment, but little more attention was paid to the subject until 1870, when Ray Lankester applied the spectroscope to its investigation. He thus considerably extended the list of chlorophyll-containing animals, and his results are summarised in Sachs' Botany (Eng. ed.). His list includes, besides the animals already mentioned, two species of Radiolarians, the common green sea-anemone (*Anthea cereus*, var. *smaragdina*), the remarkable Gephyrean, *Bonellia viridis*, a Polychæte worm, *Chætoperus*, and even a Crustacean, *Idotea viridis*.

The main interest of the question of course lies in its bearing on the long-disputed relations between plants and animals; for, since neither locomotion nor irritability are peculiar to animals, since many insectivorous plants habitually digest solid food, since cellulose, that most characteristic of vegetable products, is practically identical with the tunicin of Ascidians, it becomes of the greatest interest to know whether the chlorophyll of animals preserves its ordinary vegetable function of effecting or aiding the decomposition of carbonic anhydride and the synthetic production of starch. For although it had long been known that *Euglena* evolved oxygen in sunlight, the animal nature of such an organism was merely thereby rendered more doubtful than ever. In 1878 I had the good fortune to find at Roscoff the material for the solution of the problem in the grass-green planarian, *Convoluta Schultzii*, of which multitudes are to be found in certain localities on the coast, lying on the sand, covered only by an inch or two of water, and apparently basking in the sun. It was only necessary to expose a quantity of these animals to direct sunlight to observe the rapid evolution of bubbles of gas, which, when collected and analysed, yielded from 45 to 55 per cent. of oxygen. Both chemical and histological observations showed the abundant presence of starch in the green cells, and thus these planarians, and presumably also *Hydra*, *Spongilla*, &c., were proved to be truly "vegetating animals."

Being at Naples early in the spring of 1879, I exposed to sunlight some of the reputedly chlorophyll-containing animals to be obtained there, namely, *Bonellia viridis* and *Idotea viridis*, while Krukenberg had meanwhile been making the same experiment with *Bonellia* and *Anthea* at Trieste. Our results were totally negative, but so far as *Bonellia* was concerned this was not to be wondered at, since the later spectroscopic investigations of Sorby and Schenk had fully confirmed the opinion of Lacaze-Duthiers as to the complete distinctness of its pigment from chlorophyll. Krukenberg, too, who follows these investigators in terming it *bonellein*, has recently figured the spectra of Anthea-green, and this also seems to differ considerably from chlorophyll, while I am strongly of the opinion that the pigment of the green crustaceans is, if possible, even more distinct, having not improbably a merely protective resemblance.

It is now necessary to pass to the discussion of a widely distinct subject—the long-outstanding enigma of the nature and functions of the "yellow cells" of Radiolarians. These bodies were first so called by Huxley in his description of *Thallassicolla*, and are small bodies of distinctly cellular nature, with a cell wall, well-defined nucleus, and protoplasmic contents saturated by a yellow pigment. They multiply rapidly by transverse division, and are present in almost all Radiolarians, but in very variable number. Johannes Muller at first supposed them to be concerned with reproduction, but afterwards gave up this view. In his famous monograph of the Radiolarians, Haeckel suggests that they are probably secreting-cells or digestive glands in the simplest form, and compares them to the liver-cells of Amphioxus, and the "liver-cells" described by Vogt in *Velella* and *Porpita*. Later he made the remarkable discovery that starch was present in notable quantity in these yellow cells, and considered this as confirming his view that these cells were in some way related to the function of nutrition. In 1871 a very remarkable contribution to our knowledge of the Radiolarians was published by Cienkowski, who strongly expressed the opinion that these yellow cells were parasitic algæ, pointing out that our only evidence of their Radiolarian nature was furnished by their constant occurrence in most members of the group. He showed that they were capable not only of surviving the death of the Radiolarian, but even of multiplying, and of passing through an encysted and an amœboid state, and urged their mode of development and the great variability of their numbers within the same species as further evidence of his view.

The next important work was that of Richard Hertwig, who inclined to think that these cells sometimes developed from the protoplasm of the Radiolarian, and failing to verify the observations of Cienkowski, maintained the opinion of Haeckel that the yellow cells "fur den Stoffwechsel der Radiolarien von Bedeutung sind." In a later publication (1879) he, however, hesitates to decide as to the nature of the yellow cells, but suggests two considerations as favouring the view of their parasitic nature—first, that yellow cells are to be found in Radiolarians which possess only a single nucleus, and secondly, that they are absent in a good many species altogether.

A later investigator, Dr. Brandt of Berlin, although failing to confirm Haeckel's observations as to the presence of starch, has completely corroborated the main discovery of Cienkowski, since he finds the yellow cells to survive for no less than two months after the death of the Radiolarian, and even to continue to live in the gelatinous investment from which the protoplasm had long departed in the form of swarm-spores. He sums up the evidence strongly in favour of their parasitic nature.

Meanwhile similar bodies were being described by the investigators of other groups. Haeckel had already compared the yellow yells of Radiolarians to the so-called liver-cells of *Velella*; but the brothers Hertwig first recalled attention to the subject in 1879 by expressing their opinion that the well-known "pigment bodies" which occur in the endoderm cells of the tentacles of many sea-anemones were also parasitic algæ. This opinion was founded on their occasional occurrence outside the body of the anemone, on their irregular distribution in various species, and on their resemblance to the yellow cells of Radiolarians. But they did not succeed in demonstrating the presence of starch, cellulose, or chlorophyll. The last of this long series of researches is that of Hamann (1881), who investigates the similar structures which occur in the oral region of the Rhizostome jelly-fishes. While agreeing with Cienkowski as to the parasitic nature of the yellow cells of Radiolarians, he holds strongly that those of anemones and jelly-fishes are unicellular glands.

