THURSDAY, AUGUST 3, 1893.

A CATALOGUE OF SNAKES.

Catalogue of the Snakes in the British Museum (*Natural History*). Vol. I. By George Albert Boulenger. (London: 1893.)

IN the present volume Mr. Boulenger, the author of the Catalogues of Batrachia, and of the Lizards, Tortoises, Rhynchocephalians and Crocodiles, amongst the Reptilia, commences the description of the only order of living reptiles not hitherto treated by him in the octavo series of British Museum Catalogues.

The Ophidia, whether regarded as a distinct order, as they appear in the text of the catalogue, or as one of the suborders of Squamata, with the Lacertilia and Rhiptoglossa (Chameleons) forming the other sub-orders, as advocated in a foot-note, are by far the most important group of living reptiles after the lizards, and are, like the latter, of comparatively recent origin. No remains of true snakes have been recognised in deposits older than upper cretaceous.

Few groups of vertebrate animals have proved as difficult to classify correctly as snakes. The absence of limbs and the peculiarly specialised elongate form have made species, genera, and even in some cases families resemble each other far more exactly than is usually the case. The result in this and in some similar instances has been that characters of little or no intrinsic value have long been regarded as distinctive, and that an artificial system has been adopted. Certainly in the case of the snakes there was every excuse for characters which are now known to be adaptive and of secondary value in classification, being long supposed to be of primary importance, for the principal of these characters consisted in the presence or absence of weapons by which the life of large animals, including man, could be destroyed with extraordinary rapidity. The first inquiry naturally made by any person confronted by a snake is, "Is it poisonous?" and as the question whether the animal can or cannot inflict an injury that may be, and very often is known to be, fatal, can be certainly decided by examining the structure of the teeth, it is far from surprising that that structure should long have been accepted as the criterion for dividing snakes into primary groups. It was of course recognised that vipers and rattlesnakes, which present marked external differences from such poisonous serpents as the cobra, must be kept distinct from the latter, and consequently all ophidians were until quite recently divided into three groups, (1) harmless snakes; (2) venomous colubrine snakes, and (3) viperine snakes, both the two latter, or poisonous sections, being distinguished by having a grooved or perforated tooth situated at the anterior extremity of the maxillary on each side, and supplied with a poisonous secretion from the very slightly modified salivary gland.

But it had long been known that amongst the so-called harmless colubrine snakes there were several genera such as Dipsas, Psammophis, and Homolopsis, with grooved teeth exactly similar in structure to those characteristic of poisonous forms, but situated at the posterior instead of the anterior termination of the maxillary. These snakes, the Opisthoglypha, as they are termed, were kept apart from other colubrine snakes by several herpetologists, but it is only within the last few years that their poisonous character has been distinctly ascertained. It is true that owing to the position of the grooved fangs, and also to the small quantity of poisonous secretion, the bite of these snakes is harmless to man and to the larger animals, but it has been ascertained that some of them certainly, and probably all, paralyse or kill the small mammals or other animals on which they feed.

The last few years too have shown that grooved teeth connected with a poison gland occur in the mandible of a lizard (Heloderma), and this recurrence of the same kind of tooth in different positions, and in very distinct reptiles destroys the value of the character as evidence of genetic affinity. But if the distinction between poisonous and non-poisonous snakes is disregarded, the differences between harmless colubrines (Aglypha), such as Tropidonotus, and the forms with grooved teeth, like Dipsas or Homolopsis (Opisthoglypha), Naja or Elaps (Proteroglypha), are insufficient to justify placing them in separate subdivisions of the group.

Three years since, in his work on the Reptilia and Batrachia of British India, Mr. Boulenger rejected the old division of snakes into venomous and harmless, and proposed a new classification of the whole group founded on the characters of the skull, and the presence or absence of particular cranial bones. The occasion was a good one, for, singular to state, India is the only country in the world where all families of snakes are represented. Time only can show whether the present classification will stand; it is far from improbable that future discoveries may result in some modification of the system now adopted, but there can be not the slightest question that the principle is sound, and that the present system is a distinct improvement on its predecessors. The whole order of snakes is, by Mr. Boulenger, divided into the following nine families: (1) Typhlopidæ, (2) Glauconiidæ, (3) Boidæ, (4) Ilysiidæ, (5) Uropeltidæ, (6) Xenopeltidæ, (7) Colubridæ, (8) Amblycephalidæ, (9) Viperidæ.

Of these only three are generally known—(1) the Boidæ, containing the boas, pythons, and the curious Eryx, the two-headed snake of Indian jugglers; (2) the Viperidæ, which comprise ordinary vipers and Crotalinæ, (rattlesnakes and their allies); and (3) the Colubridæ, which play much the same part amongst snakes that the Passeres do amongst birds, and form a considerable majority of the living species. In the Indian list, out of 264 known snakes, 182, or about two-thirds, belong to the Colubridæ, and probably a similar proportion will be found to prevail throughout the world. The Colubridæ are in fact the dominant type of the present time. They are in all probability of comparatively recent origin, and the generic distinctions amongst them are frequently small and difficult to recognise.

