THURSDAY, NOVEMBER 15, 1877

BREHM'S THIERLEBEN

Die Säugethiere, von Dr. A. E. Brehm, 2 vols.; and *Die Insekten*, von Dr. E. Taschenberg, 1 vol. (Leipzig: Verlag des bibliographischen Instituts, 1877.)

THE three fine volumes of Natural History with the above titles form part of Brehm's well-known "Thierleben," a book which has had a well-merited success in Germany and on the Continent generally. The volumes on the mammalia, of which those under consideration are new and enlarged editions, and which contain the Quadrumana, Chiroptera, Carnivora, Insectivora, Rodentia, Edentata, Marsupialia, and Monotremes, had been well appreciated in this country on account of its excellent illustrations, trustworthy anecdotes, and general literary merits. The new edition issued in 1876 surpasses the old, for not only are the additional and new drawings of first class art and most truthful, but much of the context is more decidedly scientific than before. Brehm, with his practical knowledge of animals, especially of some important groups, and his literary powers and judicious choice of illustrative anecdote, was just the man to undertake a popular natural history; and the success of the very bulky attempt not only is greatly to his credit, but is a testimony of the love of good reading amongst the mass of his countrymen. A familiarly written introduction on the structure and physiology of the Mammalia occcupies the first chapter, and then the Primates are considered. There are two plates of sitting, standing, jumping, climbing, and swinging Anthropomorpha which are exquisite, and evidently carefully taken from the life. The rare Troglodytes Tschiego, the *Nsehiego mbouvé* anatomised by Duvernay, is delineated in four attitudes, and the reach of the fingers below the knee is well shown; below it are three capital chimpanzees, but none of them equalling Wolf's admirable swinging chimpanzee in the possession of the Zoological Society of London. The orangs with their globular heads, projecting lips, and hirsute arms, are drawn with great force, and three gibbons, spidery and dangling, complete the show. A plate of hands and feet illustrates this part of the book, and the transition from the highest hand, probably that of *T. tschiego*, for it is more symmetrical than that of gorilla, to the lowest paw amongst the American marmosets is admirably shown. The dwindling of the thumb, the gradual equalisation in length of the three middle fingers, and the march first on the knuckles, and then, in the lower groups, on the palms are carefully demonstrated. Osteological anatomy is not much cared for, and therefore the skeleton of gorilla is not worthy of the book; but in the chapter on this great ape there are some very remarkable plates which enable us to approach the truth.

The chimpanzee comes next—and oh! there is such a sly-faced fellow in a woodcut, utterly beyond the capacity of any British cutter on wood—illustrating the genial species, after which, instead of before, as one would think ought to have been done, comes Du Chaillu's bald Troglodyte, the *T. tschiego*. With regard to this little-known beast, Brehm gives some more information about its size and general zoology, but he does not enlarge on the *Troglodytes aubryi* of Gratiolet and Alix. A group of Entellus monkeys, with their forehead tufts rather exaggerated, illustrates in part the few pages on the Semnopitheci, and the Macaci are finely delineated, a life-like savagery being given to the Rhesus and pig-tailed kinds. Brehm's anecdotes about the baboons are first-rate, and although the drawings of Hamadryas and the mandrill are slightly in exaggeration of what is common, they give a capital idea of the impudence of the one and the brutality of the other.

Brehm has collected all the good anecdotes and descriptions from Humboldt, Schomburgk, Rennger, and Henfel about the Howlers, and in spite of the silence of those in captivity in Europe we can imagine the terrific noise of a tree full of the adults of *Mycetes caraya*. Bartlett is fully and deservedly quoted in illustration of the natural history of the spider monkeys, and the delineations of the group are fairly done, ease of position being often wanting in the illustrations, however. The short-tailed Brachyures are for once described and drawn not in caricature; the context is mainly from Bates, and the sketch looks like a monkey and not like the distressed old man with a tail like an American vegetable marrow which is usually given in books. The Saimaris are introduced under the generic title Pithesciurus to which, and indeed to much of Brehm's zoological nomenclature, we demur. The marmosets are grouped, as by Huxley, as Arctopitheci, a name given to some sloths by Gray, and there is much confusion in introducing new generic terms to the genera Hapale and Midas. The use of the term Leopithecus for Hapale, of Hapale for Midas, for instance, shows the necessity for a final zoological arrangement of these small monkeys. No less than 239 pages are devoted to the apes and monkeys, and then the Lemuroida are commenced under the old-fashioned terms Hemipitheci or Prosimii. Sonnerat, Pollen, and Peters are Brehm's authorities for the natural history of this group, and he does not appear to have had the advantage of studying Mivart, Murie, Grandidier, and Owen; nevertheless the article is of good scientific value and of course the illustrations are superexcellent. There is, however, the old jumble of synonyms for the genus Indris, and Lichanotus and Propithecus are put in most unadvisedly. The queer Stenops, oddly named *gracilis*, Galago with his ears on the move and a bogie of *Tarsius spectrum*—if it were as big as a man how truly hobgoblin-like it would be—are excellent pictures. There is nothing new, however, about the group, and really more good information on anatomical and physiological subjects might have been given without detracting from the popular nature of the book. The Chiroptera are arranged in rather an old-fashioned manner, and are rather curtly treated; and then the second part of the volume opens with the Carnivora, to the exclusion of the Insectivora. The lion of course comes first, and although there is nothing to notice particularly in the context, every one must admire *Leo capensis* and the lioness of *Leo senegalensis*, although the specific determinations should sink into those of varieties. The sequence of species then becomes rather strange to English natural history, the puma and *Felis eyra* preceding "*Tigris regalis*" or *Felis tigris*. The clouded

tiger comes next as "Neofelis," and the illustration is hardly that of the short-legged meek-looking creature in the Zoological Gardens. The jaguar, as drawn in the next page is too long in the neck, but the rounded top to the head is well given; the anecdotes and general history of this fine South American beast are beyond ordinary praise.

Brehm has paid unusual attention to the smaller cats, and the pages devoted to them are amongst the most interesting in the book, and when telling of the lynx, he gives a wood engraving by Beckmann of the common form which is wonderful in its details of face-expression and fur (p. 490). The Cheetahs, so interestingly numerous just now in our Zoological Gardens, are fully considered, and in the illustration there is the upward whisk of the tail given to perfection, but the muzzle of the beast is too long, and the fore legs hardly long and stilty enough. Cryptoprocta concludes the Felidæ, and *Canis primævus* of Cashmir commences a most interesting article on the dogs. Amongst other beauties there is "Der Bulldogg oder Boxer," and Mr. Bill Sykes would have been surprised to have learnt that it is called *Canis familiaris molossus gladiator*. It is "ein wüthendes, unzugängliches und stumpfsinniges Thier." Then there is its relation, *Mops*, with its sharply curled-up tail and black short nose, the tiny tongue tip not, however, being shown in the engraving, which tells the ladies of the period that Pug's real name is *Canis familiaris molossus fricator*. Amongst other dogs a sketch of a pointer by Beckmann is capital; he is pointing, and just a little in doubt, the tail dropping slightly and the head being not over-expectant. The first volume concludes with the natural history of *Otocyon* and *Canis procyonides*.

The second volume commences with a notice of the hyænas, and although there is not much to be said in praise of this contribution to their literature, still the delineations of *H. crocuta* and *H. brunnea* place the distinctions between the species plainly. *H. crocuta* is admirably drawn and the artist has managed to give it the peculiar weak look of the hind legs and drooping quarters of the caged animal. The Viverridæ are shortly treated, and one of the few doubtful drawings of the work is in illustration of *Cynogale bennettii*. The genus *Herpestes*, the habits of some of whose species have taxed the imagination of Europeans as well as that of Eastern races, follows; it is judiciously described and the anecdotes are good. The fur-yielding martens and their allies and other small carnivora valuable to the furrier are well illustrated, but Brehm had not the valuable volume on their natural history, lately issued by the American Survey, to learn from. The bears form a very interesting part of the book, but many of the illustrations have the positions of the animals rendered awkward by the attempt to give prominence to specific and peculiar structural points. Thus the polar bear in the water is wretchedly done, thanks to the endeavour to render the claws and narrowish snout very definitely comprehensible. The moles and hedgehogs are fairly noticed, but want of space begins to affect the treatment of these lower groups, but Galeopithecus, very shortly described, is properly placed at the head of the Insectivora. The Rodentia are of course full of anecdote and light literature, but Brehm's illustrations are by no means as good as those of the other groups; perhaps the most striking is that of *Cercolabes prehensilis*. A capital plate of the sloth shows the short snout which almost looks moist, and for once in a way amongst books of this kind, there is a truthful rendering of the long narrow wrist with its two claws. The essay on the sloths and ant-eaters is admirable, but the anxiety to show the peculiar progression of the last group, on the anterior extremities and the position of the claws, has often led the artist to exaggerate. The Marsupials are well illustrated and with great ability, but we miss some of Gould's most life-like sketches so familiar in most popular works. The pages devoted to the Monotremes contain the usual stories, and unfortunately were written before those important additions to their natural history were published, and which have lately been noticed in NATURE.

The other volume (the ninth of the work) before us is by Taschenberg, of Halle, and is a second edition of the part containing the Insecta, Myriopoda, and Arachnida. The species representing groups are of course well chosen as types, and the author has often taken pains to place novelties before the reader, especially in the way of illustration. The short anatomical introduction is sufficient for the general reader, but barely so for the young student. Amongst unusual forms, or rather unusual to the common routine of book making, is *Mormolyce phyllodes*, from the upper hill country of Java, with its wide leaf-looking elytra and long antennæ, and the very common and opposite-looking *Scarites pyracmon*. The burying propensities of Necrophorus are told and illustrated, and there is a very curious and striking plate of a mole hanging by the neck in a trap, with a crowd of Silphidæ (shield beetles) and larvæ, besides blow-flies, on and about it, doing their best to turn its protoplasm into theirs. Some pests to museum-keepers and housekeepers are especially figured in the act of working away at a hare's foot which rests on pen, ink, and paper *Anthrenus musærum* larva and adult, *Attagenus pellio* and *Dermestes lardarius* are there in full enjoyment of their mischievous propensities. The natural history of Lampyris, Meloe, and Sitaris, is cut too short, doubtless for want of space, but their interesting life cycles merit more attention than that of many others which are barely more than mentioned by name and might be left out. *Apoderus longicollis*, a Javanese species looking like a cameleopard amongst beetles, and unfortunately little known, has an interesting engraving; and equally good is that of the langkäfer Brenthus. Amongst the Hymenoptera the habits and nests of *Bombus terrestris*, of *Odynerus parietum*, and of the curious Belonogaster and the Sandwasp are very well explained and drawn; and great praise must be given to the delineations of the life cycle of Othalia and Cimbex.

The only fault to be found in the treatment of the Lepidoptera is that the article is too short, but the illustrations are very good. A plate of a rush of a myriad of the maggots of *Sciara militaris* is a strange subject, but very effective, and the long crowd of closely-packed dark-headed long things looks as if short work was to be made of carrion. Amongst the leaf insects there is *Mantis religiosa* preying rather than praying with a fly in its clasp, and a host of larvæ escaping from a mass of eggs; and there is an equally interesting cut of *Bacillus Rossii*, one of the Phasmodea. A short chapter on the unsavoury subject of Pediculi precedes a sketch of the Cochineal

insects, and then, after noticing the Chermes that attacks that very strong food the larch, we come to a full description of *Phylloxera vastatrix*. The Hemiptera are shortly mentioned, and then the Myriopoda. There is a good picture of Geophilus clinging around its great prey, a large earthworm, and also of a Polydesmus. Amongst the Scorpions the long-armed Phrynus and Gonoleptes, and amongst the Spiders a long Tetragnatha and the extraordinary-bellied Gasteracantha, form admirable illustrations. A short chapter on Pycnogonum and Nymphon concludes this really wonderful volume. P. M. D.

OUR BOOK SHELF

Heat. By B. Loewy (Lardner's Handbook of Natural Philosophy. Crosby Lockwood and Co., 1877.)

THIS, though not a bulky book, is a sort of miniature Encyclopædia of the subject. So far as we have read it it seems to have all the faults of the original (?) work to which Lardner's name was prefixed, with the important exception of the inaccuracies. These have been to a great extent removed, and the work has been brought up to date, but there is still the woeful want of order, or indeed of any guiding principle whatever which distinguished the former editions. It is a very curious mixture of good and bad, and cannot be called, in any sense, attractive to the reader. Numerous tables of experimental data are given, but they are in many cases carried to a number of places of figures quite beyond the present power of experimental science. Two, or perhaps three of the figures in the earlier places of each number are probably correct; the others give a show of minute accuracy which may altogether deceive the beginner. The treatment of the theoretical part is very meagre, but in the experimental part many curious facts not usually known are given. The book may be useful as a work of reference to those who are not in possession of Balfour Stewart's treatise, but we cannot say more in its favour.