In the hope of clearing up these contradictions, I returned to Naples in October last, and first convinced myself of the accuracy of the observations of Cienkowski and Brandt as to the survival of the yellow cells in the bodies of dead Radiolarians, and their assumption of the encysted and the amœboid states. Their mode of division, too, is thoroughly algoid. One finds, not unfrequently, groups of three and four closely resembling *Protococcus*. Starch is invariably present; the wall is true plant-cellulose, yielding a magnificent blue with iodine and sulphuric acid, and the yellow colouring-matter is identical with that of diatoms, and yields the same greenish residue after treatment with alcohol. So, too, in Velella, in sea-anemones, and in medusæ; in all cases the protoplasm and nucleus, the cellulose, starch, and chlorophyll, can be made out in the most perfectly distinct way. The failure of former observers with these reactions, in which I at first also shared, has been simply due to neglect of the ordinary botanical precautions. Such reactions will not succeed until the animal tissue has been treated with alcohol and macerated for some hours in a weak solution of caustic potash. Then, after neutralising the alkali by means of dilute acetic acid, and adding a weak solution of iodine, followed by strong sulphuric acid, the

[1] Abstract of a paper "On the Nature and Functions of the 'Yellow Cells' of Radiolarians and Cœlenterates," read to the Royal Society of Edinburgh on January 14, 1882, and published by permission of the Council.

presence of starch and cellulose can be successively demonstrated. Thus, then, the chemical composition, as well as the structure and mode of division of these yellow cells, are those of unicellular algæ, and I accordingly propose the generic name of *Philozoon*, and distinguish four species, differing slightly in size, colour, mode of division, behaviour with reagents, &c., for which the name of *P. radiolarum*, *P. siphonophorum*, *P. actiniarum*, and *P. medusarum*, according to their habitat, may be conveniently adopted. It now remains to inquire what is their mode of life, and what their function.

I next exposed a quantity of Radiolarians (chiefly *Collozoum*) to sunshine, and was delighted to find them soon studded with tiny gas-bubbles. Though it was not possible to obtain enough for a quantitative analysis, I was able to satisfy myself that the gas was not absorbed by caustic potash, but was partly taken up by pyrogallic acid, that is to say, that little or no carbonic acid was present, but that a fair amount of oxygen was present, diluted of course by nitrogen. The exposure of a shoal of the beautiful blue pelagic Siphonophore, *Velella*, for a few hours, enabled me to collect a large quantity of gas, which yielded from 24 to 25 per cent. of oxygen, that subsequently squeezed out from the interior of the chambered cartilaginous float, giving only 5 per cent. But the most startling result was obtained by the exposure of the common *Anthea cereus*, which yielded great quantities of gas containing on an average from 32 to 38 per per cent. of oxygen.

At first sight it might seem impossible to reconcile this copious evolution of oxygen with the completely negative results obtained from the same animal by so careful an experimenter as Krukenberg, yet the difficulty is more apparent than real. After considerable difficulty I was able to obtain a large and beautiful specimen of *Anthea cereus*, var. *smaragdina*, which is a far more beautiful green than that with which I had been before operating—the dingy brownish-olive variety, *plumosa*. The former owes its colour to a green pigment diffused chiefly through the ectoderm, but has comparatively few algæ in its endoderm; while in the latter the pigment is present in much smaller quantity: but the endoderm cells are crowded by algæ. An ordinary specimen of *plumosa* was also taken, and the two were placed in similar vessels side by side, and exposed to full sunshine, by afternoon the specimen of *plumosa* had yielded gas enough for an analysis, while the larger and finer *smaragdina* had scarcely produced a bubble. Two varieties of *Ceriactis aurantiaca*, one with, the other without, yellow cells, were next exposed, with a precisely similar result. The complete dependence of the evolution of oxygen upon the presence of algæ, and its complete independence of the pigment proper to the animal was still farther demonstrated by exposing as many as possible of those anemones known to contain yellow cells (*Aiptasia chamæleon*, *Helianthus troglodytes*, &c.) side by side with a large number of forms from which these are absent (*Actinia mesembryanthemum*, *Sagastia parasitica*, *Cerianthus*, &c.). The former never failed to yield abundant gas rich in oxygen, while in the latter series not a single bubble ever appeared.

Thus, then, the colouring matter described as chlorophyll by Lankester has really been mainly derived from that of the endodermal algæ of the variety *plumosa*, which predominates at Naples; while the Anthea-green of Krukenberg must mainly consist of the green pigment of the ectoderm, since the Trieste variety evidently does not contain algæ in any great quantity. But since the Naples variety contains a certain amount of ordinary green pigment, and since the Trieste variety is tolerably sure to contain some algæ, both spectroscopists have been operating on a mixture of two wholly distinct pigments—diatom-yellow and anthea-green.

But what is the physiological relationship of the plants and animal thus so curiously and intimately associated? Every one knows that all the colourless cells of a plant share the starch formed by the green cells; and it seems impossible to doubt that the endoderm cell or the Radiolarian, which actually incloses the vegetable cell, must similarly profit by its labours. In other words, when the vegetable cell dissolves its own starch, some must needs pass out by osmose into the surrounding animal cell; nor must it be forgotten that the latter possesses abundance of amylolytic ferment. Then, too, the *Philozoon* is subservient in another way to the nutritive function of the animal, for after its short life it dies and is digested; the yellow bodies supposed by various observers to be developing cells being nothing but dead algæ in progress of solution and disappearance.

Again, the animal cell is constantly producing carbonic acid and nitrogenous waste, but these are the first necessities of life to our alga, which removes them, so performing an intracellular renal function, and of course reaping an abundant reward, as its rapid rate of multiplication shows.