Of the care bestowed upon the present work it is difficult to speak too highly. One instance may be quoted, as it illustrates the author's anatomical research, and at the same time shows the light thrown on other biological inquiries by accurate systematic knowledge. The snake fauna of Madagascar has long been known to present some remarkable peculiarities. The other reptiles and

the batrachians of the Mascarene Islands are distinguished by the absence of many characteristic African families, and the presence of peculiar types, in so far conforming to the distinguishing features of the vertebrate fauna in general; whilst a few reptiles and batrachians exhibit remarkable relations to Indian genera on the one hand, and to South American on the other. The ophidians of Madagascar alone, including the Colubrine snakes, have been believed to belong almost wholly to South American genera. Mr. Boulenger, however, has ascertained that the Madagascar Colubrine species possess hæmal processes (hypapophyses) to the vertebræ, and are consequently generically distinct from their neotropical analogues, whilst some of the Madagascar Boidæ, belonging to what is very probably a family of more ancient origin than the Colubridæ, are of South American genera. Thus the Madagascar snakes agree with the lizards, tortoises, and frogs in their foreign relationships.

Nor has the thoroughness of the scientific work prevented due attention being paid to the details that are important as aids in the identification of species. The number of ventral and subcaudal shields is given for every specimen in the collection. Now as the ventral scutes alone are usually about 150 to 250 in different kinds of snakes, the mechanical work of counting them in nearly 3000 individuals (a few snakes have no ventral shields) catalogued in the volume before us may easily be conceived.

At a time when systematic zoology is not greatly studied by many biologists, and is even, it may be feared, despised by some of them, it is some satisfaction to point to the monographs that are issued from the British Museum as evidence of the work that is being done with the unrivalled collections there available for study. There is scarcely any branch of biological research in which the systematic relations to each other of different organised beings is not of importance, and if systematic biology does not represent the knowledge of the day, all biological studies are likely to suffer. It may fairly be doubted whether any branch of biological work demands greater scientific capacity, higher powers of generalisation or harder work than that of which Mr. Boulenger has afforded a good example in his Catalogue of Snakes.

W. T. BLANFORD.

AN ALPINE GUIDE.

A Handbook for Travellers in Switzerland. Eighteenth edition. (London: John Murray, 1892.)

IN the early days of mountaineering, when the Alpine climber wished to scoff at guide-books, he referred sarcastically to Murray's Handbook to Switzerland. It was so emphatically a *vade mecum* for middle-aged prosperity, and was more successful in limiting its information than in restricting its words. But times and editors have changed. The book for several years past has been up to the high standard attained by the other members of the series; and the edition of 1891, of which the present issue is a revision, even improves upon its predecessors. In the initials "W. A. B. C.," appended to the preface, it would be affectation not to recognise the name of one who unites a knowledge of the Alps, unique, perhaps, in its completeness, to an infinite capacity for taking pains.

We are told, and the book fully justifies the statement, that in preparing this edition, "every line of the text has been very carefully revised and corrected, the historical information having been considerably increased; the notices of the towns have been practically rewritten, particular attention having been devoted to their architectural monuments." The historical notices, indeed, are admirable models of terseness and clearness. That this is so, and that the information concerning the mountain districts has been brought quite up to date, while many places at present little known have been introduced to the notice of English travellers, is only what was to be anticipated in a book edited by Mr. Coolidge.

Six new maps of districts much frequented by English travellers form a special feature of this revised edition. One, of Zermatt, is on a scale of 1 : 50,000, while those of the environs of Lucerne, of Grindelwald, of the Upper Engadine, the Saasthal, and the district round Evolena, Arolla, and Zinal, are on half that scale. They are contoured at distances of 200 metres; the mountains are tinted brown, darkened as the height rises; the snows and glaciers are a pale blue. The maps themselves are excellent, but the tints do not produce a very satisfactory stereographic effect; indeed, we think that actually they have a contrary tendency. It may be that as the higher ground bears the darkened colour, and the snow region is almost white, the contrast is too violent. Be the cause what it may, the result is not quite a success. Still, notwithstanding this, the maps will be a boon to travellers. The introductory matter in this handbook is excellent, and we have observed only one omission. Avalanches, glaciers, structural geography are duly noticed, even natural history is not wholly forgotten, but geology is excluded. But in the course of two or three pages a general outline of the structure and geology of the Alps might have been given, and the attention of travellers called to the significance of the wonderful sections which are so often exhibited in Alpine regions.

We have dipped here and there into the two volumes, which include not only Switzerland, but also the Alps of Savoy and Piedmont, the Italian Lakes, and part of the Dauphiné, reading the accounts of the districts with which we are personally more familiar. Needless to say that we find them clear, accurate, and terse, yet full of information. The book, good before, is even better now, and cannot fail to be most useful to the British tourist.

T. G. B.

OUR BOOK SHELF.

A Handbook on the Steam Engine. By Herman Haeder, Civil Engineer. English Edition. Translated, with considerable additions and alterations, by H. H. F. Fowles, Assoc. M. Inst. C.E. (London: Crosby Lockwood and Sons, 1893.)

THIS is an excellent book, and should be in the hands of all who are interested in the construction and design of medium-sized stationary engines.