Ferns, British and Foreign. The History, Organography, Classification, and Enumeration of the Species of Garden Ferns, with a Treatise on their Cultivation. By John Smith, A.L.S., Ex-Curator of the Royal Gardens, Kew. New and Enlarged Edition. (London: Hardwicke and Bogue, 1877.)

THAT Mr. Smith's "Ferns, British and Foreign" should have reached a new edition in a comparatively short time is no small tribute to its value as a book of reference for amateurs and fern cultivators. The chief portion of this very neatly got up work is occupied by an enumeration of cultivated ferns. The different genera, as understood by the author, who was one of the foremost pteridologists of his day, are described and figured, while a list of the cultivated forms, with synonyms and range of geographical distribution, follow under each genus, no attempt being made to give a diagnosis of the species. The scope of the work is therefore entirely different from that of the "Synopsis Filicum" of Hooker and Baker. The classification adopted is that propounded by Mr. Smith in his early publication on ferns, an arrangement not much used by modern writers. An appendix of recently-introduced ferns is given. These have been collected and arranged under their respective genera and tribes, as their names have from time to time been noticed in the horticultural journals and in nurserymen's catalogues. The list has thus no pretensions to be a critical one. The most interesting part of the book is the history of the introduction of exotic ferns, a subject about which, probably, no man living knows more than Mr. Smith. This is followed by an explanation of terms used in describing ferns, perhaps the least satisfactory part of the whole volume, as many of the terms are more or less obsolete, or only used in the book now before us. In this section nothing is said about the recent researches into the nature of the prothallus, construction of the reproductive organs, and morphological nature of the sporangia. The last part of the work is occupied by an essay on the cultivation of ferns, reprinted without alteration from the first edition, but giving the results of long experience of the successful cultivation of all groups of ferns. As a work of reference and guide to the cultivation, this book will most undoubtedly be of great service to the fern-growing public.

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 Radiometer and its Lessons

I HAVE little doubt that Prof. Osborne Reynolds is much more competent than I am to say what is or is not consistent with the kinetic theory of gases, but I hardly think that he gives evidence of this in his letter to last week's NATURE (p. 27). Unless my ignorance of the matter is more complete than I am aware of, the law that the rate of communication of heat to a gas is independent of the density, applies only when the space occupied by the gas is so great, or the variations of density so small, that these variations do not alter the temperatures of those portions of the gas which are at each instant respectively receiving and giving out heat. This condition cannot, I imagine, be fulfilled in the radiometer, where it seems to me inevitable that an action of the kind to which Mr. Johnstone Stoney called attention must take place. G. CAREY FOSTER

P.S.—Since writing my previous letter to NATURE, a fortnight ago, I have read a paper by Mr. R. Finkener, in *Poggendorff's Annalen* (vol. clviii. pp. 572–595). This paper contains, besides a theoretical investigation of the motion of the radiometer founded on the kinetic theory of gases, an experimental proof that the action becomes much less when an extremely high degree of rarefaction is reached. The paper itself is not dated, but, as the Part of the *Annalen* which contains it was "closed" on July 31, 1876, the experiments described in it cannot have been much, if at all, subsequent to those (communicated to the Royal Society, June 13, 1876) which led Mr. Crookes to a like result. G. C. F.

UNTIL I read Dr. Carpenter's letter in your issue of the 8th inst., it had never occurred to me that his "special purpose" was to bring out strongly my "thoroughly scientific and philosophical method!" This is an act of disinterested kindness which recalls to me the exquisite truth of Dean Swift's remark, "No enemy can match a friend.'

Dr. Carpenter's only reply to my letter which appeared in your issue of the 1st inst. is contained in the following passage:—"If I had not found," he says, "after the publication of my Lectures, that he had himself been 'digging up the hatchet,' which I was quite disposed to keep buried, by giving his public attestation to the 'spiritualistic' genuineness of what had been proved to be a most barefaced imposture, I should not have again brought his name into the controversy."

Further on Dr. Carpenter paraphrases passages from his article in *Fraser's Magazine* for this month, in which he goes more into detail touching this "public attestation," of which in his eyes I stand accused.

"Eva Fay," he says, "returned to the United States, carrying with her a letter from Mr. Crookes, which set forth that since doubts had been thrown on the Spiritualistic nature of her 'manifestations,' and since he in common with other Fellows of the Royal Society had satisfied himself of their genuineness by 'scientific tests,' he willingly gave her the benefit of his attestation. This letter was published in *facsimile* in American newspapers."

My answer to this calumny shall be brief.

It is untrue that I dug up the hatchet—Dr. Carpenter's

expression—in the interval between November 30, 1875, when he proposed it should be buried, and the time of his first subsequent attack upon me.

It is untrue that during this interval, or at any other time, I gave my "public attestation to the spiritualistic genuineness of what had been proved to be a most barefaced imposture."

It is untrue that I gave Eva Fay a letter, speaking of the "Spiritualistic nature of her manifestations," and referring to "Fellows of the Royal Society."

It is untrue that Eva Fay "returned to the United States carrying with her" such a letter.

It is untrue that "this letter was published in *facsimile* in American newspapers."

When Dr. Carpenter limits himself to definite statements, my task is not difficult. It is, however, less easy to answer a *rumour* of *something* which *somebody* told Dr. Carpenter I *privately* admitted.

"It has been rumoured," says Dr. Carpenter, in *Fraser's Magazine*, "that Mr. Crookes has *privately* admitted that some of his 'mediums,' when they could not evoke the 'manifestations' by *fair* means, have done so by *foul*."

I admit that such a rumour respecting Eva Fay was circulated in the United States, and a Boston gentleman wrote and asked me if there was any truth in this statement. I replied as follows under date November 8, 1875:—

"In reply to your favour of October 25, which I have received this morning, I beg to state that *no one* has any authority from me to state that I have any doubts of Mrs. Fay's mediumship. The published accounts of the test *séances* which took place at my house are the best evidence which I can give of my belief in Mrs. Fay's powers. I should be sorry to find that any such rumours as you mention should injure Mrs. Fay, whom I always found most ready to submit to any conditions I thought fit to propose."

Considering that this was a private letter from one gentleman to another, written *currente calamo* without any thought of subsequent publication, few of your readers, I believe, will see much harm in it. Not being aware that private communications were less sacred in America than in England, I was certainly surprised one morning to receive a copy of an American newspaper containing a *facsimile* of this private letter.

It will be observed that this letter is dated November 8, 1875, whereas the "bury-the-hatchet" episode took place on November 30, 1875; this therefore cannot be the letter which convicts me of attesting to a "barefaced imposture" subsequent to November 30.

Moreover, this letter does not contain the words "Spiritualistic nature of her manifestations." Neither does it allude to "Fellows of the Royal Society." Nor did Eva Fay return to "the United States, carrying with her this letter." Nor was it even addressed to Eva Fay. It is then impossible that this can be the letter to which Dr. Carpenter refers, and I demand that he prove the truth of his allegation by producing a copy of the "American newspapers" containing a *facsimile* of a letter written by me answering his description, containing the words which he professes to quote from it, and justifying his defamatory remarks.

In your issue of last week (p. 26) Dr. Carpenter says nothing about this *facsimile* letter, but lays stress on an article written by me ten months previously. Does he seriously mean that the publication in March, 1875, of an account of some test experiments is a breach on my part of his "bury-the-hatchet" offer made the following November?

I have evidently been labouring under a misapprehension as to what Dr. Carpenter meant when he proposed to "bury the hatchet." I supposed he intended to cease misrepresenting my views and falsifying my experiments at his public lectures, and never afterwards to repeat such calumnies on my scientific position as he had anonymously contributed to the *Quarterly Review* for October, 1871. It seems, however, that Dr. Carpenter really meant that I was no longer to go poaching on his own special preserve, and was to abstain for the rest of my life from writing even a private letter on a subject which he has investigated for more than thirty years, and about which he is now writing and lecturing with redoubled vigour.

Dr. Carpenter refers to an offer made in May, 1875, "by Eva Fay's manager, that for an adequate sum of money the 'medium' should expose the whole affair," and he vouches for its truth by saying he has seen "copies of the letters." I can supply, not *copies*, but *original* letters. I have before me letters from Eva Fay, dated Birmingham, May, 1875, speaking bitterly of the temptations and persecution to which she was being subjected to induce her to join in the scheme, to which she was no party.

But how, may I ask, does an abortive conspiracy to complicate "*six big guns*" prove that my "scientific tests"—which with all deference to Dr. Carpenter's "good authority" can *not* be evaded by a "dodge"—were useless, and that in spite of them Eva Fay cheated me?

I am weary of protesting against the imputation which Dr. Carpenter conveys in the words "scientific advocates of the system." I emphatically deny that I have ever advocated any "system" in connection with the phenomena ascribed to spiritualism. I have never for one moment doubted that this name has covered an enormous mass of fraud and trickery; but being convinced that amidst all this falsehood—which it is Dr. Carpenter's mission to denounce in the most fervid eloquence at command—there was a solid nucleus of fact, and believing that every unrecognised fact is a reproach to science, and every uninvestigated phenomenon is a probable mine of discovery, I considered myself not merely entitled, but almost bound in scientific honour, to attempt the solution of the question. My attempt to bring the so-called supernatural within the realm of fact, to turn the light of science on a problem that required investigation, has exposed me to many misrepresentations, but especially to the ire of Dr. Carpenter, who never tires of repeating every idle tale from hearsay evidence. I look back to the days of the alchemists, and find the very same kind of fraud, mysticism, and trickery, differing but little from the impostures of the present day. But then, as now, there were a few earnest students who detected the germs of truth amidst the ravings and juggleries of the gold makers; they cherished these germs, and although the Dr. Carpenter of that period would doubtless have denounced those students as "scientific advocates of the system" of alchemy, and felt it his duty to "undermine" their reputations, they persevered through calumny and ridicule, and thereby laid the foundations of our modern science of chemistry.

The readers of NATURE have now before them ample illustration of the falsity of the accusations with which I have been persecuted for so many years. A calumny once born, said the Great Napoleon, can never be killed. I have, however, done my utmost to prove the groundlessness of the very serious charges Dr. Carpenter has brought against me, down to the grave indictments in your issue of last week (p. 26). There is not a single charge which Dr. Carpenter has ever brought against me that I am unable to answer with like completeness; and, judging from long experience, I venture to say that any future charges he may bring will be equally unfounded. But I cannot, out of regard for your readers, to say nothing of the sacrifice of time, continue to defend myself from every petty accusation; and unless really forced by some imputation too serious to pass over, this must be my last letter on a subject which to me involves painfully too much self-reference. I have been constrained, in self-defence, to speak in somewhat downright fashion, but Dr. Carpenter's industrious misconstruction has drawn this protest from me. Misstatements expressed in a few lines may require pages to refute them. A calumny which takes a minute to write may demand days to answer. Memories of half-forgotten occurrences have to be revived, conversations recalled, old letters hunted out, journals exhumed, and, in fact, as much time and trouble expended as if getting up evidence for an important legal trial. So great a tax for so trivial a purpose is monstrous in its disproportion, and I can waste on this fruitless discussion no more precious time—time stolen from my physical work in the laboratory, already too much curtailed by the pressure of outward business.

November 10 WILLIAM CROOKES

THE latter half of Dr. Carpenter's letter in last week's NATURE (p. 26) consists of almost verbatim extracts from his article in this month's *Fraser*. I beg to refer your readers to a reply to Dr. Carpenter's attack, and a full exposure of his false accusations against Mr. Crookes and myself, which will appear in the next issue of that magazine. They will then see *who* has been led by "prepossession" to adopt "methods which are thoroughly *un*-scientific," and *whose* are "the statements which ought to be rejected as completely untrustworthy."

ALFRED R. WALLACE

Experiment on Fluid Films

I AM experimenting on the optical phenomena exhibited by thin fluid films in a state of vibration, and have just obtained

some beautiful results, including the formation of fixed straight and curved coloured bands, arranged in symmetrical figures, and of pairs of colour-vortices rotating in opposite directions.

Unless these results prove to have been already described, I shall shortly publish an account of my experiments.