Nor do the services of the *Philozoon* end here; for during sunlight it is constantly evolving nascent oxygen directly into the surrounding animal protoplasm, and thus we have actually foreign chlorophyll performing the respiratory function of native hæmoglobin! And the resemblance becomes closer when we bear in mind that hæmoglobin sometimes lies as a stationary deposit in certain tissues, like the tongue muscles of certain molluscs, or the nerve cord of *Aphrodite* and Nemerteans.

The importance of this respiratory function is best seen by comparing as specimens the common red and white Gorgonia, which are usually considered as being mere varieties of the same species, *G. verrucosa*. The red variety is absolutely free from *Philozoon*, which could not exist in such deeply-coloured light, while the white variety, which I am inclined to think is usually the larger and better grown of the two, is perfectly crammed. Just as with the anemones above referred to, the red variety evolves no oxygen in sunlight, while the white yields an abundance, and we have thus two widely contrasted *physiological varieties*, as I may call them, without the least morphological difference. The white specimen, placed in spirit, yields a strong solution of chlorophyll: the red, again, yields a red solution, which was at once recognised as being tetronerythrin by my friend M. Merejkowsky, who was at the same time investigating the distribution and properties of that remarkable pigment, so widely distributed in the animal kingdom. This substance, which was first discovered in the red spots which decorate the heads of certain birds, has recently been shown by Krukenberg to be one of the most important of the colouring matter of sponges, while Merejkowsky now finds it in fishes and in almost all classes of invertebrate animals. It has been strongly suspected to be an oxygen-carrying pigment, an idea to which the present observation seems to me to yield considerable support. It is moreover readily bleached by light, another analogy to chlorophyll, as we know from Pringsheim's researches.

When one exposes an aquarium full of *Anthea* to sunlight, the creatures, hitherto almost motionless, begin to wave their arms, as if pleasantly stimulated by the oxygen which is being developed in their tissues. Specimens which I kept exposed to direct sunshine for days together in a shallow vessel placed on a white slab, soon acquired a dark, unhealthy hue, as if being oxygenated too rapidly, although I protected them from any undue rise of temperature by keeping up a flow of cold water. So, too, I found that Radiolarians were killed by a day's exposure to sunshine, even in cool water, and it is to the need for escaping this too rapid oxidation that I ascribe their remarkable habit of leaving the surface and sinking into deep water early in the day.

It is easy, too, to obtain direct proof of this absorption of a great part of the evolved oxygen by the animal tissues through which it has to pass. The gas evolved by a green alga (*Ulva*) in sunlight may contain as much as 70 per cent. of oxygen, that evolved by brown algæ (*Haliseris*) 45 per cent., that from diatoms about 42 per cent.; that, however, obtained from the animals containing *Philozoon* yielded a very much lower percentage of oxygen, *e.g.* *Velella* 24 per cent., white *Gorgonia* 24 per cent., *Ceriactis* 21 per cent, while Anthea, which contains most algæ, gave from 32 to 38 per cent. This difference is naturally to be accounted for by the avidity for oxygen of the animal cells.

Thus, then, for a vegetable cell no more ideal existence can be imagined than that within the body of an animal cell of sufficient active vitality to manure it with carbonic acid and nitrogen waste, yet of sufficient transparency to allow the free entrance of the necessary light. And conversely, for an animal cell there can be no more ideal existence than to contain a vegetable cell, constantly removing its waste products supplying it with oxygen and starch, and being digestible after death. For our present knowledge of the power of intracellular digestion possessed by the endoderm cells of the lower invertebrates removes all difficulties both as to the mode of entrance of the algæ, and its fate when dead. In short, we have here the relation of the animal and the vegetable world reduced to the simplest and closest conceivable form.

It must be by this time sufficiently obvious that this remarkable association of plant and animal is by no means to be termed a case of parasitism. If so, the animals so infested would be weakened, whereas their exceptional success in the struggle for

existence is evident. *Anthea cereus*, which contains most algæ, probably far outnumbers all the other species of sea-anemones put together, and the Radiolarians which contain yellow cells are far more abundant than those which are destitute of them. So, too, the young gonophores of Velella, which bud off from the parent colony and start in life with a provision of *Philozoon* (far better than a yolk-sac) survive a fortnight or more in a small bottle—far longer than the other small pelagic animals. Such instances, which might easily be multiplied, show that the association is beneficial to the animals concerned.

The nearest analogue to this remarkable partnership is to be found in the vegetable kingdom, where, as the researches of Schwendener, Bornet, and Stahl have shown, we have certain algæ and fungi associating themselves into the colonies we are accustomed to call lichens, so that we may not unfairly call our agricultural Radiolarians and anemones *animal lichens*. And if there be any parasitism in the matter, it is by no means of the alga upon the animal, but of the animal, like the fungus, upon the alga. Such an association is far more complex than that of the fungus and alga in the lichen, and indeed stands unique in physiology as the highest development, not of parasitism, but of the reciprocity between the animal and vegetable kingdoms. Thus, then, the list of supposed chlorophyll-containing animals with which we started, breaks up into three categories: first, those which do not contain chlorophyll at all, but green pigments of unknown function (*Bonellia*, *Idotea*, &c.); secondly, those vegetating by their own intrinsic chlorophyll (*Convoluta*, *Hydra*, *Spongilla*); thirdly, those vegetating by proxy, if one may so speak, rearing copious algæ in their own tissues, and profiting in every way by the vital activities of these.

PATRICK GEDDES

SCIENTIFIC SERIALS

Journal of the Royal Microscopical Society for December, 1881, contains:—Diatoms from Peruvian guano, by Rev. L. G. Mills (plate xi.).—B. W. Richardson, on multiple staining and the usual summary of current researches relating to zoology and botany (principally Invertebrata and Cryptogamia). — Microscopy.—This part concludes volume i. ser. ii., and is accompanied by a very excellent index to the 980 pages, a list of authors, and full tables of contents.