It is a real pleasure to find so much information gathered together, particularly when it is from the practical side of the subject. The number of text-books

on the steam engine is legion, but few are of any use to the engineer as distinguished from the student.

The book appears to largely consist of notes accumulated both in the drawing office and in the works. These are of great value, and particularly so because all dimensions have been reduced to British units, thus rendering possible a comparison between Continental and British practice.

A careful study of the contents of this book and the arrangement of the sections, leads to the conclusion that there is probably no other book like it in this country. The volume aims at showing the results of practical experience, and it certainly may claim a complete achievement of this idea.

It must not be imagined from these remarks that the steam engine has not been treated in any other manner than that of rule of thumb, a term often used by those who would place theory before practice in the training of an engineer. Take, for instance, the diagrams intending to illustrate the defects in valve gears, which may often be met with in practice; these make the different defects perfectly clear, and one can see at a glance where the mistake is to be found.

Section x. deals with the calculations for power and steam consumption, and section xi. explains the effect of the inertia of the reciprocating parts of a steam engine; with an ordinary amount of mathematics all these can be easily followed. Section xiv. is on boilers. This section is the weak part of the book, and in future editions should be considerably augmented with information having reference to the design and strength of boilers.

The book is fully illustrated, in fact, we are told in the preface that the letter-press has been reduced as much as possible to allow of the introduction of the numerous tables and drawings; among the latter there is an excellent illustration of a compound Willan's central valve engine with two cranks—probably the best engine of the kind to be had. Some of these illustrations have evidently been especially prepared with the intention of giving an idea of principles of construction to the reader, particularly those having reference to types of steam engines, various ways of arranging cylinders and cranks in double and three-cylinders, compound, and triple expansion engine. These outline diagrams are exceedingly clear. Other illustrations are sectioned and finished in such a way so as to render the details evident. All these points add considerably to the value of the work as a text-book for senior students in our technical colleges; for draughtsmen engaged in stationary engine work, and for mechanic engineers generally.

N. J. LOCKYER.

Heat. By Mark R. Wright. (London: Longmans, Green, and Co., 1893.)

"OF making many books there is no end, and much study is a weariness of the flesh." Truer words than these were never written, and they are specially applicable at the present day. Mr. Wright's addition to the literature of science is avowedly "written specially to meet the requirements of the Advanced Stage of Heat as laid down in the Syllabus of the Directory of the Science and Art Department." To say that the author has satisfactorily accomplished his design is, therefore, to give him praise. In an examinational text-book there is little, if any, scope for originality, and all the author can do is to develop new methods of treatment. This Mr. Wright has done to a small extent, and he seems to be in touch with the work that has been done in connection with his subject during the last few years. Of the 136 illustrations only thirty-five have been drawn for the book: the majority of the others being of the well-known stock character, which have "had their day" and should have "ceased to be" long ago.

LETTERS TO THE EDITOR.

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Slickensides.

IN the account of M. Daubrée's experiments on the geological work of high-pressure gas (NATURE, July 6, p. 228), the following sentence occurs:—"In any case it is perhaps a little difficult to understand how a *single* movement of one rock surface over another . . . could produce anything like a perfect polish."

This recalls to my mind a freshly-made fault I examined in 1890, in a pit at Longcliff, Derbyshire. The rock was a moist, sandy fireclay or gannister; an area of about 80 feet square, lying on a slope of 35°, had slid down some 3 or 4 feet. The operations at the foot of the slope removed the support of the mass of rock above the sliding plane, and shortly afterwards it split across the middle, and the lower portion moved about

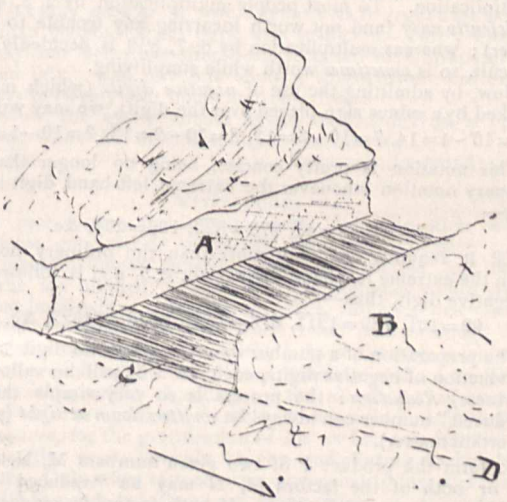


Diagram of fault at Longcliff Clay Pit.—A, Mass that slid down 4 ft. and then stopped: B, portion of A that slid 4 ft. further; C, Slickenside surface; D, fault or sliding plane.

3 feet further down, disclosing in the gap thus made the surface of the stationary rock. This surface exhibited every appearance of a typical slickenside; it was *highly polished*, *striated*, and even *blackened*, though the clay itself is cream-coloured. The striations corresponded with the direction of the movement, which had been a simple downward one.

Some slickensides may possibly be explained by reference to the action of high-pressure gas, but here at Longcliff was an unmistakable example of one caused by a "single movement of one rock surface over another," and it is very probable that the majority of ordinary slickensides have had a similar origin.

Mile End Road, London E., July 12. J. ALLEN HOWE.

Potstones found near Seaford.