SEDLEY TAYLOR

Trinity College, Cambridge, November 12

Expected High Tides

IN your "Notes" last week you say that you cannot understand why the burden of such predictions should fall solely upon Capt. Saxby. This is what many of the public also do not understand. Why does not, say, the Meteorological Office take the matter in hand, and not leave it to some private individual? There can be no doubt the forewarnings are often of the greatest service and have saved the public tens of thousands of pounds and prevented a great deal of misery. What I think Capt. Saxby is to be blamed for is the desire—it may be only apparent—to make a mystery of his predictions with the general public; and what gives weight to this is the fact that the Astronomer-Royal and the heads of the Meteorological Office and Society do not offer the public any aid in what is a purely scientific and eminently practical subject, in which Londoners are more interested than in the transit of Venus, and quite as much as in the storm-warnings for the Channel.

When in March, 1874, Capt. Saxby came forward and in an oracular way predicted a great tide on the 20th, he gave no reasons. This many felt was unsatisfactory. Knowing that it must result from the action of natural laws curiosity led me to investigate the matter, and I found that the subject of extraordinary tides was a matter of much simplicity; that the chief factors reside in the moon with its varying distances and declinations; the next in the sun and the seasons; the next in the winds and atmosphere; and the next, perhaps, in the action of the planets, as Venus and Jupiter, the former of which we know affects the orbit of the earth, and both have probably some power in producing the atmospheric disturbances in the sun.

With these factors I predicted a year in advance the extraordinary tide of November, 1875, which had escaped Capt. Saxby's notice. I was also able to say that there are two unusually high tides revolving through the year, exactly six-and-a-half synodic months apart, each forty-eight days after the same tide of the previous year; that these with the preceding and succeeding tides are chiefly those which may with bad weather develop into extraordinary ones; and that the next great one—a very giant among tides—will be on March 20, 1878.

If Capt. Saxby has some knowledge on the subject which others have not, how is it he did not predict the unusually high tide of October 26 last, which happened when the moon was neither full nor new, nor in perigee? Why it happened is somewhat of a mystery; the only explanation I can suggest is, that the moon had her highest northern declination on that day, and that a barometric depression passed over the North Sea the previous day, both which would tend to heighten the tide.

November 12 B. G. JENKINS

The Towering of Wounded Birds

LAST season I fired at a song thrush at a distance of fifty yards, but the bird continued its course, as if uninjured, for upwards of 200 yards, when it suddenly "towered" in the air, and as suddenly fell to the ground. Upon examination the bird was found to have been shot through the lungs alone, and had bled internally, the throat being full of clotted blood. The head was totally free from any injury. I have known similar instances occur in the pigeon, swallow, and starling. In all these cases the head remained uninjured, and death occurred through internal hæmorrhage. In the case of the starling one pellet entered the spine; the bird continued its course for a few yards, towered, and suddenly fell to the ground dead.

Should you consider these instances bearing on the matter of sufficient importance for an insertion in NATURE they may prove acceptable to those who are interested in the subject.

Heeley, near Sheffield CHARLES DIXON

Cruelty to Animals' Act and Physiological Teaching

I AM desirous of knowing through your many readers if, amongst physiologists, the belief is anything like general, that showing under the microscope the circulation of the blood in a web of a frog's foot is a contravention of "The Cruelty to Animals' Act, 1876."

Dr. M. Foster, in his "Primer of Physiology" (Macmillan and Co., 1877), advises the reader to "go and look at it at once; you will never know any physiology till you do;" and some naturalists here say if no incision is made, the animal being merely tied down, the exhibition of the phenomenon is quite legitimate, while, on the other hand, Prof. Huxley, in his paper before the Domestic Economy Congress (reported in NATURE, vol. xvi. p. 234) states it as his opinion that a teacher is "open to the penalty of fine and imprisonment if he *uses*" a frog "for the purpose of exhibiting one of the most beautiful and instructive of physiological spectacles."

It was this, the expressed opinion of so distinguished an authority as Prof. Huxley, which caused me first to doubt the teacher's right to exhibit the experiment, and it is because of the differences of opinion I have mentioned that I seek to know through your columns, if a teacher is or is not at liberty to illustrate the blood circulation by this harmless experiment.

FRANK W. YOUNG

High School, Dundee, November 12

Smell and Hearing in Moths

NUMBERS of moths, of many different species, are attracted into my room on summer evenings by the light; and they are fond of resting on the lamp shade. One night I was using some very strong ammonia solution—and by way of driving them off I held a 3-ounce bottle of it with the open mouth almost close to them. To my surprise they seemed quite unconscious of it *as a smell;* they would bear it unmoved for a minute, or sometimes for two or three minutes, and they then merely walked an inch or two further away from it. I have since tried the experiment repeatedly, and with several different species; but none of them seem to detect the presence of ammonia except as a man might detect the presence of carbonic acid or of nitrogen in excess, that is, by their effects on his system generally.

The common black and white "magpie moth," it is well known, often feigns death when captured. I caught two, one after the other; both pretended to be dead, and I laid them gently on the table a few inches apart. They had remained motionless for ten minutes, when I took up a wine glass by the stem, and gave it one sharp stroke with a pencil, about six inches away from them. Both moths flew off at the instant the sound was heard. I repeated this many times with the same result—both with these and with other individuals of the same species; and I also found that merely holding the glass near them and waving the pencil about noiselessly, did not arouse them.

Loughton J. C.

Bees Killed by Tritoma

IN a friend's garden here where there are quantities of Tritomas or "red-hot-pokers," hundreds of bees have been this year destroyed by them. The honey produced by the flower is very abundant, and the bees enter the tube of the corolla to get at it; but the tube, which is only just large enough at the mouth, tapers gradually, and so the bee gets wedged in and cannot extricate itself. I saw numbers so caught, some in the fresh flower, while others remained in the completely withered and decaying blossoms. Perhaps it may be due to the fine warm days we have had this autumn, inducing the bees to work too late after our native honey-producing flowers have been destroyed by the wet and frosts; or is it a regular thing which happens every year? If so bee-keepers should discourage the Tritoma, or set to work to select varieties with flowers large enough not to kill their bees.

ALFRED R. WALLACE

Dorking, November 3

Lecture Experiment

THE experiment described below illustrates in a very striking manner the particular instance of the "conservation of energy" exhibited by the equilibrium of liquids of unequal densities, in communicating vessels.

The apparatus consists of a two-necked bottle, having in one neck a very strong glass tube half a metre, or more, in length, and terminating above in a funnel of 200 c.c. capacity, while its lower end nearly reaches the bottom of the bottle; in the other neck is a piece of glass tube, drawn to a jet, and passing only a short distance into the bottle. As the pressure inside the appa-

ratus is considerable, the corks by which these tubes are fixed must fit very tightly.

In using the arrangement the bottle is filled with water, the jet is then closed with the finger, and the funnel, which should be supported on the ring of a retort stand, is filled with mercury; on removing the finger from the jet the mercury falls into the bottle, expelling the water which rises in a fountain to a height depending upon that of the column of mercury, but rather less than is theoretically possible, the height of the fountain being ten or eleven times that of the fall of mercury. By employing mercury as the falling liquid in Hero's fountain a similar increase of effect may be obtained with that apparatus.

W. A. SHENSTONE

Fownes' "Manual of Chemistry"

IN my review of Fownes' "Manual of Chemistry" are two mistakes which I beg to correct. On page 25, line 1, read *improbable* instead of improvable; and line 6, *dimorphides* instead of isomorphides. THE REVIEWER

OUR ASTRONOMICAL COLUMN

THE TRANSIT OF MERCURY, MAY 6, 1878.—The transit of Mercury, which will occur on May 6 in the ensuing year, is the last during the present century in which the planet can be observed upon the sun's disc for any length of time in this country, and on that occasion the nearest approach of centres will take place only half an hour before sunset; owing, however, to the long duration of the transit, 7h. 35m. geocentric, Mercury will have been upon the disc more than four hours and a quarter when the sun sets. Reducing to Greenwich by the *Nautical Almanac* data it appears the first external contact will occur at 3h. 10m. 58s. mean time, and the first internal contact at 3h. 14m. 4s., or the planet will be 3m. 6s. in wholly entering upon the disc. The least distance of centres will occur at 7h. 0m., and sun-set at 7h. 29m. The duration of the transit is longer than in any other of this century, or indeed than in any one that has occurred since the year 1756.

Up to the present year twenty-four transits of Mercury have been more or less observed; in this number are included that of 1631, November 7, predicted by Kepler, when the planet was seen upon the sun's disc for the first time by Gassendi, at Paris, who observed on the dark-chamber method—by allowing the sun's light to pass into the room through a small aperture in the window, and throwing his image upon a white screen; that of 1651, November 3, imperfectly seen by Shakerley at Surat, and that of 1707, May 6, which was observed through clouds by Roemer at Copenhagen near the egress. Of these *twenty-four* transits it is singular that only *eight* have taken place at the descending node or in May, as will be the case next year. Two-thirds of the number have therefore occurred in November, when we might have expected the hindrances to observation to have operated unfavourably in these latitudes.

Of the three transits of the present century subsequent to 1878, that of 1881, November 7, will be wholly invisible in this country, the ingress taking place at 10h. 16m. and the egress at 15h. 37m.; in the transit of 1891, May 10, the egress occurs soon after sun-rise; and in that of 1894, November 10, it occurs near sun-set. The reader who is curious respecting the transits of Mercury in the next century may consult a communication from the Rev. S. J. Johnson to the Royal Astronomical Society in the *Monthly Notices*, vol. xxxvii. p. 425; and for an account of Gassendi's long watch for the transit of 1631, and his successful observation of it, he may be referred to Prof. Grant's classical work, the "History of Physical Astronomy."

NOVA CYGNI, 1876.—Prof. Julius Schmidt mentions that the star which he first remarked on November 24, 1876 (and which is not found in the *Durchmusterung*) diminished very regularly from January to August of the present year; it exhibited none of the slight oscillations in brightness which are still seen in T Coronæ, and we may add in other "Novæ." With the Athens refractor he has observed three small stars near the variable, with the following differences of right ascension and declination:—

				s.			"
13m	...	γ = Nova	−	1·0	...	Nova	− 45
13	...	z = ,,	−	1·6	...	,,	− 81
12·5	...	x = ,,	+	4·6	...	,,	+ 20

It will be remembered that this star suddenly shone out of 3·4 magnitude, and had diminished to the limit of naked-eye vision soon after the middle of December. Its mean place for 1880·0 is in R.A. 21h. 36m. 59·9s., N.P.D. 47° 42′ 16″.

COMET 1873, IV.—M. Raoul Gautier has worked out definitive elements of the comet discovered by M. Borrelly on August 20, 1873, and finds the observations best represented by an ellipse with a period of 3,277½ years, the probable errors of perihelion distance and eccentricity limiting the period between 3,012 and 3,585 years. This comet, however, was observed for one month only, or through an orbital arc of only 58°, and such results of calculation in the present case are not perhaps to be allowed any great weight. There are many other comets which we imagine would better have repaid the labour expended by M. Gautier upon Comet 1873, IV. Expressing his best *parabolic* elements in the manner adopted in catalogues of comet-orbits, we have the following figures:—

Perihelion Passage, 1873, September 10·83679 M.T. at Berlin.

		°	′	″	
Longitude of perihelion		36	48	40	M.Eq. 1873·0
,, ascending node ...		230	38	4	
,, inclination		84	0	50	
Log. perihelion distance		9·899956			

Motion—retrograde.

MINOR PLANETS.—A remark in this column some time since upon the probability of several discoveries of so-called new planets proving to be observations of bodies previously detected, appears to be justified by recent experience. Thus the object announced as a new planet by Prof. Watson and M. Borrelly in August last was shown by Herr Knorre, of Berlin, to be identical with No. 141, detected by M. Paul Henry at Paris, on January 13, 1875, and it is now stated that the small planet remarked by Herr Palisa at Pola on October 2 is really No. 161, which was discovered by Prof. Watson on April 18, 1876, and received the name *Athor*. As was to be expected from the rapidity with which discoveries of small planets have succeeded one another of late years, calculation is now considerably behind observation, and we are still without published elements of a number of the bodies lately brought to light.—Prof. Peters states that he has proposed the name *Idunna* for the planet discovered by him on October 14, which is No. 175, a name which he says will be understood by those members of the "Astronomische Gesellschaft" who, at their late meeting at Stockholm, participated in the hospitality of "Ydun."—There is now a strange confusion of mythologies and systems of nomenclature in the minor-planet group, a state of things that at one time might have been readily avoided.