Transactions and Proceedings of the New Zealand Institute for 1880, vol. xiii. Wellington, April, 1881.—In this large volume of over 460 pages, in addition to a short account of the proceedings of most of the scientific societies of New Zealand, the following memoirs are published *in extenso*:—*Astronomical*: H. Skey, on periodic vertical oscillations in the Sun's atmosphere, and their connection with the appearance and disappearance of of the solar spots.—M. Chapman, on the permanency of solar and stellar heat.—A. W. Bickerton, on the causes tending to alter the eccentricity of planetary orbits,—On the origin of the solar systems.—On the origin of double stars.—On a simple method of illustrating the motions of the earth.—On the probability of impact.—*Zoological*: Julius von Haast, on *Balænoptera huttoni*, Gray.—On Harpagornis (3rd paper).—W. Arthur, on migratory salmon.—Dr. Hector, on a new fish.—F. E. Clark, on a new species of Trachypterus.—F. W. Hutton, contributions to New Zealand Malacology.—G. M. Thomson, New Zealand crustacea.—T. F. Cheeseman, new species of mollusca.—Prof. Liversidge, analysis of Moa eggshell.—Capt. Broun, description of coleopterous larvæ and pupæ.—T. W. Kirk, notes on birds.—On crustacea.—P. Buller, on new diurnal moths.—W. L. Buller, a new lizard.—T. Jeffery Parker, a new species of Chirodota.—On the venous system of the skate.—*Botanical*: W. Colenso, on the vegetable food of the ancient New Zealanders.—On the ferns of Scinde Island (Napier).—On some new ferns of New Zealand.—On a new species of Metzgeria.—G. M. Thomson, on fertilisation in New Zealand flowers.—On *Donatia novæ-zealandiæ*.—Dr. Berggren, on New Zealand plants.—T. F. Cheeseman, on the fertilisation of Thelymitra.—On a new Loranthus.—W. M. Marskell, New Zealand Desmids.—T. A. Mollet, on the structure of *Hormosira billardieri*.—Dr. Petrie, flora of Stewart Island.—On a new Carex.—T. B. Armstrong, on the genus Corallospartium.—On new or rare New Zealand plants.—On the occurrence of the Morel.—On a natural arrangement of the New Zealand ferns.—T. Kirk, some new plants.—Charles Knight, on a new Thysanothecium.—*Chemical*: W. Skey, on an allotropic form of zinc and cobalt salts.—On a periodide and an iodo-carbonate of lead.—On the dimorphism of magnesia.—*Geological*: A. D. Dobson, on a dyke near Heathcote.—A. Hamilton, on the Foraminiferæ of the tertiary beds at Petane.—A. M'Kay, on the genus Rhynconella.—S. Percy Smith, on changes in coast line level in the north of the North Island.—T. A. Mollet, on an artesian well at Avonside.—This volume is illustrated with eighteen lithographic plates.

Zeitschrift für wissenschaftliche Zoologie, Bd. 36, Part 2 (Nov. 1881), contains:—Prof. Hubert Ludwig, on the history of the development of the skeleton in Ophiuroids (plates x. and xi.).—Dr. Julius Andreæ, contribution to the anatomy and histology of *Sipunculus nudus*, L. (plates xii. and xiii.).—Dr. F. Mayser, comparative anatomy studies on the brain of osseous fishes, with especial reference to the Cyprinoids (plates xiv. to xxiii.).

Atti della R. Accademia dei Lincei, vol. vi., fasc. 1.—The reactions of biliary pigments, by S. Capranica.—Synthesis of naphtil-acrylic acid, by F. Lugli.—Researches on the spider's web, by L. Valente.—On the light of the comet, by L. Respighi.

Atti della R. Accademia dei Lincei, vol. vi., fasc. 2.—On bilinear quaternary forms, by G. Battaglini.—On the origin of some linear differential equations, by S. Brioschi.—On the discharges of condensers, by Srs. Villari and Righi.—The endoptic perception of colour at the back of the eye, by C. Emery.—Contribution to the anatomy of leaves, by G. Briosi.—On dimethylnaphthaline, by G. Giovanozzi.—Reports, &c.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 8, 1881.—"On the Structure and development of *Lepidosteus*," by F. M. Balfour, LL.D., F.R.S., and W. N. Parker.

The first section of this paper is devoted to the general development. In this section an account is given of the structure of the ripe ovum, of the segmentation, of the history of the germinal layers, of the first development of the principal organs, and of the external features of the embryo during embryonic and larval life. The more important points established in this section are—

1. The ovum when laid is invested by a double covering formed of (*a*) a thick inner membrane, the outer zone of which is radially striated, and (*b*) an outer layer made up of highly refractive pyriform bodies, which are probably metamorphosed follicular epithelial cells.

2. The segmentation is complete, though very unequal, the lower pole being very slightly divided up into segments, and its constituent parts fusing together again to form an unsegmented mass of yolk, like the yolk-mass of Teleostei.

3. The epiblast is divided into an epidermic and nervous stratum, as in Teleostei.

4. The walls of the brain, spinal cord, and optic vesicle are formed from a solid medullary keel, like that found in Teleostei.

5. The lens, the auditory vesicle, and olfactory pit, are wholly developed from the nervous layer of the epidermis.

6. The segmental or archinephric duct is developed as in Teleostei, from a hollow ridge of the somatic mesoblast, which becomes constricted off, except in front, thus forming a duct with an anterior pore leading into the body cavity.

The section on the general development is followed by a series of sections on the adult anatomy and development of various organs.