PARAMOUDRA or potstones are known to geologists as existing in the chalk strata around Norwich and Belfast, but till lately I had supposed they were confined to those districts.

Last Whitsuntide, whilst enjoying a ramble along the chalk cliffs, east of Seaford, I was surprised to come across what seemed a real, but unusual potstone, lying among the stones below high-water mark, but which must, presumably, have originally fallen from the chalk above. Although consisting of a mass of chert, instead of pure flint like those near Norwich, in every other respect it resembles them. In form it is a large irregular cylinder and lies on its side, so that the sea water, when the tide rises, flows freely through it. It measures roughly between four and five feet in each direction, and the aperture has a diameter of twelve inches.

The enclosure of several large black flint nodules indicates that this peculiar shaped mass of chert has been formed since the flint itself segregated.

It seems probable that the "pipes" frequently found in sand will give us a clue as to its formation. In that case silica in the form of quartz is held together by ferruginous matter; here water holding silica in solution must have passed through the chalk like a vortex, and cemented together masses of chalk with its enclosed flints, with the result that we have a "pipe" of cretaceous matter held together by silica.

Here also, as on the Norfolk coast, are to be seen rings of flint on the shore, sometimes so placed as to form two or three concentric circles.

These instances, as well as others, point to the fact that masses due to segregation often assume the form of rings or cylinders. In flint this arrangement of growth is probably much more common than is generally known. I have already suggested (*Geol. Mag.*, June, 1893) a theory to account for the existence of these forms in flint, which, since Lyell's description of them, have been an enigma to geologists.

Tunbridge Wells, July 18. GEO. ABBOTT.

Simplified Multiplication.

THE object of this note is to explain a process of simplifying multiplication. To most people multiplication by 2, 3, 4, 5 is *sufficiently* easy (and not worth incurring any trouble to make easier); whereas multiplication by 6, 7, 8, 9 is decidedly more difficult, so is *sometimes* worth while simplifying.

Now, by admitting the use of *negative digits* (which may be marked by a minus sign placed over the digit), we may write—

$6=10-4=1\bar{4}$, $7=10-3=1\bar{3}$, $8=10-2=1\bar{2}$, $9=10-1=1\bar{1}$,

This notation is pretty concise, being no longer than the ordinary notation whenever the extreme left-hand digit is <5, thus—

$17=2\bar{3}$, $39=4\bar{1}$, $278=3\bar{2}\bar{2}$, $196=2\bar{0}\bar{4}$, &c.

whilst it requires one digit more than the ordinary notation when the extreme left-hand digit is not <5, and is followed by a negative digit, thus—

$99=10\bar{1}$, $789=1\bar{2}1\bar{1}$, $676=13\bar{2}\bar{4}$, $5678=1\bar{4}3\bar{2}\bar{2}$, &c.

The preparation of a number so as to contain no digit >5 (by introduction of negative digits, each not >5) will be called (for shortness) *Reduction*: the process is so very simple that the "reduced" number can always be *written down at sight* (a most important matter).

To form the product P of two given numbers M, N, either one or both of the factors M, N may be "reduced" as a preliminary to multiplication. If both factors be reduced, the rule of signs of algebraic multiplication must be used, viz.

$+\times+=+$, and $-\times-=+$; but $+\times-=-$, and $-\times+=-$

This "reduction" of both factors is particularly useful when many large digits occur in succession in both factors, in which case the whole of the multiplication can often be done mentally (without even writing out at length), thus—

$99^2=10\bar{1}^2=10\bar{2}01=9801$

$999^2=100\bar{1}^2=100\bar{2}001=998001$

$998^2=100\bar{2}^2=1004004=996004$

The following factors become particularly simple by this "reduction," viz.

$999\ldots9=1000\ldots\ldots\bar{1}$, $888\ldots9=1\bar{1}1\bar{1}\ldots\ldots\bar{1}$

$777\ldots8=1\bar{2}2\bar{2}\ldots\ldots\bar{2}$, $666\ldots7=1\bar{3}3\bar{3}\ldots\ldots\bar{3}$

When the results cannot be readily done mentally, the multiplication may be done by writing out at length *in the usual way* (attending of course to signs), thus—

89	$=1\bar{1}\bar{1}$	789 =	$1\bar{2}1\bar{1}$
89	$=1\bar{1}\bar{1}$	789 =	$1\bar{2}1\bar{1}$
	$\bar{1}11$		$\bar{1}211$
	$\bar{1}11$		$\bar{1}211$
	$1\bar{1}\bar{1}$		$\bar{2}422$
			$1\bar{2}1\bar{1}$

$\therefore 89^2=1\bar{2}121=7921$ $\therefore 789^2=1422521=622521$

It will be seen that the ease of the above procedure depends chiefly on the digits being so small (in both factors) as not to involve any *carrying* from digit to digit in the multiplications; this will always be the case when no digit exceeds 3 or $\bar{3}$ (because the greatest product $3\times3=9$ only). But when the digits 4, 5, 6 occur *in either factor*, this will usually involve *carrying* in the multiplications (because 3×4 and 2×5 are both >9). In this case it is generally better to "reduce" one factor only, and by preference that factor which has the greatest number of large digits (*i.e.* 7's, 8's, 9's), and further to use this factor as "multiplier," keeping the other factor unreduced as multiplicand. Further, it is often convenient in this case (especially when the factors are large) to completely separate the positive and negative products, add them separately, and finally take the difference of these sums; this will be the required product: this procedure (of using negative digits only in the multiplier, and then separating the + and − products) has the great advantages that (1) no further attention need be paid to the signs, and (2) the final line has all its digits necessarily positive, so is itself the required product (in ordinary notation).