THE ROYAL DUBLIN SOCIETY

A SCHEME for the reorganisation of this society as a branch of the National Museum of Science and Art established by the Government has been under consideration for some time, and a report of the council on the subject was submitted to the society at its meeting on November 8. The scheme includes a recommenda-

tion in favour of the amalgamation of the agricultural department of the society and the Royal Agricultural Society, under the title of the Royal Irish Agricultural Society; after some discussion the report was carried. The following are the principal points involved in the reorganisation:—

In accordance with the agreement entered into with the Government, the principal conditions of which are embodied in the "Act for the Establishment in Dublin of a Science and Art Museum and the Development of the Library of the Royal Dublin Society into a National Library," the property of the society in land, buildings, and collections has passed into the possession of the Government. The society will, in accordance with such agreement, receive the sum of 10,000*l.*, which will be invested in such security as, subject to the approval of the Treasury, may be selected; it will continue to be provided with the requisite accommodation in Leinster House; the members will have free access to the several departments as heretofore, whilst the existing members, as well as all those who shall be admitted before January 1 next, will have the right to borrow books from the National Library. In order to assist in the more complete development of that part of the society's work which is devoted to the promotion of science and the useful arts, it has been arranged that all the scientific serials and transactions of learned societies, as well as all duplicates in the library, shall remain the property of the society; the Lecture Hall and Laboratory will be reserved for its use; and the collections in the Botanic Garden and Museum of Natural History will be available as formerly for the illustration of papers read before the society. The most important condition, however, for the successful prosecution of the society's scientific work, pure as well as applied, is that for five years the cost of printing the scientific papers read before the society will be defrayed by the Government. Concessions equally favourable have been obtained for the agricultural department. Thus in lieu of the premises around Leinster House, which will be required for museum buildings, &c., the Government has undertaken to provide accommodation for agricultural shows elsewhere, and to reimburse the society for any pecuniary loss it may sustain in consequence of the change of site from the city to the suburbs. In order to develop the scientific work of the society, and thus secure to the fullest extent the great advantage of having the scientific papers read before it, printed, the Committee of Science have submitted a scheme for the complete reorganisation of the department under their superintendence. Thus, the meetings for the discussion of subjects connected with science pure and applied will be held in these sections:—1. For the physical and experimental sciences. 2. For the natural science, including geology and physical geography. 3. Science applied to the useful arts and industries. The papers to be read at these sectional meetings will be published in 8vo, as the Scientific Proceedings, the more important to be published in 4to, under the title of "Transactions." In order to consolidate and economise both work and time other scientific bodies have been invited to associate themselves with the work of the sections, the meetings of which will be held simultaneously on the third Monday of each month, an invitation to which the Royal Geological Society and the Scientific Club have responded. A special committee is now engaged in considering the measures most advisable to adopt with regard to the future of the society, so as to maintain it as an object of attraction to the educated classes, and a preliminary report has been presented to the council, in which it is advised that in addition to the more complete organisation of the scientific department steps should be taken to render the reading-rooms more efficient, to establish a lending library for the use of future as well as present members, to arrange for the delivery of lectures for the elucidation of the latest discoveries in science, and to hold occasional *conversaziones*. According to one of the conditions contained in Lord Sandon's letter of February 9, 1876, the National Library will be placed under the superintendence of a council of twelve trustees, eight of whom are to be nominated by the Royal Dublin Society and four by the Government.

Then followed the Report of the Committees of the Royal Dublin Society and of the Royal Agricultural Society on the subject of amalgamation, which, as we have said, was adopted. The two societies will to some extent remain connected; the Agricultural Society, Lord Powerscourt stated, would be a branch of the Royal Society, though under different management.

ON THE EOCENE FLORA OF BOURNEMOUTH

DURING this last summer and autumn I have seized several opportunities of continuing my examination of the Bagshot Beds of Hampshire and the Isle of Wight, some of the results of which I think may interest your readers. This series is, as is now well known, of great importance from the fact of its being almost the only series from the tertiaries whose absolute relative geological age is positively known, it being under and overlapped on the mainland by the London clay and Bracklesham beds respectively, whilst in the Isle of Wight, occurring in a complete series of eocene strata, upheaved vertically, its true position is even still more plainly seen. It is further important as exhibiting in gradual sequence the change from an upland to a swamp flora, and represents very fairly the local flora of a long period and of an entire continent that has passed away. Of the richness and completeness of the flora an idea may be formed from the fact that I can reckon in my own collection not less than 10,000 selected specimens, many of large size, exclusive of twice that number which I have discarded, whilst there are also local collections at Bournemouth, a splendid series in the Cambridge Museum, and a scarcely less important one from Alum Bay, at the British Museum. But perhaps the most valuable discovery—to the botanist, at all events—is that of various beds containing well-preserved fruits above the horizon of the leaf-patches, identifiable with fruits from Sheppey which are found in the London clay, and therefore below the leaves. We thus appear to have at Bournemouth the leaves of trees which may be descended from those whose fruits are imbedded at Sheppey. The assistance, it will be readily seen, of the Sheppey fruits will be of the greatest value in determining the genera of the Bournemouth leaves and flowers. At Bournemouth about sixteen kinds of fruit may be collected in the seed-beds just mentioned, including Nipadites, Hightea, Cucumites, and Petrophiloides, quite sufficient to establish the fact that no break took place in the succession of the London clay flora.

The number of forms also common to Bovey Tracey is worthy of note. The most abundant fern at either locality is *Pecopteris lignitum* (now believed to be an Osmunda). *Palmacites dæmonorops* of Heer, from Bovey, is no other than the Cactus of which I have frequently made mention. The dicotyledons of Bovey ascribed to Laurus, Ficus, Daphnogene, Dryandroides, &c., appear also to be identical with those of the Bagshots, and it is therefore not at all improbable that the miocene age of the Bovey Tracey beds, determined, as it seems to me, on most slender grounds, will have to be reconsidered.

The extremely local distribution of the leaves in patches, each with its distinguishing group of plants, has again in fresh instances come prominently under my notice. At Studland, in one bed, fan palms with a three-foot radius lie massed together, but in a decomposed state; and I only succeeded by using the utmost care in extracting one specimen showing the full length of the leaf. At

Bournemouth a small bed of dark clay was found full of leaves of feather palm, crossing each other in every direction; the tip of a frond in my collection measures four feet in length, by three feet broad. Amongst other interesting specimens is a Smilax leaf of larger dimensions than any now living, and a twig of Dryandra, with many leaves attached, from Alum Bay, which unites in itself several of M. Watelet's species from the Grès du Soissonnais. The discovery of a finely preserved neuropterous wing, and of two apparently hemipterous abdomens, are of interest in connection with the large series of insect remains from Gurnet Bay, Isle of Wight, lately deposited in the British Museum.

The history remains to be written of the subsidence of the great continent, whose further limits Edward Forbes surmised are yet traceable in the banks of Gulf Weed, ranging between the 15th and 45th parallels. Many, however, have written on Atlantis, but lacking the direct proof of its former existence in comparatively recent times, which has since come to light. The disappearance of almost an entire continent, is not a more startling proposition than the elevation of the Alps, Pyrenees, Apennines, and Carpathians, over whose highest summits the sea rolled at this period. Of the history of this disappearance Bournemouth presents us with but a page, still a page full of meaning. The incoming and disappearance in succession of oaks and beeches, figs and laurels, palms and delicate ferns, the swamp-loving aroids and Eucalyptus, Chrysodeum and Osmunda, on the same spot; the appearance in masses of the fruit of Nipa, which is stated by travellers to be found in brackish estuaries; the incoming of shore crabs and mud-boring crustacea, sea-shells and Flustra, shingle beeches and deeper sea deposits, are each well-marked stages in the history of the disappearance of this continent, whose existence at this and a later period may be gathered from the writings, made from different standpoints, of Prestwich, Godwin-Austen, Sorby, and many others. The Bournemouth and Sheppey vegetable remains were brought down by one of the rivers draining this continent, which at a later period silted over the reptiles of Hordwell and the estuarine shells of the fluvio-marine series. That the oscillations which gradually led to the disappearance of the land, vestiges of which remain in Cornwall, the Channel Isles, Brittany, Madeira, &c., have not ceased, even in historic times, there is ample local evidence to show. This branch of the subject, however, is scarcely yet ripe for discussion, nor would space here allow it to be fully entered into.

Baron Ettingshausen and myself are preparing a monograph upon the ferns of this flora which I hope very shortly to place in the hands of the Palæontographical Society.

J. S. GARDNER

THE TELEPHONE

AT the Society of Telegraph Engineers on the evening of October 31 a lecture of great interest was given by Prof. Graham Bell on the Telephone, with the invention and improvement of which his name is so intimately connected. The lecture was largely illustrated by diagrams, to which Prof. Bell made constant reference, and with these illustrations will be published at length in the forthcoming part of the *Journal* of the Society. We have already given a full account of the telephone and its principles, and will only now refer to some of the interesting episodes which occurred in the course of Prof. Bell's experiments.

Prof. Bell's account of his experiments for devising methods of exhibiting the vibrations of sound, specially for use in teaching the deaf and dumb, is very interesting. For some time he carried on experiments with the manometric capsule of Koenig, and with the phonautograph of Léon Scott. He was led to the idea of constructing a phonautograph modelled closely on the mechanism of the human ear, and at the suggestion of Dr. C. J. Blake, he made use of the human ear itself, a specimen of which was prepared by Dr. Blake, for conducting these experiments.

It occurred to him that if a membrane as thin as tissue paper could control the vibration of bones that were, compared to it, of immense size and weight, why should not a larger and thicker membrane be able to vibrate a piece of iron in front of an electro-magnet, in which case the complication of steel rods in his first form of telephone could be done away with, and a simple piece of iron attached to a membrane be placed at either end of the telegraphic circuit.

The form of apparatus he was then employing for producing undulatory currents of electricity for the purposes of multiple telegraphy he describes thus: a steel reed was clamped firmly by one extremity to the uncovered leg of an electro-magnet, and the free end of the reed projected above the covered leg. When the reed was vibrated in any mechanical way, the battery current was thrown into waves, and electrical undulations traversed the circuit, throwing into vibration the corresponding reed at the other end of circuit. He immediately proceeded to put his new idea to the test of practical experiment, and for this purpose he attached the reed loosely by one extremity to the uncovered pole of the magnet, and fastened the other extremity to the centre of a stretched membrane of goldbeater's skin. He presumed that upon speaking in the neighbourhood of the membrane it would be thrown into vibration and cause the steel reed to move in a similar manner, occasioning undulations in the electrical current that would correspond to the changes in the density of the air during production of the sound; and he further thought that the change of the intensity of the current at the receiving end would cause the magnet there to attract the reed at that end in such a manner that it should copy the motion of the reed at the transmitting end, in which case its movements would occasion a sound from the membrane there similar in *timbre* to that which had occasioned the original vibration.

The results, however, were unsatisfactory and discouraging. With a reduction, however, in the size and weight of the spring employed, distinctly audible effects were obtained. "I remember," Prof. Bell said, "an experiment made with this telephone, which at the time gave me great satisfaction and delight. One of the telephones was placed in my lecture-room in the Boston University, and the other in the basement of the adjoining building. One of my students repaired to the distant telephone to observe the effects of articulate speech, while I uttered the sentence, 'Do you understand what I say?' into the telephone placed in the lecture-hall. To my delight an answer was returned through the instrument itself, articulate sounds proceeded from the steel spring attached to the steel membrane, and I heard the sentence, 'Yes, I understand you perfectly.' It is a mistake, however, to suppose that the articulation was by any means perfect, and expectancy no doubt had a great deal to do with my recognition of the sentence; still, the articulation was there, and I recognised the fact that the indistinctness was entirely due to the imperfection of the instrument." After a time he produced a form of instrument which served very well as a receiving telephone; and it was in this condition his invention was exhibited at the Centennial Exhibition in Philadelphia. It was in this condition also that Sir William Thomson exhibited the instrument to the British Association in Glasgow.

In pursuing his investigations Prof. Bell has come across many interesting facts which we regret we cannot refer to in detail. It has long been known that when an intermittent current of electricity is passed through the coils of an electro-magnet a musical tone proceeds from the magnet. "I have discovered," he said, "that these sounds

are not due wholly to sudden changes in the magnetic condition of the iron core, as heretofore supposed, but that a portion of the effect results from vibrations in the insulated copper wires composing the coils. An electro-magnet was arranged upon circuit unto an instrument for interrupting the current, the rheotome being placed in a distant room so as to avoid interference with the experiment. Upon applying the ear to the magnet a musical note was clearly perceived, and the sound continued after the iron core had been removed from the coils. The effect may probably be explained by the attraction of the coils for one another during the passage of the galvanic current and the sudden cessation of such attraction when the current ceased. It is probable, too, that a molecular vibration is occasioned in the conducting wire by the passage of an intermittent current. I have found that very distinct sounds proceed from straight pieces of iron, steel retort-carbon, and plumbago, when an intermittent current is passed through them."