The Brain.—The authors give a fuller description of the adult brain than has previously been given. The new features in this description are (1) that the parts identified by previous anatomists as the olfactory lobes are really parts of the cerebral hemispheres, the true olfactory lobes being small prominences at the base of the olfactory nerves; (2) that there is attached to the roof of the thalamencephalon a peculiar vesicle, which has not hitherto been noticed, but which is similar to the vesicle found by Wiedersheim on the roof of the thalamencephalon of Protopterus. They further show that the cerebrum is divided into a posterior portion, with an unpaired ventricle, and an anterior portion in which the ventricle is paired. They consider the presence of the portion of the cerebrum with an unpaired ventricle to be an indication that this part of the brain retains characters which are only found in the embryonic brain of other groups. They point to ths presence of lobi inferiores on the

infundibulum, of tori semicirculares in the mid-brain, and of a large cerebellum as indications of an affinity between the brain of Lepidosteus and that of Teleostei. In the embryological section full details are given as to the development of the thalamencephalon, the pineal gland, the cerebrum, and the olfactory lobes.

Organs of Special Sense: Eye.—In the adult eye a vascular membrane is described bounding the retinal aspect of the vitreous humour. This membrane is supplied by an artery piercing the retina close to the optic nerve, and the veins from it fall into a circular vessel placed at the insertion of the iris. The membrane itself is composed of a hyaline ground substance with numerous nuclei. In the developmental section devoted to the eye the main subject dealt with is the nature of the mesoblastic structures entering the cavity of the optic cup, through the choroid slit. It is shown that a large non-vascular mesoblastic process first enters the optic cup, and that together with the folded edge of the choroid slit it forms a rudimentary and provisional processus falciformis. At a later period an artery, bound up in the same sheath as the optic nerve, enters the optic cup, and the vascular membrane found in the adult then becomes developed.

The Suctorial Disk.—The structure of a peculiar larval suctorial organ placed at the end of the snout is described, and the organ is shown to be formed of papillæ constituted by elongated epidermic cells, which are probably glandular (modified mucous cells), and pour out a viscid secretion.

Muscular System.—The lateral muscles of Lepidosteus are shown to differ from those of other fishes, except the Cyclostomata, in not being divided into a dorso-lateral and ventro-lateral group on each side of the body.

Vertebral Column and Ribs.—The early stages in the development of the vertebral column are similar to those in Teleostei; the vertebræ being at first biconcave, and the notochord vertebrally constricted. Subsequently an invertebral growth of cartilage takes place, derived from the neural and hæmal arches, and gives rise to invertebral constrictions of the notochord.

The embryological part of this section is followed by a comparative part treated under three headings. In the first of these the vertebral column of Lepidosteus is compared with that of other forms; and it is pointed out that there are grave difficulties in the way of comparing the vertebræ of Lepidosteus with those of some Urodela in the fact that in Lepidosteus the intervertebral cartilages originate from the bases of the arches, while in the Urodela they are stated by Götte to be thickenings of a special cartilaginous investment of the notochord, which would seem to be homologous with the cartilaginous sheath placed in Elasmobranchii and Dipnoi *within the membrana elastica externa*.

On the other hand, the development of the vertebræ of Lepidosteus is shown to resemble in most features that of Teleostei, from which it mainly differs in the presence of intervertebral cartilaginous rings.

In the second section, devoted to the homologies of the ribs of Pisces, the conclusions arrived at are as follows:—

The Teleostei, Ganoidei, Dipnoi, and Elasmobranchii are provided with homologous hæmal arches, which are formed by the coalescence below the caudal vein of simple prolongations of the primitive hæmal processes of the embryo.

In the region of the trunk the hæmal processes and their prolongations behave somewhat differently in the different types. In Ganoids and Dipnoi, in which the most primitive arrangement is probably retained, the ribs are attached to the hæmal processes, and are placed immediately without the peritoneal membrane at the insertion of the intermuscular septa. These ribs are in many instances (Lepidosteus, Acipenser), and very probably in all, developed continuously with the hæmal processes, and become subsequently segmented from them. They are serially homologous with the ventral parts of the hæmal arches of the tail, which, like them, are in many instances (Ceratodus, Lepidosteus, Polypterus, and to some extent in Amia) segmented off from the basal parts of the hæmal arches.

In Teleostei the ribs have the same position and relations as those in Ganoids and Dipnoi, but their serial homology with the ventral parts of the hæmal processes of the tail is often (*e.g.* the Salmon) obscured by some of the anterior hæmal arches in the posterior part of the trunk being completed, not by the ribs, but by independent outgrowths of the basal parts of the hæmal processes.

In Elasmobranchii a still further divergence from the primitive arrangement is present. The ribs appear to have passed outwards along the intermuscular septa into the muscles, and are placed between the dorso-lateral and ventro-lateral muscles (a change of position of the ribs of the same nature is observable in Lepidosteus). This change of position, combined probably with the secondary formation of a certain number of anterior hæmal arches, similar to that in the Salmon, renders their serial homology with the ventral parts of the hæmal processes of the tail far less clear than in other types, and further proof is required before such homology can be considered as definitely established.

Under the third heading the skeletal elements supporting the fin-rays of the ventral lobe of the caudal fin of various types of fishes are compared and the following conclusions are arrived at.

1. The ventral lobe of the tail-fin of Pisces differs from the other unpaired fins in the fact that its fin-rays are directly supported by spinous processes of certain of the hæmal arches instead of by independently developed interspinous bones.

2. The presence or absence of fin-rays in the tail-fin supported by hæmal arches may be used in deciding whether apparently diphycercal tail-fins are aborted or primitive.

Urogenital Organs.—With reference to the character of the adult urogenital organs, the authors show that for the female the descriptions of Müller and Hyrtl are substantially accurate, but that Hyrtl's description of the generative ducts of the male is wholly incorrect.

They find that in the male the semen is transported from the testes by means of a series (40—50) of vasa efferentia, supported by the mesorchium. In the neighbourhood of the kidney these vasa unite into a longitudinal canal, from which transverse trunks are given off, which become continuous with the uriniferous tubuli. The semen is thus transported through the kidney into the kidney-duct (segmental duct), and so to the exterior. No trace of a duct homologous with the oviduct of the female was found in the male.