Ex.—Given M = 34,892, N = 89,795; to find M × N. Choose N as "multiplier," because it contains four large digits. The work proceeds thus—

	34 892	= M
	$1\bar{1}0\,\bar{2}1\bar{5}$	= N
	174 460	= 5 × M
3 489 2		= 1 × M
	3 489 374 460	= Positive sum = p
All negative	348 92	= $\bar{1}$ × M
	6 978 4	= $\bar{2}$ × M
	348 92	= $\bar{1}$ × M
	356 247 32	= Negative sum = n

$\therefore p\ldots n=3\,133\,127\,140=$ Product M × N

It will be seen that this process requires two more lines than the ordinary process (viz. the two lines p, n), but the *actual multiplications are far easier*.

It is obvious that the two lines p, n may be separately tested by the usual processes of "casting out the nines, elevens, &c."

The whole process above is so simple that it might well find a place in works on elementary algebra immediately after the explanation of the rule of signs in multiplication; it is thoroughly practical, and having been much used by the author, can be confidently recommended.

The use of negative digits, as above explained, may also be applied to the process of division, and in some cases with advantage. This application is, however, in general by no means quite easy, so cannot be recommended as a practically useful process.

[This process—as applied to multiplication—is not of course new; but it seems worth while to attempt to revive it now; as a process, somewhat the same in principle, has just been published (in the *Annales des Ponts et Chaussées* for April 1893, p. 790) by Mr. Ed. Collignon. The only *actual multiplication* required in his process is by the digits 2 and 5; the elimination of actual multiplication by 3, 4, 6, 7, 8, 9 is of course an immense advantage. To this end he first shows how to "reduce" any number N to the algebraic sum (say $N_1+N_2-N_3$) of three others, N_1, N_2, N_3, composed solely of the four digits 0, 1, 2, 3. To multiply two numbers M, N, one of them, say N, is to be "reduced" as explained: the products MN_1, MN_2, MN_3 are then to be formed in the usual way; their algebraic sum $MN_1+MN_2-MN_3$ is the product required. The process has two decided defects, viz.—(1) the "reduction" of N is somewhat troublesome; (2) the forming and adding the three products ($MN_1+MN_2-MN_3$) is a good deal longer than the ordinary process.] ALLAN CUNNINGHAM.

Thunderstorm Phenomena on the Matterhorn.

IN 1888-1889 I witnessed some eight-and-twenty thunderstorms on the Pampas of South America; and came to the conclusion—

(1) That there was no reason to suppose that the so-called "sheet-lightning," or "summer-lightning," is anything more than the glare of distant spark-discharge;

(2) That by far the greater number of discharges took place between different layers of cloud, and not between clouds and the earth;

(3) That the origin of these storms lay in the electrical excitation due to the friction between opposed currents of air (carrying cloud), upper and lower respectively.

This year I was witness of a thunderstorm under very differ-

ent circumstances, and I observed a phenomenon that appears to me to be of interest.

On July 10 I was on the Matterhorn in very doubtful weather. It appeared as though the Föhn (or southerly wind) were struggling with a northerly wind, and as though the former conquered. Clouds or mist pressed up from Italy, and rose higher and higher, covering the other mountains before the Matterhorn. We had some snow at intervals even before midday, and by the time that we had, on return from the summit, descended as far as the upper hut, it was snowing steadily. I think that, as regards the Matterhorn, the electrical hissing of ice-axes, rocks, &c., began about 3.30 p.m. or 4 p.m., and lightning began rather later.

At last came one flash, apparently very near to us, the thunder following close with a crash. *Before the thunder*, however, and apparently *with* the flash, came a curious splitting, cracking, and shivering sound, with a kind of "splash" from the rocks—as it seemed. I give many adjectives for want of one good expressive word. This sound preceded the thunder, and was both sharp and faint; I felt that I only heard it because I was on the spot.

Later, another flash came close to us. This time I heard no "splash" from the rocks; but, apparently *with* the flash, and before the thunder-crash, there came a light, shivering, branching crack again, something like the "ghost" of thunder, one might say. It reminded me this time of the shiver that passes over the surface of new snow, only very slightly crusted, when first broken in any part by the feet of a traveller. (Some climbers will know this sound; but I myself have only occasionally noticed it, and that only when I have been the first on a snowfield soon after a heavy fall of snow.) I received a slight shock in the head this time. A third flash gave the same sound as the second; but no others seemed so close, and I never heard this sound again.

It was dark when we reached the lower hut; and all down the arête the brushes of purple light that streamed from our fingers (when held up) and from our axes, hats, hair, &c., were very beautiful. The fingers gave better brushes when wetted. There were numerous brushes streaming from the rocks, these being wet with water melted from the snow.