When a powerful current is passed through the body a musical note can be perceived when the ear is closely applied to the arm of the person experimented upon. The sound seems to proceed from the muscles of the fore-arm and from the biceps muscle. Mr. Elisha Gray has also produced audible effects by the passage of electricity through the human body. An extremely loud musical note is occasioned by the spark of a Ruhmkorff's coil when the primary circuit is made and broken with sufficient rapidity; when two rheotomes of different pitch are caused simultaneously to open and close the primary circuit a double tone proceeds from the spark.

A curious discovery has been made by Prof. Blake. He constructed a telephone in which a rod of soft iron, about six feet in length, was used instead of a permanent magnet. A friend sang a continuous musical tone into the mouth-piece of a telephone, which was connected with the soft iron instrument alluded to above. It was found that the loudness of the sound produced in this telephone varied with the direction in which the iron rod was held, and that the maximum effect was produced when the rod was in the position of the dipping needle.

This curious discovery of Prof. Blake has been verified by Prof. Bell.

"Prof. Peirce has observed the most curious sounds produced from a telephone in connection with a telegraph-wire during the aurora borealis; and I have just heard of a curious phenomenon lately observed by Dr. Channing. In the City of Providence, Rhode Island, there is an over-house wire about one mile in extent with a telephone at either end. On one occasion the sound of music and singing was faintly audible upon one of the telephones. It seemed as if some one were practising vocal music with a pianoforte accompaniment. The natural supposition was that experiments were being made with the telephone at the other end of the circuit, but upon inquiry this proved not to have been the case. Attention having thus been directed to the phenomenon, a watch was kept upon the instruments, and upon several subsequent occasions the same fact was observed at both ends of the line by Dr. Channing and his friends. It was proved that the sounds continued for about two hours, and usually commenced about the same time. A searching examination of the line disclosed nothing abnormal in its condition, and I am unable to give you any explanation of this curious phenomenon. Dr. Channing has, however, addressed a letter upon the subject to the editor of one of the Providence papers, giving the names of such songs as were recognised, with full details of the observations, in the hope that publicity may lead to the discovery of the performer, and thus afford a solution of the mystery."

Prof. Bell referred to some experiments made by Mr. F. A. Gower and himself to show the slight earth connection required to establish a circuit for the telephone.

"One experiment which we made is so very interesting that I must speak of it in detail. Mr. Gower made earth connection at his end of the line by standing upon a grass plot, whilst at the other end of the line I stood upon a wooden board. I requested Mr. Gower to sing a continuous musical note, and to my surprise the sound was very distinctly audible from the telephone in my hand. Upon examining my feet I discovered that a single blade of grass was bent over the edge of the board, and that my foot touched it. The removal of this blade of grass was followed by the cessation of the sound from the telephone, and I found that the moment I touched with the toe of my boot a blade of grass or the petal of a daisy, the sound was again audible."

Prof. Bell concluded as follows:—"The question will naturally arise, through what length of wire can the telephone be used? In reply to this I may say that the maximum amount of resistance through which the undulatory current will pass, and yet retain sufficient force to produce an audible sound at the disturbed end, has yet to be determined; no difficulty has, however, been experienced in laboratory experiments in conversing through a resistance of 60,000 ohms, which has been the maximum at my disposal. On one occasion, not having a rheostat at hand, I may mention having passed the current through the bodies of sixteen persons, who stood hand in hand. The longest length of real telegraph line through which I have attempted to converse has been about 250 miles. On this occasion no difficulty was experienced so long as parallel lines were not in operation. Sunday was chosen as the day on which it was probable other circuits would be at rest. Conversation was carried on between myself, in New York, and Mr. Thomas A. Watson, in Boston, until the opening of business upon the other wires. When this happened the vocal sounds were very much diminished, but still audible. It seemed, indeed, like talking through a storm. Conversation, though possible, could be carried on with difficulty, owing to the distracting nature of the interposing currents.

"I have had the opportunity of testing the telephone upon the artificial cable owned by Sir William Thomson. No difficulty was experienced in conversing through the equivalent of 120 miles of submarine cable. Vocal sounds were audible when the equivalent of the whole Atlantic cable was interposed between the two telephones, but the sounds were so faint that conversation could not be carried on. Songs that were sung into one telephone were readily recognised at the other end of the circuit, and the articulation of pre-arranged sentences was readily recognised. That the sounds were electrically produced was evident from the fact that they ceased when the circuit was broken and when the coils of the telephone were short circuited. No difference was observed between the pitch of the note which was transmitted through the artificial cable and the same note when transmitted directly through the air. The artificial cable experimented upon had four times the resistance of the Atlantic cable, and one-fourth its electrostatic capacity. I am informed by my friend, Mr. Preece, that conversation has been successfully carried on through a submarine cable, sixty miles in length, extending from Dartmouth to the Island of Guernsey, by means of hand telephones."

In a lecture on the 8th inst. at Glasgow, Prof. Bell, referring to the use of the telephone in mines, pointed out how the instrument might be of the greatest service in determining whether the ventilation of a mine was perfect or not; for by listening to the telephone, if the mine was in good order, a little sound could be heard every moment.

AFRICAN EXPLORATION

MR. STANLEY'S letter and the map in the *Telegraph* of Monday enable us to realise somewhat more fully the nature and extent of the discoveries made by the

intrepid traveller. Mr. Stanley is bent on calling the great river, so much of which he has explored, by the name of Livingstone. As a rule we think it a mistake to change native geographical names where these can be satisfactorily ascertained. In the case of the Lualaba-Congo, however, the river seems to have quite as many names as there are tribes or villages on its banks, and it would be a happy solution of the difficulty to confer upon it the most memorable name among African explorers. Mr. Stanley himself has taken great pains to obtain accurately the native names of tribes and places, and he animadverts with severity on geographers for crowding the map of Africa with names that probably correspond to nothing. For this they cannot be greatly blamed, neither need he be too hard on previous travellers for misunderstanding the significance of native words.

A glance at the map, notwithstanding that it is based to some extent on conjecture, shows at once the vast importance of Mr. Stanley's discovery. Great tributaries join the main river from both sides, and we are assured there are many more besides these shown on the map. For more than 800 miles of its course, above the Yellala Falls, the river looks more like a long winding lake than anything else, forming a magnificent channel for navigation. Above the upper cataract, again, about the equator, many other long reaches are capable of navigation, while the affluents will afford over 1,200 miles, and perhaps much more. Some idea of the increasing magnitude of the river below Nyangwe may be obtained from Stanley's statement that at Nyangwe the volume is 124,000 cubic feet per second, while Behm's calculation on the basis of Tuckey's trustworthy observations makes its volume at the mouth to be 1,800,000 cubic feet per second. Poor Tuckey comes in for a share of Stanley's castigation, because, according to Stanley, the former mistook the number of stages of the Yellala Rapids; even if Tuckey was a little out in his counting, which we doubt, he will still be found to have been, all circumstances considered, an accurate observer. Many points, also, in connection with the map, show how true was Livingstone's geographical instinct, and how near the truth his inferences came from the information obtained from the Arabs and natives. Stanley is probably right in conjecturing that the Aruwimi, coming from the north-east, and joining the Livingstone a little north of the equator, is the Welle, and that the Ikelemba is the lower course of the Kasai. The water of the latter is of the colour of tea, and does not thoroughly mingle with the main stream until after 130 miles below the confluence. The banks of the great river are thickly populated by what appear to be industrious people living in extensive and well laid out towns, and naturally jealous of intruders. The three most powerful tribes on the middle and lower rivers are the Wa-Mangala, the Warunga, and the Wyanzi.

The Livingstone, Mr. Stanley found, is subject to periodical rises mainly owing to the rains, and varying from eight to fifty feet. The entire length of the Livingstone Mr. Stanley calculates at 2,900 miles, and its basin at 860,000 square miles. The extreme sources of the Bemba Lake, from which the Luapula flows, are in 33° E. long. Lake Bemba, or Bangweolo, Stanley states—and there appears to be good ground for the belief—is the residuum of an enormous lake that in very ancient times must have occupied an area of 500,000 square miles, "until by some great convulsion the western maritime mountain chain was riven asunder, and the Livingstone began to roar through the fracture." As to the "great convulsion" and the "fracture," geologists may be able to decide when they are in possession of full information as to Mr. Stanley's observations. Nyangwe, Mr. Stanley informs us, is in 4° 16′ S., and 26° 5′ E.; but by an unaccountable mistake in another place he gives the latitude as 26° 15′ 45″, and that, too, while pointing out, in his peculiar way, a slight mistake in the position on Stanford's map of 1874. The position then was perfectly correct according to the data, and in the latest editions the position is exactly as Stanley gives it.

Mr. Stanley insists on the importance of the river as a commercial highway, the country traversed by it being abundantly rich in products that would find a ready market in Europe. Naturally, on Monday night, Africa was the burden of the president's address at the opening of the Geographical Society. Sir Rutherford Alcock insisted that it now remained with the merchant, aided if need be by Government, to open up Africa still further. Indeed the country is now being attacked by national and private expeditions on all sides, and if a basis for minute exploration were formed by trading stations under government sanction and regulation, along the Livingstone, our knowledge of the country would grow rapidly, and the benefits to commerce would be incalculable. Only, however, could the natives have fair play by governmental regulation of private enterprise. There is no danger of extinction for the native African, and it would be both prudent and just to protect him from the horrible cruelties at which Mr. Stanley hints in the conclusion of his letter.

It is worth noticing that in the map the Lukuga runs boldly from Lake Tanganyika and joins the Lualaba, and the source of the Alexandra Nile is brought to near 4° south on the east side of the lake.

According to latest intelligence Mr. Stanley is at the Cape wanting to get his followers sent back to Zanzibar. In his letter in yesterday's *Telegraph* he gives an interesting account of his companion, Frank Pocock, of whom he speaks in the highest terms, and whose death is a real loss to African exploration.

The *Daily News* Alexandria Correspondent writes (on the 5th) that Signori Gessi and Matteucci have just started from Cairo for Khartum, *viâ* Assouan, by the Nile, instead of taking the shorter route by the Red Sea to Massowa. They are provided with the newest and most improved scientific instruments, and having promised to keep up constant communication with the Geographical Society at Rome, interesting accounts of their movement and progress will be looked for.

MODERN TORPEDO WARFARE

TWO elements have contributed to make torpedo warfare what it is: electricity and the new explosive compounds. It is true that in the Whitehead or fish torpedo recourse is had only to the latter of these, but it is the sole material exception, and all the mischief effected by this branch of marine warfare has been, so far, the result of electric torpedoes. Both on the Danube and in the last American war, when no less than twenty-five ships were sunk by the Confederates, the electric torpedo has worked extensive injury, and it is no wonder therefore that a keen interest should be taken in all that pertains to so novel and destructive a method of killing and wounding.

We have called the torpedo a novel weapon, and the instruments that go by the name to-day undoubtedly are so. At the time of the Crimean war, we had to do with torpedoes of a kind; nay, even so far back as the beginning of the seventeenth century, floating charges, called petards, were employed, but these were of too insignificant a nature to merit attention. The "infernal machines" strewn in the Baltic by the Russians twenty years ago were small canisters of powder containing by way of igniting arrangement a mixture of chlorate of potash and sugar, together with a glass bulb with sulphuric acid; and the latter, escaping from its envelope when this was broken by a shock or collision, brought about an immediate explosion. These mechanical torpedoes had two disadvantages; the igniting arrangement was of such a character that it could be set in action just as well by friend as by foe, and the explosion of the gun-

powder was insufficient to effect any material injury. All this has been remedied. Electricity is nowadays employed as the igniting agent, and those terribly violent explosives, gun-cotton and dynamite, replace the comparatively innocuous gunpowder.