With reference to the development of the excretory system, the authors have established the following points:—

1. That the segmental (archinephric) duct is developed as in Teleostei.

2. That a pronephros, resembling in the main that of Teleostei, is developed from the anterior end of the segmental duct. But they found that the pronephric chambers, each containing a glomerulus, with which the coiled pronephric tube opens, are not, as in Teleostei, completely shut off from the body cavity, but remain in communication with it by two richly ciliated canals, one on each side of the body.

3. The pronephros eventually undergoes atrophy.

4. Some of the mesonephric tubes have peritoneal funnels in the larva.

5. The ovarian sac continuous with the oviduct, is established by a fold of the peritoneal membrane, near the attachment of the mesovarium uniting with the free edge of the ovarian ridge to form a canal, the inner wall of which is constituted by the ovarian ridge itself.

6. The posterior part of the oviduct is not formed until the ovarian sac has become developed, and had not been developed in the oldest larva (11 centims.) the authors have succeeded in obtaining.

The Alimentary Canal and its Appendages.—In this section the authors give a detailed account of the topographical anatomy of the alimentary tract in the adult. They have detected a small pancreas close to the bile-duct, and call special attention to a ventral mesentery passing from the posterior straight section of the intestine to the ventral wall of the body.

In the embryological part of the section a detailed account is given of the development (1) of the pancreas, which is described as emerging as a dorsal diverticulum of the duodenum on a level with the opening of the bile-duct; (2) of the yolk-sac and vitelline duct; (3) of the spiral valve, which first appears as a hollow fold in the wall of the intestine, taking a slightly spiral course, and eventually becoming converted into a simple spiral ridge. The so-called hyoid gill, which the authors expected to find well-developed in the larva, is shown not to be found even in the oldest larva examined (26 millims.)

The last section of the paper is devoted to the consideration of the systematic position of Lepidosteus. The Teleostean affinities of Lepidosteus are brought into prominence, but it is shown that Lepidosteus is nevertheless a true Ganoid.

The arguments used in this portion of the paper do not admit of being summarised.

Geological Society, January 11.—Mr. R. Etheridge, F.R.S., president, in the chair.—Messrs. W. J. Clunies Ross, Joseph William Brown, William Hunter, Henry Tomlinson, and Charles Otto Trechmann, were elected Fellows of the Society.—The following communications were read :—On the chalk masses or boulders included in the contorted drift of Cromer, their origin and mode of transport, by T. Mellard Reade, F.G.S.—Observations on the two types of Cambrian beds of the British Isles (the Caledonian and Hiberno-Cambrian), and the conditions under which they were respectively deposited, by Prof. Edward Hull, LL.D., F.R.S. In this paper the author pointed out the distinctions in mineral character between the Cambrian beds of the North-West Highlands of Scotland and their assumed representatives in the east of Ireland and in North Wales. In the former case, which included the beds belonging to the "Caledonian type," the formation consists of red or purple sandstones and conglomerates; in the latter, which included the beds belonging to the "Hiberno-Cambrian type," the formation consists of hard green and purple grits and slates contrasting strongly with the former in structure and appearance. These differences the author considered, were due to deposition in distinct basins lying on either side of an Archæan ridge of crystalline rocks which ranged probably from Scandinavia through the central highlands of Scotland, and included the north and west of Ireland, with the counties of Donegal, Derry, Mayo, Sligo, and Galway—in all of which the Cambrian beds were absent—so that the Lower Silurians repose directly and unconformably on the crystalline rocks of Laurentian age. As additional evidence of the existence of this old ridge, the author showed that when the Lower Silurian beds were in course of formation, the Archæan floor along the west of Scotland must have sloped upwards towards the east; but he agreed with Prof. Ramsay that the crystalline rocks of the Outer Hebrides formed the western limit of the Cambrian area of deposition, and that the basin was in the form of an inland lake. On the other hand, looking at the fossil evidence both of the Irish and Welsh Cambrian beds, he was of opinion that the beds of this basin were in the main, if not altogether, of marine origin, and that the basin itself had a greatly wider range eastward and southward—the old Archæan ridge of the British Isles forming but a small portion of the original margin.—The Devono-Silurian formation, by Prof. E. Hull, LL.D., F.R.S. The beds which the author proposed to group under the above designation are found at various parts of the British Isles, and to a slight extent on the Continent. The formation is, however, eminently British, and occurs under various local names, of which the following are the principal:—England and Wales—Devonshire: The Foreland Grits and Slates lying below the Lower Devonian beds ("Lynton Beds"). Welsh Borders: "The passage-beds" of Murchison, above the Upper Ludlow Bone-bed, and including the Downton Sandstone, and rocks of the Ridge of the Trichrug. These beds form the connecting link between the Estuarine Devonian beds of Hereford (generally, but erroneously, called the "Old Red Sandstone") and the Upper Silurian Series. South-east of England (Sub-Cretaceous district): The author assumed, from the borings at Ware, Turnford, and Tottenham Court Road described by Mr. Etheridge, that the Devono-Silurian beds lie concealed between Turnford and Tottenham Court Road on the south and Hereford on the north. Ireland—South: "The Dingle beds," or "Glengariff Grits and Slates," lying conformably on the Upper Silurian beds, as seen in the coast of the Dingle promontory, and overlain unconformably by either Old Red Sandstone or Lower Carboniferous beds, 10,000 to 12,000 feet. North: "The Fintona beds," occupying large tracts of Londonderry, Monaghan, and Tyrone, resting unconformably on the Lower Silurian beds of Pomeroy, and overlain unconformably by the Old Red Sandstone or Lower Carboniferous beds, 5000 to 6000 feet in thickness. Scotland: Beds of the so-called "Lower Old Red Sandstone," with fish and crustaceans, included in Prof. Geikie's "Lake Orcadie, Lake Caledonia, and Lake Cheviot," underlying unconformably the Old Red Sandstone and Lower Calciferous Sandstone, and resting unconformably on older crystalline rocks. Thickness in Caithness about 16,200 feet. The author considered that all these beds were representative of one another in time, deposited under Lacustrine or Estuarine conditions, and as their name indicated, forming a great group intermediate between the Silurian on the one hand and the Devonian on the other. He also submitted that their importance, as indicated by their great development in Ireland and Scotland, entitled them to a distinctive name such as that proposed.