Some other people who were on the Gorner Grat the same day told me, before I mentioned my experiences, that the lightning seemed to give a splashing sound on the rocks. They also told me that those who wore felt hats, felt return shocks, while those with straw hats did not. All the hats were wet.

So much for observation; now for a theory.

To begin with, since the thunder distinctly crashed *after* the lightning-flash, it would seem that the phenomenon that caused the sound I heard must have preceded the spark.

I would suggest the following explanation.

I do not think that those who have never been actually in a storm realise how very indefinite, in substance and boundaries, "a thundercloud" is. It seems certain that we must not regard it as if it were a polished conductor that is gradually charged until it sparks to earth or to other clouds. More probably there is a fall (or rise) of potential through the substance of the cloud itself. When the stress is too great, there is probably a breakdown along many paths in the form of the fine branching sparks observed when a Wimshurst is used without a condenser. This preliminary breakdown suddenly gives a very much larger potential-difference between the portion of the cloud-masses towards which it takes place; so suddenly in fact, that a spark-discharge occurs before more diffuse modes of readjustment can obtain. It seems to me that it is only by some such preliminary discharge from behind that such irregular "surfaces" as those of clouds could attain the condition requisite for the true spark. In something the same way we can pass a spark between two rough or pointed metal terminals by a sudden discharge through them, while we could not raise them in any slower way to the necessary condition.

According to this view, a slighter and more branching discharge in the body of a cloud would be the necessary preliminary to a regular flash; and the, relatively faint, sound of it would precede the "thunder" of the final flash. When once the flash occurs, resistance is much diminished, and the stress of the whole region is relieved through the path created.

An obvious objection to this view, however, will occur to many. "Would the time-interval be long enough? Would not the first sound be practically heard with the thunder, and be drowned in it?'

Another explanation might be, that (as is often the case with a Wimshurst or other machine) there are fainter, tentative, branching discharges that precede the bright spark. But, if this were the case, they should surely be heard in some cases before any spark occurs at all.

Finally, the sound, though it appeared to come out of the air, might have been due to the movements of the stones and rocks over the surface of the mountain, occurring when the stress was relieved. Such a sound might well reach one before the sound of the spark. WALTER LARDEN.

R. N. E. College, Devonport, July 24.

Highest Rainfall in Twenty-four Hours.

WITH reference to the paragraph quoted in your notes of this week's NATURE from the *Indian Planters' Gazette* of Jan. 28, 1893, the most elementary knowledge of Indian meteorology would suffice to show that the remarkable figure, 48 inches, supposed to represent the fall of a single night in January at Dehra Dun, is simply a misprint for 4·8. The entire rainfall of the winter season in no part of India exceeds one-half this amount, and I have no hesitation in declaring such a figure as 48 inches in twenty-four hours to be absolutely without precedent, and, in my opinion, so extraordinary at such a season, that, if it really were 48, it would require us to regard all existing Indian meteorological data with suspicion. Thirty inches in twenty-four hours has often been recorded at Chirapunji in June and July. Can any one show a single instance of even 20 inches in twenty-four hours at Dehra Dun?

Moreover, the whole annual supply at Dehra Dun is only 75 inches, while that of Chirapunji is 600 inches!

July 29. E. DOUGLAS ARCHIBALD.

Vivisection.

THE recent remarkable discoveries in connection with Myxœdema conclusively prove the value of vivisection as a means whereby human suffering may be alleviated, and only those who are blinded by ignorance or prejudice would dare deny that hundreds of sufferers from goître, and other distressing symptoms of cretinism, have obtained relief solely through experimental research upon animals. Inconsistency is closely linked to prejudice, and the greatest anomaly is the Anti-Vivisectionist who, while objecting to the alleviation of human suffering on the score of "cruelty to animals," enjoys and countenances, for the gratification of his or her own individual pleasures, the most horrible cruelty and torture to helpless creatures. Only a few of such cases now occur to me, and these I herewith append, but there are many others as disgustingly cruel.

Boiling lobsters, prawns, etc., *alive*.

"Whitening and tendering" veal by bleeding, and beating with sticks, the calf *while still living*.

Skinning and cooking eels *alive*.

Maiming, and shattering to pieces, pigeons and other birds ("sport"), hundreds dying a lingering death.

Hacking and mauling rabbits by gins.

Hounding to death harmless hares, and exulting over this torture ("sport").

Plucking feathers from *living* birds, and skinning *living* animals.

When every professed anti-vivisectionist undertakes to endeavour to put a stop to these, and similar cruelties, their sincerity will at least be visible.

Bournemouth, July 24. CECIL CARUS-WILSON.

A Correction.

IN my "Preliminary Note," as read at the Royal Society meeting, June 15 last (NATURE, vol. xlviii. p. 311), the first paragraph reciting "The laws connecting pairs of axes, by successive rotations round which a given displacement of a rigid body in space may be effected," should read: "If the first axis is taken arbitrarily in a plane parallel to that of the 'central axis,' and any given direction ζ' meeting it, to which latter the axis remains parallel, there is a direction determined to which its conjugate must be parallel, in the side common to three quadric cones the constants of which are functions of ζ' and the vectors defining the displacement and the position of the first axis."