Electric torpedoes may be broadly divided into two classes: offensive and defensive torpedoes. The latter are employed for the protection of harbours, channels, and roadsteads; the former, in the shape of drifting or spar-torpedoes, are carried to the attack in small swift-sailing steam-launches. In this country we are favourably disposed to the employment of compressed gun-cotton in our machines, while on the Continent they seem to entertain a predilection for nitroglycerine, or rather dynamite. Both compounds are what chemists term nitro-compounds, in contradistinction to gunpowder, which comes under the class of nitrate-compounds, and appear to exercise an explosive force of almost similar violence, measuring the substances weight for weight. Compressed gun-cotton, we need hardly say, is cotton yarn acted upon by nitric and sulphuric acids and then pulped and washed, so that the result is a finely-divided mass which may be made to assume any shape or form. As a rule the material is pressed into cakes of disc-like form, which weigh from a few ounces to a pound, and while still wet the slabs are stored away in the magazines. In this moist condition

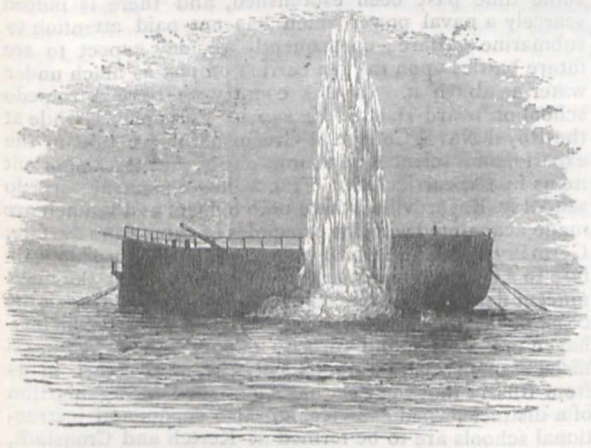

FIG. 1.—Fish Torpedo exploding against a ship.

the compressed pulp is not only non-explosive, but actually non-inflammable, except one possesses the key to its detonation. This is nothing more than a dry cake of the same material, or as the latter is termed in military parlance, a "primer," which on being detonated by a few grains of fulminate, brings about the explosion of any wet gun-cotton in its immediate neighbourhood. Thus if simply a net is filled with gun-cotton slabs and thrown into the sea, the whole charge may be ignited by a primer contained in a waterproof bag having an electric fuze and wire attached. The possibility of communicating explosion in this way by vibration instead of by spark or flame is, too, as we shall presently see, the germ of a system of counter-mining, or torpedo annihilation, which bids fair to develop into a particularly effective means of defence against these terrible machines. Dynamite is similarly exploded to gun-cotton. The active principle in this case is nitro-glycerine, or, if you will, liquid gun-cotton, prepared by simply allowing glycerine to fall drop by drop into nitric acid. As a solid is usually more convenient to handle than a liquid, the use of pure nitro-glycerine has given way to dynamite, which may be described as siliceous earth impregnated with the explosive fluid.

Dynamite and gun-cotton explode with something like four or five times the force of gunpowder, and for this reason a very destructive charge may be confined within a comparatively small space. Moreover they are peculiarly adapted to submarine mines, since nitro-glycerine is no more affected by water than gun-cotton; and the old adage "to keep your powder dry" does not apply to either of them. In the case of moored torpedoes which are connected with batteries to the shore or carry their own means of generating electricity, as in the Herz topedo of our German cousins, there is no limit to size, and machines containing as much as 500 lbs. of gun-cotton have, in fact, been constructed; but for a spar-torpedo, or in other words one which is thrust under an enemy's keel by means of a thirty-foot pole projecting from the prow of a launch, the charge must be considerably smaller, and for two reasons. A great weight at the end of such a lever could not be properly manipulated, while the explosion, if the charge were a very large one, would destroy both the attacking and attacked. A big moored torpedo of 500 lbs. has been found, when sunk in thirty or forty feet of water, to be fatal to a strong ironclad if the latter happens to be within this distance of the source of explosion; or, in other words, a cushion of water forty feet in thickness is not sufficient to secure the immunity of such a vessel. What would happen if this terrible volcano were to erupt—if we may use the word—in contact with the sides of an armoured ship, must be left to the imagination; but despite Mr. Ward Hunt's opinion to the contrary, we do not think it would require

FIG. 2.—A moored Torpedo exploding. Height of column 60 feet, base 220 feet.

three such torpedoes successfully exploded, to bring our boasted *Inflexible* to grief. And in this opinion our readers, we suspect, will fully agree, when we inform them that a heavy torpedo like this throws up a cone of water sixty feet in height, with a diameter at its base of no less than 220 feet. Such an heaving of waters, if it did not break the back of an ironclad, as there is every reason to suppose it would, must inevitably capsize her without more ado. But it is, of course, only on very rare occasions that such a monster torpedo could be brought to bear, and in all cases of attack the charge must needs be considerably less. The smaller Whitehead torpedoes, which, as our readers know very well, are narrow cigar-shaped weapons, that move through the water by the agency of compressed air, do not in all probability carry more than a 40 lb. or 50 lb. charge in the head, while a spar or drift torpedo of 100 lbs. is already as large as would be convenient to handle. At the same time either of these would quite suffice to fracture an iron plate several inches in thickness, and therefore be fatal, probably, to any ironclad afloat, supposing there was no water-cushion between the craft and the torpedo. We have no definite information respecting the size or weight of the torpedoes which sank the Turkish monitor in the Matchin Canal, but as the expedition was hastily arranged and organised, the charges were, no doubt, not very large.

The fish torpedo is a rare example of a complicated apparatus coming into practical use, and its elaborate

construction and fine workmanship may be imagined when the reader is informed that the machines cost 500*l.* a piece to manufacture. The long tube is divided into three compartments: the head, which contains the explosive charge, the reservoir, in which the compressed air is stored, and the machinery by means of which the stored-up energy is converted into a propelling force. The air is compressed to the extent of 600 lbs. on the square inch, and to bring about this result an exceedingly powerful air-pump is necessary, which forms an additional item of expense in the case of this torpedo. The latter when properly charged will do a journey of a mile, or mile and a half, under water, the first 1,000 yards being got over at a rate of no less than twenty miles an hour, and if unaffected by tide or current, the machine will proceed in a perfectly straight direction. It floats at any distance under water that may be desirable, but is usually made sufficiently buoyant to swim at eight feet from the surface; it explodes on striking any object, but the machine is so contrived that if it fails to strike, then it floats to the surface, and a trigger guard renders the fish at the same time innocuous, and permits of its recapture without risk. Ingenious as the little creature is, there has been, we repeat, no authenticated employment of it during the present war.

On the Danube the spar-torpedo alone seems to have been used against Turkish monitors. As in the case of the *Thornycroft* launch, of which we are to have a flotilla of thirty in the British navy, the torpedo is projected at the end of a spar, and is ignited either by concussion or by electricity. The Turkish ironclad at Matchin was the victim of two torpedoes of this class, the first of which, we are told, was ignited by the crew of the launch by electricity, and the other on concussion with the vessel attacked. These Russian torpedoes are said to be innocuous at a distance of ten feet from the seat of explosion, and hence those in the launch do not suffer much except from the water that is thrown into the air. From the fact that small batteries in the boat are used to fire the charges, we may safely conclude that their explosion is brought about by a platinum wire fuze, which, together with a few grains of fulminate, would determine the detonation of dynamite or gun-cotton. Each launch is provided with a pair of these spar torpedoes, carried, when not in action, on each side, running the length of the boat, and only on making an attack is one or other projected at the bow, the torpedoist being stationed behind a shield, or under an iron screen, where he can make his observations tolerably free from danger.

In the case of moored torpedoes depending for their ignition upon electricity, many points of scientific interest have recently been brought to light. Some experiments undertaken in Denmark two or three years ago showed most conclusively that dynamite torpedoes cannot be placed close together without incurring the danger of one charge bringing about the explosion of others. A dynamite torpedo of 150 lbs. ignited in ten feet of water, was found capable of exploding other charges at a distance of 300 feet by the mere vibration imparted to the water; so that in constructing coast defences with dynamite torpedoes it is absolutely necessary to keep them far apart from one another. Another point was also noted. A current of electricity, if it emanates from a powerful frictional electric machine, traversing one of a bundle of wires, will induce a current in the other wires, and thus bring about the explosion of torpedoes other than that which the operator on shore desires to ignite. It is these facts particularly which have led to the development of a system of counter-attack and have enabled our sailors to devise a means of defending themselves from the terrible sea-monsters. Both dynamite and gun-cotton are peculiarly sensitive to vibration—indeed their detonation, as we have seen, is brought about by no other cause—and hence a captain of a man-of-war by exploding countermines in his vicinity may soon get rid of any lurking torpedoes lying in wait for him, at any rate if they contain a nitro-glycerine compound, and so speedily clear a way for his ship.

This is certainly subject for congratulation, for it seemed at one time as if the poor sailor was absolutely defenceless against these submarine abominations. A crinoline of spars and wire rope may be employed to catch the fish torpedo and explode the vermin harmlessly in its toils, provided the ingenious brute is not a very large one, and the net is at some distance from the ship; but heavy moored torpedoes have been hitherto considered too dangerous to approach, so that marine countermining must prove invaluable. The spar or drifting torpedo cannot be dealt with by nets or booms alone, and in this case the only plan would seem to be to meet attack with attack and beat off launches with other small boats. That all ironclads in time of war will have to be surrounded by lesser craft as a protection is a matter that we may now take for granted, as also that such vessels must be provided with some powerful means of illumination—the electric light, for instance—to prevent swift, low-lying torpedo launches from approaching unperceived at night time.

Special schools of instruction for acquainting officers with the science of electricity and explosives have for some time past been established, and there is indeed scarcely a naval power which has not paid attention to submarine warfare; consequently we may expect to see future battles upon the sea carried on just as much under water as above it. In this country we have a torpedo school on board H.M.S. *Vernon* at Portsmouth, while at the Royal Naval College at Greenwich instruction in the experimental sciences now forms one of the most important items in the curriculum. France has its naval torpedo school at Boyardville, where both officers and seamen are made acquainted with the principles of submarine warfare. Germany, as all the world knows, practised torpedo warfare to such good purpose seven years ago that the magnificent fleet of the French never once ventured to visit the coast of the Fatherland. Both at Kiel and at Wilhelmshaven are to be found torpedo depôts and a well-organised staff of instructors. Lastly the news comes to us from Russia that the Czar has sanctioned the organisation of a distinct torpedo service, and two depôts and instructional schools are to be formed at Kertch and Cronstadt, whence torpedo appliances are to be issued for the defence of the Baltic and the Black Sea.

NOTES

MR. DARWIN will receive the honorary degree of LL.D. at Cambridge on Saturday next, at 2 P.M., at a congregation specially convened for the purpose. In the evening the annual dinner of the Philosophical Society will take place in the Hall of Clare College, when a brilliant gathering is expected to meet the illustrious visitor, among the non-resident guests being Profs. Huxley, Tyndall, and Parker, and Sir John Lubbock.

THE Postmaster-General of the German Empire is about to have an extensive series of experiments made with a view to the introduction of the telephone into the telegraphic service. Several hundred specimens of the telephonic apparatus manufactured by Siemens and Halske have been ordered.

THE French Ministry had granted a pension to the widow of Leverrier. Unfortunately the lady died, as we mentioned in our last number, before the first monthly instalment became due. It is hoped that a part of the pension will go, against ordinary rules, to the son and daughter of the astronomer.

THE Minister of Public Instruction has been authorised by a

decree of the President of the French Republic to accept a sum of 8,000*l.*, bequeathed by Madame Thuret, in order to establish at Antibes, in the Department of Alpes Maritimes, an agricultural station connected with the lectureship on Agriculture and Botany of the Paris Museum of Natural History.

MR. PARK HARRISON has completed the exploration of the galleries belonging to the "Cave Pit" at Cissbury—in which rune-like characters were found in 1875—and found that they communicate with galleries connected with other shafts, at distances of from 20 to 30 feet, on the north, west, and east sides. Mr. Harrison thinks there appears to be sufficient evidence that they were used for purposes of shelter or concealment long after they were originally excavated. One of the shafts last cleared out, was found to have been left in an incomplete state, as if the work had been for some reason interrupted. On the south of the cave pit, and immediately adjoining it, Mr. Harrison has discovered several small pits, the largest being 5 feet in diameter, and 4 feet 6 inches deep. All contained flint flakes, sling-stones, and a few bones. In some there were small ornaments, pots of good quality, bone combs, terra-cotta beads, and hard polishing-stones. In one pit there was an iron hook.

THE following testimony from so competent and disinterested an observer as Prof. Monier Williams to the necessity for systematic meteorological observation in India is valuable, and we hope will have weight with the proper authorities. In the last of his series of articles on his second tour in India, in the *Times* of November 7, Prof. Williams writes thus :—"One thing requires instant attention. The connection between agriculture, meteorology, and astronomy is now admitted on all hands, and no country in the world would be benefited more than India by systematic meteorological and astronomical observations carried on under Government direction. Much is already being done in this way. Yet I could only find one effective astronomical observatory, and that not adequately supported by Government, though I travelled from Cashmere to Cape Comorin. It is not generally known that from his observations of the present condition of the disc of the sun, in connection with various atmospherical phenomena, the Madras astronomer, Mr. Pogson, prophesied in 1876 a recurrence of the drought and famine in 1877."