Zoological Society, January 17.—Prof. W. H. Flower, F.R.S., president, in the chair.—Prof. A. Newton, F.R.S., exhibited (by favour of Messrs. Hallett and Co.) the skin and bones of the trunk of an example of *Notornis mantelli* recently received from New Zealand. This was stated to be the third example of this almost extinct bird which had been yet obtained.—Mr. W. K. Parker, F.R.S., read a memoir on the structure and development of the skull in the Crocodilia.—Mr. Oldfield Thomas gave an account of a series of Rodents lately collected by Mr. Stolzmann in Northern Peru. The chief interest in the collection was stated to lie in the fine series of Mice of the genera *Hesperomys* and *Holochilus* contained in it.—A communication was read from Mr. T. E. Buckley on the variability of plumage exhibited by the Red Grouse.—A communication was read from Mr. G. B. Sowerby, jun., containing descriptions of some new species of shells in the collection of Mr. J. Cosmo Melvill.—Prof. F. Jeffrey Bell read descriptions of several new or rare species of *Asteroidea* contained in the collection of the British Museum.—A communication was read from Mr. W. L. Distant, containing the characters of some undescribed species of *Cicadidæ* from the Australian and Pacific regions.

Meteorological Society, January 18.—Mr. G. J. Symons, F.R.S., president, in the chair.—The Secretary read the Report of Council for the past year, which showed the Society to be in a very flourishing condition, for while in 1871 the Society continued its work without an office, accessible library, or an assistant secretary, and the number of the Fellows was 314; the staff at present very fully employed consists of an assistant secretary and three computers with 555 Fellows on the roll. The receipts and expenditure in 1871 show a marked contrast to the year just past; the receipts amounted to only 244*l.* against more than 840*l.* in 1881. The expenditure was only 197*l.* against 780*l.* in 1881. The Society also now receives Second Order and Climatological Observations from eighty-three stations, the results of which are published quarterly in the *Meteorological Record*. In addition to the *Quarterly Journal*, two publications have been prepared and issued under the direction of the Council, viz. "Hints to Meteorological Observers, with Instructions for taking Observations and Tables for their Reduction," and "Index to the Publications of the English Meteorological Societies, 1839 to 1881."—The President then delivered his address, which was devoted to the consideration of the present state and future prospects of Meteorology. He began by asking in what respects is our present system of observation capable of improvement? Should it be extended, either as regards distribution of stations, additional instruments, or additional hours of observation? Can any of the millions of entries at present made annually be safely dispensed with? These questions can only be properly answered after considering two others—What observations are being made? and for what object? After referring to the different patterns of barometer and the number of observations made, Mr. Symons said that he is aware there are several grounds upon which the maintenance of numbers of stations in excess of all possible requirements can be defended. In the first place there is the constant difficulty which arises from the removals and deaths of the observers, and from the extension of buildings and growth of trees, &c. This renders it necessary that we should have two or three stations wherever we desire to make sure of a continuous record. But a far better and more scientific plan would be to choose a few unexceptional localities remote from towns, purchase the freehold of a few surrounding acres, erect thereon stations, identical in design and in every respect, and endow them with moderate funds so that the observations may, humanly speaking, be established on an unalterable basis. That would be the way to detect secular changes. For climatic purposes the numerous climatological stations started by the Society are of great value. After speaking of hygrometers, anemometers, and ozonometers the President referred to daily maps of Atlantic weather, which should be on a scale of not less than 1 inch for 100 miles. A compilation of such charts is essentially national work, and falls wholly within the domain of the Government Office. After referring to weather forecasts, the lack of original workers in discussing meteorological observations, the absence of academical encouragement, and the little prospect of those who devote themselves to meteorology obtaining more than a bare livelihood, the President concluded as follows:—"It is just possible that the severe manner in which I have criticised a few of our existing arrangements may have led some one to consider that meteorology is languishing, feeble, or moribund. I believe that the very contrary is the fact; when

a case is weak, one hesitates to point out its weaknesses for fear of a total collapse. No. The Meteorological Society never advanced so rapidly in numbers as it has in the two last years, and if it will but apply the pruning knife to fruitless observations and try to secure the application of more brain power to the many problems yet unsolved, it will contine to receive an ever-increasing amount of recognition and support, and to maintain that high position among kindred societies which it at present holds."—The following gentlemen were elected Officers and Council for the ensuing year :—President, John Knox Laughton, M.A., F.R.A.S., F.R.G.S. Vice-Presidents: William Ellis, F.R.A.S., Rogers Field, B.A., Joseph Henry Gilbert, F.R.S., Baldwin Latham, F.G.S. Treasurer, Henry Perigal, F.R.A.S. Trustees: Hon. Francis Albert Rollo Russell, M.A., Stephen William Silver, F.R.G.S. Secretaries: George James Symons, F.R.S., John William Tripe, M.D. Foreign Secretary, Robert Henry Scott, F.R.S. Council: Edmund Douglas Archibald, M.A., Arthur Brewin, F.R.A.S., John Sanford Dyason, F.R.G.S., Edward Ernest Dymond, Henry Storks Eaton, M.A., Charles Harding, Robert John Lecky, F.R.A.S., William Marcet, F.R.S., Edward Mawley, F.R.H.S., Richard Strachan, George Mathews Whipple, F.R.A.S., Charles Theodore Williams, M.D.