The next two paragraphs will require slight modifications accordingly; and the last will, of course, be unnecessary.

I owe this correction to a correspondence with which Prof. W. Burnside, F.R.S., has favoured me since the meeting.

July 29. J. J. WALKER.

THE ASTRONOMICAL HISTORY OF ON AND THEBES.

IN a previous article I have attempted to show that there was a considerable difference of astronomical thought between those, on the one hand, who built pyramids and temples facing true east and west and those, on the other, who built solar temples not oriented to the equinox, but rather, though not exclusively, to the solstice.

It was suggested that although in the matter of simple worship the sun would come before the stars; in *temple* worship the conditions would be reversed in consequence of the stable rising and setting places of the latter as compared with those of the sun at different times of the year.

Another suggestion was hazarded that sun temple-worship might have been an accidental result of the sunlight entering a temple which had really been built to observe a star; and that such temple sun-worship might possibly have preceded the time at which the solstices and equinoxes, and their importance, had been made out. I think it is possible to show that this really happened, and we owe the demonstration of this important fact to the Egyptian habit of having two associated temples at right angles to each other, because this habit justifies the assumption that at On the single obelisk which now remains not only indicates the certain existence in former times of one temple, but in all probability of two at right angles to each other.

But this is only one point among many to which one may appeal in approaching the study of the question. Another of great importance is brought before us in the masterly essay by M. Virey, entitled "Notices Générales," on the discoveries made at Der el-Bahari by MM. Maspero and Grébaut.

In his account of the confraternity of Amen and of the various attempts made by the Theban priests to acquire political power he refers to the action of Amenhetep IV. (Chu-en-Aten).[1]

In the time of Thotmes III. the alliance between the royal and the sacerdotal power was of the closest, and in no time of the world's history have priests been more richly endowed than were then the priests of Amen. Not content, however, with their sacred functions, they aimed at political power so obviously that Thotmes IV. and Amen-hetep III., to check their intentions, favoured the cults and priesthoods of On and other cities of the north. Amen-hetep IV. went further; he looked for alliances out of Egypt altogether, and entered into diplomatic relations with the princes of Asia, including even the king of Babylon. This brought him and the priests to open warfare. He replied to their anger by prescribing the cult of Amen. The name of Amen was effaced from the monuments, still the priestly party was strong enough to make it unpleasant for the king in Thebes, and to deal them yet another blow, he quitted that city and went to settle at Tell el-Amarna, at the same time reviving an old Heliopolitan cult. He took for divine protection the solar disc *Aton*, "which was one of the most ancient forms of one of the most ancient gods of Egypt, Rā of Heliopolis."[2] Now let us say that the time of Amen-hetep IV., according to the received authorities, was about 1450 B.C. The lines of the "Temple of the Sun" at Tell el-Amarna are to be gathered from Lepsius's map, the orientation is 13° north of west. This gives us a declination of 11° north, and the star Spica at its setting would be visible in the temple, and the sunlight at sunset would enter the temple on April 18 and August 24 of the Gregorian year.

Hence, then, the temple was probably built really to observe the sunset on a special day in the year. In this view how appropriate was the prayer of Aahmes, Chu-en-Aten's chief official.

"Beautiful is thy setting, thou sun's disk of life, thou Lord of Lords and King of the worlds. When thou unitest thyself with the heaven at thy setting, mortals rejoice before thy countenance and give honour to him who has created them, and pray before him who has formed them, before the glance of thy son who loves thee the King Khu-en-aten. The whole land of Egypt and all peoples repeat all thy names at thy rising, to magnify thy rising in like manner as thy setting."

Still perhaps more beautiful was the prayer of the queen.

"Thou disk of the Sun, thou living God! there is none other beside thee! Thou givest health to the eye through thy beams. Creator of all beings. Thou goest up on the eastern horizon of heaven to dispense life to all which thou hast created; to man, four-footed beasts, birds, and all manner of creeping things on the earth, where they live. Thus they behold thee, and they go to sleep when thou settest.

"Grant to thy son, who loves thee life in truth, to the lord of the land, Khu-en-aten, that he may live united with thee in eternity.

"As for her, his wife, the Queen Nefer-it-Thi, may she live for evermore and eternally by his side, well pleasing to thee; she admires what thou hast created day by day."[1]

Still the light of Spica would not enter it axially if the orientation is correct. This would have happened in 2000 B.C., that is 600 years before the time of Amen-hetep IV. This is a point which Egyptologists must discuss;[2] it is quite certain that such a pair of temples as those of which Lepsius gives us the plans could not have been completely built in his short reign, and they would not perhaps have been commenced on *heretical* lines in any previous reign during the 18th dynasty. It must therefore have been commenced before 1700 B.C., perhaps in the 17th dynasty In any case it was certainly finished by Chu-en-Aten.

But this "temple of the Sun" was not built alone. There was another at right angles to it, and while Spica was seen setting in one, a star near γ Draconis was rising in the other.