ON October 24, we learn from *L'Exploration*, Signor D'Albertis and Prof. Od. Beccari left Genoa in the steamer *Australia* for a year's voyage round the world. They will first visit Egypt, and thence to India, China, and Japan, returning to Europe by New York. They intend to collect during their voyage birds, mammals, and insects for the museums of Italy, principally for that of Genoa.

FOR several years past Major J. W. Powell, in charge of the United States Geographical and Geological Survey of the Rocky Mountain Region, has been paying particular attention in his researches, to the ethnology and philology of the American Indians; and having received from the Smithsonian Institution an immense mass of material on this subject, collected during a period of many years, he has called to his assistance numerous experts for the purpose of preparing a series of memoirs on these topics. We have now a partial result of his labour in the first of a series of quarto volumes, entitled "Contributions to North American Ethnology," and published in most excellent style, with numerous illustrations, at the Government Printing-office. The present volume is occupied with the Indians of North-western America, embracing several papers by Mr. Dall and others on the tribes of Alaska and adjacent territories, and a number of vocabularies, principally by the late Mr. George Gibbs.

OUR readers may remember that last spring Capt. Burton made an expedition into the Land of Midian, which lies to the south-east of the Gulf of Akaba, in the Red Sea. He was accompanied by a mining engineer, M. Marie, and the two explorers came upon traces of extensive mining operations, the ruins of ancient towns, and many other evidences of a flourishing mining district. They brought back specimens containing gold, silver, copper, and other metals, and were most sanguine as to their discovery. Capt. Burton is now again in Egypt, the *Times'* Alexandria correspondent writes, preparing another expedition to Midian. He is now determined to investigate thoroughly that biblical country of which he only got a superficial idea in his twenty-day visit last spring. His intention now is to penetrate to the mountains in the interior, and thoroughly satisfy himself as to their nature and capabilities. He estimates the distance under twenty days' march. It is a curious fact that these mines were known to the ancients so long ago as the time of Ramses III., whose cartouche is inscribed on the Needle which is on its way to England. In the Harris Papyrus in the British Museum is a passage referring to the copper mines of Akaba.

AT the last meeting of the Russian Geographical Society, the Secretary gave some account as to this year's expeditions sent out by the Society. The results of Prshevalsky's expedition are a survey from Kuldja for 800 miles into the interior of the country, seven determinations of latitudes and longitudes, many barometrical measurements of heights along the route, a botanical collection of about 300 species, a zoological collection, numbering 85 mammalia, 180 species (500 specimens) of birds, 50 specimens of fishes, 150 reptiles, and 2,000 insects. The most important objects in the collection are four skins of wild camels. All the collections are now in Kuldja, and will be forwarded to St. Petersburg during the winter. About the end of August M. Prshevalsky had started for Tibet. M. Potanin has returned without having penetrated far into the interior of Mongolia. He proposes now to go to the sources of the Yenissei. M. Mainoff has returned from his travels among the Mordva population of Eastern Russia with very valuable materials. He has obtained anthropological measurements according to the 126 queries of the programme, of 510 individuals, and he brings detailed answers on the queries of the programme as to the ethnographical and juridical customs of the Mordva, as well as numerous skulls, photographs, tools, and dresses.

A RAILWAY official in Berlin was lately fined by the district courts for appending to his name the title of *doctor juris utriusque*, on the strength of a diploma from the University of Philadelphia. An appeal to a higher court resulted in a confirmation of the sentence.

WE notice a very useful Russian work, just published by the St. Petersburg Committee of Primary Education, being a review of all works that have appeared in Russia in the department of primary instruction. The book, 640 pages, gives a complete catalogue of such works, with critical notices on each of any importance, and it is sold at a very low price, for the use of primary teachers.

A YOUNG schoolmistress of Tlemcen (Algeria) has successfully passed her examinations before the Faculty of Aix for Baccalaureate in Letters, and has been warmly congratulated by the Board.

THE statue of Lagrange, the celebrated mathematician, born in Italy, but a naturalised Frenchman, was erected last week in the hall of the Bureau des Longitudes.

AT a recent meeting of the Paris Academy of Sciences a letter from M. Fabre to M. Dumas was read, referring to an American vine which he had cultivated for a long time in the very heart of phylloxeric centres, but which has

escaped the least sign of infection. It flourishes under the most unfavourable circumstances, grows rapidly, and readily receives grafts from French vines.

THE French Association Polytechnique, created in 1830, has just published its programme for 1877-1878. Lectures are given by this institution to working men in each of the twenty municipal districts of Paris, and in almost every manufacturing district of France. For the first time the programme of lectures is uniform, and special text-books are published at a cheap rate under its authority. No salaries are given to teachers, and no fees taken from pupils. It is called "La Sorbonne de l'Ouvrier." All expenses are covered by voluntary contributions. M. Dumas, the perpetual secretary of the Institute has been elected president of the Association. He has filled this important position for a number of years.

THE *Jardin d'Acclimatation* of Paris, as we recently stated, has received a family of Esquimaux, who are quartered alongside the Nubians, who were recently in London. They consist of three men, a woman, and two children, and have charge of a collection of phocas, white bears, and trained dogs. The customary Esquimaux huts have been erected for their accommodation, and their time is spent in the ordinary occupations to which they are accustomed in the Polar regions. The *Société d'Anthropologie de Paris* has appointed a commission to study these unusual visitors, consisting of Dr. Broca, president, and MM. Bordier, Dolly, Girard de Rialle, Mazard, and Topinard.

THE Ministry of Public Instruction has just established, in Paris, a "Bibliothèque Universitaire," containing all works appearing from the pens of the professors of the French University.

AMONG the medals awarded by the Photographic Society in connection with their Exhibition, are one for the best microphotograph, "Proboscis of a Blowfly," to Mr. Edward Viles, and a special medal to Mr. W. J. A. Grant for his Arctic Views.

THE Institution of Civil Engineers resumed its meetings on Tuesday. Among the papers announced to be read early in the session are, a "Review of the Progress of Steam Shipping during the last Quarter of a Century," by Mr. Alfred Holt, M. Inst. C.E. of Liverpool, whilst the latest development of electrical invention and its application to lighting purposes, will be discussed in a paper by Dr. Paget Higgs and Mr. Brittle, Assocs. Inst. C.E., entitled "Some Recent Improvements in Dynamo-Electric Apparatus."

THE fourth annual meeting of the Dundee Naturalists' Society was held recently. Mr. Grothe, the president, occupied the chair. The secretary read the council's report for the past year, which showed that it had been one of great activity and prosperity. The year began with a membership, including all classes, of 232, but at the date of the report this number had increased to 401, being an increase of 169. The property of the society had also been considerably increased during the year, chiefly by gifts of books and specimens for the society's museum. During the last winter nine original papers had been read by members at the ordinary meetings of the society, treating of geological, biological, physical, and archæological subjects. During the summer the interest in, and work of, the society was kept alive by a series of very attractive excursions. One excursion was a sea-dredging expedition, and opened up for the society a new field for its energies. In order to secure a more exhaustive and systematic treatment of the various branches of natural science, the society was formed into sections, three in number, viz. :—1. Physical and Chemical; 2. Geological; 3. Biological. From this arrangement it is hoped that much good will result. The society is in a very healthy and vigorous condition.

THE following modification of an experiment of Prof. Tyndall's is described by M. Terquem in the *Journal de Physique* for October. A trumpet-bell connected by a thick caoutchouc tube with one of König's manometric flames, is fixed vertically over a square plate, which is vibrated so as to give two nodal lines as in Tyndall's experiment. If the axis of the bell be placed exactly over the centre of the plate, the flame remains quite motionless, and the same if the bell be placed above a nodal line. On the other hand, the flame vibrates when the bell is displaced, however little, and the vibrations become very strong when the bell is placed above a ventral segment. With two similar trumpet-bells placed over two ventral segments having similar, or contrary movements, the vibrations may be united on a single flame, by means of a Y-tube, a drawing-tube being placed in the passage of one of the vibratory movements. The advantage of this arrangement consists in producing very strong separate vibrations; moreover, it is possible to give them exactly the same intensity by displacing laterally one of the bells. To obtain absolute motionlessness in the flame the two combined movements must have exactly the same amplitude. To render the flame more brilliant M. Terquem passes the gas through pumice-stone soaked with benzine or the like, and incloses the jet in a tube through which a current of oxygen is sent. A cylinder of mica blackened interiorly, except on the side next the revolving mirror, surrounds the flame.

A RECENTLY-PUBLISHED report by the Criminal Administration of France gives some curious statistics with regard to suicides in 1874. There were in that year 5,617 suicides, the highest number ever recorded in the country. Of these 4,435 (79 per cent.) were committed by men, and 1,182 (21 per cent.) by women. The ages of 105 of the suicides are unknown. The 5,512 others are thus divided :—Minors of 16 years, 29; 16 to 21 years of age, 193; 21 to 40, 1,477; 40 to 60, 2,214; and beyond 60, 1,599. Among the suicides there are enumerated 1,946 celibates (36 per cent.), 2,645 (48 per cent.) were married, and 881 (16 per cent.) were widowed. Of the number of those forming the last two categories there were 2,259, or nearly two-thirds, who had children. The civil state of 145 individuals could not be ascertained. More than seven-tenths of the suicides were by strangulation (2,472), or by submersion (1,514). The suicides were, as always, more frequent in spring (31 per cent.) and in summer (27 per cent.) than in winter (23 per cent.) and in autumn (19 per cent.). As to the motives, there is no information about 481 of the suicides; the others are classed as follows :—Misery and reverses of fortune, 652; family troubles, 701; love, jealousy, debauchery, misconduct, 815 (of which 572 were brought about by drunken habits); physical sufferings, 798; various troubles, 489; mental maladies, 1,622; suicides of persons guilty of capital crimes, 59.

AT the meeting of the Eastbourne Natural History Society, of October 19, Mr. Roper read an important paper on "The Addition to the Flora of Eastbourne since 1875."

THE additions to the Zoological Society's Gardens during the past week include a Tiger (*Felis tigris*) from China, presented by Mr. A. Forbes Angus; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. H. W. Henderson; a Saker Falcon (*Falco sacer*) from Egypt, presented by Mrs. Arthur Coote; two Grey Plovers (*Squatarola helvetica*), a Ringed Plover (*Ægialitis hiaticula*), a Dunlin (*Tringa cinclus*), European, presented by Mr. F. Cresswell; a Californian Quail (*Callipepla californica*) from California, presented by Mrs. A. H. Jamrach; a Ring Hals Snake (*Sepedon hæmachates*) from South Africa, presented by Mr. Eustace Pillans; a Brown Pelican (*Pelecanus fuscus*) from West Indies, a Cape Zorilla (*Ictonyx zorilla*) from South Africa, purchased; five Reindeer (*Ranifer tarandus*) from Lapland, deposited; a Cape Buffalo (*Bubalus caffer*) from South Africa, received in exchange.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

EDINBURGH.—The Marquis of Hartington has, by a large majority over Mr. Cross, been elected Lord Rector of Edinburgh University.

PRUSSIA.—We notice from the last report of the Prussian Minister of Instruction that the present number of instructors in the ten universities amounts to 896, viz., 466 ordinary professors, 7 honorary, 199 extraordinary, and 224 *privat-docenten*. The philosophical faculties include 400, the medical, 250, the legal, 86, and the theological, 110. The number of instructors varies from 29 at Münster, to 201 at Berlin. The number of students is about nine times that of the professors, viz., 8,209, and includes 1,080 from other countries than Prussia. According to their faculties they are divided as follows: evangelical-theological, 684, catholic-theological, 289, legal, 2,261, medical, 1,349, and philosophical, 3,626. The attendance at the universities during the past summer was Berlin 2,237, Breslau, 1,245, Göttingen, 917, Bonn, 897, Halle, 827, Königsberg, 620, Greifswald, 503, Marburg, 401, Münster, 315, and Kiel, 241.

In the budget submitted to the present Prussian House of Deputies are the following items:—Erection of the German Industrial Museum, 998,000 mk.; erection of a Polytechnic in Berlin, 8,393,370 mk.; erection of an Ethnological Museum in Berlin, 1,800,000 mk.; and for the Berlin University, erection of a Herbarium, 422,000 mk.; of a Clinic, 1,955,000 mk.; of a new building for a second Chemical Laboratory, as well as of a Technical and Pharmaceutical Institute, 967,000 mk.