PARIS

Academy of Sciences, January 16.—M. Jamin in the chair.—The following papers were read :—On the velocity of propagation of explosive phenomena in gases, by MM. Berthelot and Vieille. These experiments were fuller and more exact than the former. An explosive mixture of H and O in a straight horizontal lead tube about 40 m. long and 0·005 m. internal diameter, was fired at one end with an electric spark, and the travelling flame broke two electric circuits in passing (by acting on fulminate of mercury). Again, the tube was divided into a series of connected parallel pieces. For both cases the high general average of 2841 m. per second was obtained. The same with a caoutchouc tube (excluding the idea of a vibratory motion of metal inducing rupture of the circuits). With narrower capillary glass tubes the mean was 2341 m. The velocity was not affected by one or other orifice, or both, or neither, being open. The propagation was uniform in the tubes. The velocity was independent of pressure. CO and O gave a velocity of 1089 m., and dilution of the other mixture with air reduced the velocity.—Chemical studies on the skeleton of plants; second part, vasculose, by MM. Frémy and Urbain. Vasculose most abounds in the parts that present resistance or hardness. To get it pure, the authors treat elder pith with weak hydrochloric acid, the ammoniacocupric reagent, &c. *Inter alia*, atmospheric oxygen seems, in time, to transform vasculose into resinous acids soluble in alkalies. In reaction of fused alkalies on wood, it is the vasculose only that forms the different ulmic acids; while cellulose produces acetic and oxalic acid. Methylic alcohol is specially generated by vasculose. The composition of vasculose is $C_{36}H_{20}O_{16}$. Many vegetable fibres (hemp, &c.) have a layer of vasculose, the thickness of which has influence in retting, bleaching, and dyeing.—On the mode of publication most favourable to the progress of scientific studies, by M. de Saint-Venant. He urges the printing of mathematical and other works on such paper as will allow of annotations, in ink, by the reader.—On two small epidemics of plague in Khorassan, by M. Tholozan. This region, thought refractory to plague, has been attacked in a way which is apparently not explained by contagion.—M. Hirn gave some account of a controversy between himself and M. Zeuner, relative to steam-engine cylinders.—M. Gaudry was elected Member in Mineralogy, in place of the late M. Sainte-Claire Deville.—On the spherical representation of surfaces, by M. Darboux.—New theorems on the indeterminate equation $ax^4 + by^4 = z^2$, by M. Pepin.—On an extension of the arithmetical notion of genus (continued), by M. Poincaré.—On waves produced in water at rest in a canal, by immersion of a solid cylinder plunged crosswise into the canal, by M. Boussinesq.—Influence of the form of polar surfaces on the explosive potential, by M. Baille. The results with concentric cylinders and spheres of different diameters (exterior to each other) are given. In the latter case, for a given explosive length, the potential is maximum when the spark passes between two spheres of the same diameter; and it departs from the maximum more, the greater the difference of curvature and the higher the potential.—On the essence of savory, by M. Haller.—On a diatomic alcohol derived from β-naphtol, by M. Rousseau.—Phosphoric acid in the arable land of the north of France, by M. Ladureau. A farmer at Honplin (Nord), for twenty years grew beet and wheat alternately on the same land, to which he applied, every two years, the *vinasses* (or liquid residue) of a distillery he had, and a very little dung. The beet kept good, but the wheat crop steadily went down. M. Ladureau showed that the ground had too little phosphoric acid. The evil was remedied by large use of soluble and insoluble phosphates of lime.—Discovery of some new genera of fossil mammalia in the deposits of phosphate of lime at Quercy, by M. Filhol. One belongs to the Moschidæ, and is to be placed near Gelocus. The other resembles Cainotherium. The deposits belong to the Upper Eocene.—Anatomical researches on *Spatangus purpureus*, by M. Kœhler.—On the discordance between the respiratory variations of the intracarotidian and the intrathoracic pressure; second note by M. Frédericq.—On the interpretation of the weight of the brain and its applications, by M. Manouvrier. The increase of mass of the body is a cause of increase of absolute, but of diminution of relative, cerebral brain-weight. He offers an explanation of this in mathematical form, based on the fact that the development of the intellectual faculties is not proportional to that of the body. The impossibility of ranking species and individuals hierarchically according to weight of brain did not arise from the imperfection of the term of comparison chosen between the brain and the mass of the body (as some suppose). The author finds a more suitable term in the *skeleton*. The portion of the brain whose development is in ratio of the intellectual faculties serves for classifying hierarchically; man is then above all animals; and different races, &c., take their right places.—Contributions to the geological knowledge of Japan, by M. Metchnikoff show that Japan is not so exclusively volcanic as has been supposed.

VIENNA

Imperial Academy of Sciences, January 5.—V. Burg in the chair.—The following papers were read :—Albert von Ettingshausen, determination of the index of diamagnetism of metallic tungsten in absolute measure.—Dir. Hann, on the temperature of the southern hemisphere.

January 12.—V. Burg in the chair.—The following papers were read :—E. Mach, on the fundamental notions of electrostatics.—G. Gruss, determination of the trajectory of the Comet V. 1877 (it is found to be a parabola).—T. Haubner, on the stationary streaming of electricity through flat-shaped conductors.—A. v. Obermayer, on the diffusion of gases.

Imperial Institute of Geology, January 10.—The anniversary meeting was held.—Franz v. Hauer gave the president's address. Then the following papers were read :—Fr. Kraus, on finds of remains of *Ursus spelæus* in the Dachstein Mountains.—Edm. v. Mojsisowic, on the Russian Triassic formations.—V. Uhlig exhibited geological maps of the North-Eastern Transylvania.

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