BONN.—On entering upon the duties of rector of the University, Prof. Kekulé, the distinguished chemist, delivered, on October 18, a brilliant address on the scientific position of chemistry, and the fundamental principles of this science. He made the following definition of chemistry as distinct from physics and mechanics:—"Chemistry is the science of the statics and dynamics of atoms: physics that of the statics and dynamics of molecules; while mechanics considers the masses of water consisting of a large number of molecules." After rapidly sketching the growth of the present atomic theory, he claimed that the mass of results now obtained showed that chemistry was slowly but surely approaching its goal, the knowledge of the constitution of matter. In opposition to the opinion that theory should be banished from the exact sciences, he regarded it as an actual felt necessity of the human mind to classify the endless series of individual facts from general standpoints—at present of a hypothetical nature—and that it was precisely the discussion of these hypotheses which often led to the most valuable discoveries.

VIENNA.—In Vienna the question is being agitated of separating the natural sciences at the University into a separate faculty, apart from the philosophical faculty, as is the case in Strassburg and a few other universities, which have risen superior to the old mediæval classification.

STRASSBURG.—The imperial authorities have finally decided upon extensive appropriations for the new buildings of the University. They will embrace edifices for lecture-rooms, chemical and physical laboratories, and chirurgical and psychiatric clinics. The new observatory will be completed next year, and the botanical gardens are rapidly being laid out. In 1882 the University expects to occupy its new buildings.

KÖNIGSBERG.—Prof. W. Lossen, of Heidelberg, well known by his researches on hydroxylamine, has accepted a call to the Chair of Chemistry at the University of Königsberg.

UPSALA.—The University is attended at present by 1,395 students, of whom the half are included in the philosophical faculty. The corps of teachers embraces sixty-three ordinary and extraordinary professors, and fifty-four *privat-docenten*. Of these eighty-two are in the philosophical faculty.

ST. PETERSBURG.—The lectures at the St. Petersburg Ladies' High Medical School re-opened this year on October 13. One hundred and eighteen students were admitted, though a far larger number of applicants passed the examination. The number of the students admitted, however, was limited as above because of want of room. A fifth class has now been added, and the students receive, after having finished the studies, the degree of surgeons.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, November 1.—Prof. Allman, F.R.S., president, in the chair.—Messrs. S. M. Samuel and P. Wyatt Squire were duly elected fellows of the Society.—A communication was read by Dr. G. King on the source of the winged cardamom of Nepal. By Dr. Pereira it had been regarded as the produce of *Amomum maximum*, Roxb.; but this is indigenous to Java. Roxburgh named two Indian species, *A. aromaticum* and *A. subulatum*, and Dr. King shows that the latter is the so-called winged cardamom of Nepal, its true habitat being the Morung mountains and not the Khasia hills as asserted by Voigt.—There followed a paper by Capt. W. Armit on Australian finches of the genus *Poëphila*. Mr. Gould had recognised two birds, *P. gouldiæ* and *P. mirabilis*, as good and distinct specific forms, a statement questioned by Mr. Diggles at the Queensl. Phil. Soc., 1876. Capt. Armit having studied the live birds in their native haunts gives his evidence in favour of Mr. Gould as to the just separation of the said Australian finches.—The self-fertilisation of plants formed the subject of an interesting paper by the Rev. G. Henslow, a notice of which we shall give elsewhere.—Mr. Ed. J. Miers gave a revision of the Hippidea." This group of the Anomourous Crustacea, although, by their elongated carapace and antennæ bearing considerable resemblance to certain of the Corystoidea, to wit the Chilian, *Blepharipoda spinnimana* and *Pseudocorystes sicarius*, yet the author considers their true affinities to be with the Oxystomatous Brachyura, through the Raninidæ. The Hippidea inhabit all the warmer temperate and tropical seas of the globe. Their life history and habits lately have received considerable elucidation at the hands of Mr. S. J. Smith, of Connecticut, in a study of the development of the common species of the eastern shores of the United States. Their limits are restricted northwards by the cold winters. The *H. talpoidea* lives gregariously, burrowing in the loose, changing sands near low-water mark. Other species, however, inhabit deep water, such as the *Albunea guerinii* in the Gulf of Algiers, &c.—Mr. E. M. Holmes laid before the meeting the late Dr. Hanbury's collection of cardamoms (from the Pharmaceutical Society) in illustration of Dr. King's paper above mentioned; he also drew attention to an undetermined fungus in a sugar cane, which mould had caused the destruction of a plantation in South India.—The Rev. T. H. Sotheby exhibited branches of two remarkable shrubs, *Colletia cruciata*, Hook., and *C. Bictonensis*, Lindl., grown in Lady Rolles' garden at Bicton. These South American plants it seems, are not unknown in this country (one Fellow present stating he possessed them now in flower), but the history of their introduction, nevertheless, is a curious one.—Dr. Masters showed an unusual specimen of a grape within a grape, viz., adventitious fruit developed in place of the normal seeds; he also explained the *rationale* of adventitious tubers producing buds on the root of some examples of *Brassica Rapa* exhibited by him.—Some twigs and flowers of British grown gum trees were shown by Mr. A. O. Walker, among others *Penstemon Clevelandii* said to have flowered here for the first time.

Physical Society, November 3.—Prof. G. C. Foster, president, in the chair.—The following candidate was elected a member of the Society: Alexander Jesseman.—Prof. McLeod described some experiments he has recently made to determine the exact number of vibrations of tuning forks by means of the apparatus he exhibited to the Society on April 28 last, and which was designed for determining slight variations in the speed of machinery or other analogous purposes. He has studied two sets of forks belonging to the Physical Laboratory at South Kensington, and a new set just received from König, and his results exhibit a remarkable concordance, the extreme results in the worst set of observations on a fork of 256 complete vibrations only differing by 0·005 per cent., and in a good set they agreed within 0·00078 per cent. Examining the new series from 256 to 512, he found them to give from 0·3 to 0·5 of a vibration more than was anticipated, but as this variation may be due to a difference between the temperature and that at which they were adjusted, he is waiting to ascertain what this was. He considers also that the manner in which the fork is held has an effect on its vibrations, and he hopes to be able to get some information as to the effect of temperature on elasticity.—Dr. Huggins exhibited some artificial gems recently prepared by M. Feil, the well-known glass manufacturer of Paris, who has succeeded in crystallising stones of the corundum class.

Rubies, as well as a topaz and emerald, were exhibited. Dr. Huggins believes that the colour is imparted by small quantities of metallic oxides, and that the mass is mixed with boracic acid and maintained in a fused condition for a considerable period. M. Feil hopes to obtain larger stones by maintaining the heat constant for several weeks consecutively.—Dr. Lodge then read a communication from Professors Ayrton and Perry, of the Imperial College, Japan, in continuation of one read to the Society on May 26 last, on ice as an electrolyte, and since published in the *Philosophical Magazine*. The experiments therein described led them to expect a very sudden rise in the specific inductive capacity as the temperature of the ice increased through zero and it became water. Recent results have shown that, though rapid, this increase is not as great as they anticipated, and, whereas at − 12° C. the capacity is 0·002 microfarads, at + 5° C. it is 0·1185 microfarads, and after this temperature the increase was so rapid as to render exact readings difficult. Referring to Prof. Clerk Maxwell's theory in which he compares electromagnetic disturbances with light vibrations, they point out that he exclusively regards a conducting medium. But they showed in a former paper that no dielectric can be considered non-conducting, hence they conclude that the measured specific inductive capacity can never be even approximately equal to the square of the index of refraction. Prof. Foster mentioned that he recently had occasion to collect as many results as possible on specific inductive capacity and refractive index, and he found that, where these figures were low, the agreement with the law was fairly close, but with greater values the inductive capacity and the square of the refractive index separate very rapidly.—Prof. Guthrie described a simple means for showing the interference between two plane waves by means of two long cords vibrating side by side. If a vibration of considerable amplitude be imparted to them, and the plane in which they travel be carefully examined, two faint black lines will be seen, which cross and recross each other more rapidly as the cords are less and less in unison, and with perfect unison remain stationary.

Royal Microscopical Society, November 7.—Mr. H. C. Sorby, president, in the chair.—A paper was read by Mr. Thos. Palmer on the study of evergreens by means of the micro-spectroscope, in which he described the results of his examination of solutions of the colouring matters, oils, &c., from the leaves in various stages of growth. The paper was illustrated by drawings and by the exhibition under the micro-spectroscope of some of the solutions referred to.—A paper by Mr. F. A. Bedwell on the building apparatus of *Melicerta ringens*, was read by the secretary. It minutely described the structure and functions of those organs, and was an important addition to the number of contributions to the history of this beautiful rotifer. The paper was illustrated by drawings, some of which were enlarged upon the black board by Mr. Charles Stewart.—A paper was taken as read on the lachrymal gland of the turtle, by Mr. Charles Stewart.

PARIS

Academy of Sciences, November 5.—M. Peligot in the chair.—The following papers were read :—On some applications of elliptic functions (continued), by M. Hermite.—*Résumé* of a history of matter (third article), by M. Chevreul. This comprises from the thirteenth to the seventeenth century.—On the hydrogenation of benzine and aromatic compounds, by M. Berthelot. The experiments show that the action (sufficiently intense and prolonged) of hydriodic acid brings all these carburets to the composition of carburets absolutely saturated, such as hydride of hexylene, $C_{12}H_{14}$, volatile about 69°.—Reply to a recent note of M. de Parville, "On the semi-diurnal variation of the barometer," by M. Faye.—The echidna of New Guinea, by M. Gervais. This animal is very different from the echidna of Australia. *Inter alia*, it is larger and has darker hair; the claws (which are strong and adapted for digging) number three on the fore as on the hind feet; and the (black) muzzle is much longer than in *E. aculeata*, and sensibly arched; the tongue is also much longer and very slender, and the horny papillæ are differently arranged; the number of vertebræ and ribs is different, &c. M. Gervais regards the animal as belonging to a separate genus, termed *Acanthoglossus*.—On a project of an inter-oceanic canal; studies of the international commission of the Isthmus of Darien, by M. de Lesseps. This relates to a report of recent scientific exploration by Lieut. Wyse (of the French Navy). The project comprises a tunnel of about 17 kilometres, the remainder of the length being about 55 kilometres. The total cost is estimated at 600,000,000 francs.—Stellar systems formed of stars associated in a common and rapid proper motion, by M. Flammarion.—On the order (or class) of a plane algebraic curve, of which each point (or each tangent) depends on a corresponding point of another plane curve and on the tangent at that point, by M. Fouret.—Applications of a mode of plane representation of classes of ruled surfaces, by M. Mannheim.—On the liquefaction of acetylene, by M. Cailletet. The gas was compressed by means of a hydraulic pump through mercury, in an apparatus of special form. Acetylene is liquefied, *e.g.*, at + 1° under 48 atm., at 18° under 83 atm., at 37° under 103 atm. The liquid is colourless and extremely mobile; it seems very refringent, and is lighter than water, in which it can be largely dissolved. It dissolves paraffin and fatty matters. Hydride of ethylene was liquefied in the apparatus at a slightly higher pressure than that of acetylene. The tensions of these two carburets and ethylene are but little different about zero. Reaction of chlorhydric acid on two isomeric butylenes and on olefines in general, by M. Le Bel. The ethylenic carburets combine with cold chlorhydric acid; on the contrary, the hydrocarbons $CH_2 = CHR$ and probably those with the formula $CHR = CHR'$ are not attacked.—On the alteration of eggs produced by mould from without, by MM. Béchamp and Eustache. Hen's eggs may remain long in a medium filled with infusoria without these organisms penetrating. The shell and its lining membrane can be traversed by mucedineæ, which develop abundantly on the inner face of the latter. The yolk-membrane, however, is impenetrable by mucedineæ or any other microzoa or microphytes. The mediate relations of mucedineæ with the yolk produce a true fermentation apart from any organic ferment except microzymas. The acidification of the white is due exclusively to the mycelium of the mould. The production of bacteria in the yolk is due to development of the normal microzymas of the yolk.—On a new function of the genital glands of sea-urchins, by M. Giard. During part of the year these glands play the part both of excretory organs and of deutoplasmigenic organs. This fact presents a new point of relation between echinoderms and annelids, and even arthropods.—Causes which determine the liberation of agile bodies (zoospores, antherozoids) in the lower plants, by M. Cornu. The exit is not the result simply of a physical phenomenon of endosmose, but is at least partly due to the activity of the corpuscles themselves. This activity requires a sufficient temperature, or a certain quantity of oxygen (furnished directly or by oxidation of the green parts), for its exercise.—Meteorological observations made in a balloon, by M. Terrier. This ascent was made on October 18, at 3.30 P.M., from Paris. It is affirmed that the temperature of the atmospheric layers at sunset decreases uniformly with increase of height (the decrease was 1° per 100 metres). The lower winds are less stable than the upper, and it is necessary to interpret the latter for weather prognostication. The aërial currents of small height and velocity are influenced and notably deflected by the inequalities of the ground.

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