Remembering then that the temple attributed to Amen-hetep IV. pointed to Spica, let us recur for a moment to the temple conditions at Thebes. There, as we have seen, the temple of Mut is associated with one at right angles to it, facing north-west. The amplitudes are 72½° north of east and 17½° north of west. I have shown that the temple of Mut would allow γ Draconis to be seen along its axis about 3200 B.C. *I now state that* Spica *would be seen along the axis of the rectangular temple at the same time.*

We have next to consider what had taken place at Thebes, so far as we can trace it on the orientation hypothesis since 3200 B.C.; but to understand thoroughly what was done another reference to M. Virey's essay is necessary. One of the chief aims of the confraternity of Amen was to abolish the worship of Set, Sit, or Sutech, that is generically the stars near the north pole, and, as it can be shown, in favour of the southern ones. The temple of Mut was the chief temple at Karnak, in which the cult of the northern stars was carried on.

We can now realise what the Theban priests got Thotmes to do.

In his day the cult of Spica (the solar disc, Aton, Min, Khem), and γ Draconis (the Hippopotamus and Lion Isis) was supreme. The little shrine of the Theban Amen was enlarged and built right aross the fairway

[1] "Notices des Principaux Monuments Exposés au Musée de Gizeh," p. 260. 1893.

[2] Gizeh Catalogue, 1893, p. 68.

[1] Translated by Brugsch, "Egypt," p. 221.

[2] Since the above was written, Prof. Flinders Petrie has been good enough, in reply to an inquiry, to state his opinion that the temple was entirely built by Chu-en-Aten. Should this be confirmed, it may have been oriented directly to the sun, on the day named, or more probably built parallel to some former temple, for traces of other temples are shown on Lepsius' plan, and I presume Chu-en-Aten is not supposed to have built all of them.

of the temple of Mut, so that the worship was as effectively stopped as the worship of Isis was stopped at Pompeii by the town authorities (when it was prohibited by law), bricking up the window through which the star was observed.

Further, the shrine so restored was of such magnificence that the Spica temple, which had hitherto held first rank, became an insignificant chapel in comparison. Nor was this all. In order still to emphasise the supremacy of Amen, a third-rate temple was erected to Ptah.

We may now return to Amen-hetep's doings at Tell el-Amarna. The worship he emphasised there exactly resembled that which had in early times been paramount at Heliopolis. One based on it, but not identical with it, had been in vogue at Thebes from 3200 B.C. to the time of Thotmes, who, as the tool of the confraternity of Amen, intensified the solstitial worship, and did his best to kill that which had been based upon the Heliopolis cult.

The next question we have to consider is whether the researches at Heliopolis bear this surmise out. It is true we have but one poor obelisk, but let us see what we can make of it. As I have shown, the north and south faces bear 13° north of west—13° south of east. Amen-hetep or some one of the preceding kings of Egypt, when reintroducing the old worship at Tell el-Amarna orients the solar temple 13° north of west according to the data available. Now when we take the difference of latitude between Heliopolis and Tell el-Amarna into account we find that the same declination (within half a degree) is obtained from both.

I have elsewhere shown that there is good reason for believing that the original foundation of the temple at On dates from the time when the north member of the system was directed to *α* Ursæ Majoris. This was somewhat earlier than 5000 B.C.

Bearing in mind the facts obtained with regard to other similar rectangular systems, we are led to inquire whether at that date a temple oriented to declination 11° north was directed to any star.

We find that the important star Capella was in question.

Now so far in my references to stars no mention has been made of Capella. It is obvious that the first thing to be done on the orientation hypothesis is to see whether any other temple, and if of known cult so much the better, is found oriented to Capella. There is one such temple ; it is the small temple of Ptah, just mentioned as having been erected by Thotmes. (Time of Thotmes III. 1600 B.C. Amplitude of temple ± 35° west of north = with hills 3° high 32½° north declination ; Capella 33° north declination about 1700 B.C.)

And now it appears there is another. During the year 1892 the officers of the Museum of Gizeh, under the direction of M. de Morgan, excavated a temple at Memphis to the north of the hut containing the recumbent statue of Rameses, and during their work they found two magnificent statues of Ptah, "les plus remarquables statues divines qu'on ait encore trouvées en Egypte," [1] and a colossal model in rose granite of the sacred boat of Ptah.

These discoveries have led the officers in question to the conclusion that the building among the ruins of which these priceless treasures have been found is veritably the world-renowned temple of Ptah of Memphis. It may therefore be accepted as such for the purpose of the present inquiry, although it is difficult to reconcile its *emplacement* in relation to the statues with the accounts given by the Arab historians.

In January, 1893, Captain Lyons, R.E., was good enough to accompany me to determine the orientation of the newly uncovered temple walls. We had already, two years previously, carefully measured the bearings of the statues of Rameses. We found the temple in all probability facing westwards, and not eastwards, this we determined by a seated statue facing westwards ; and its orientation, assuming a magnetic variation of 4½° west- to be 12¾° north of west and the hills, in front of it, as, suming the village of Mit-Rahineh non-existent, to be 50′ high.

Here, then, we get reproduced almost absolutely the conditions of the obelisk at Heliopolis in a Ptah temple oriented to Capella 5200 B.C.

We are driven then to the conclusion that the star Capella is personified by *Ptah*, and that as Capella was worshipped setting, Ptah is represented as a mummy. If this be so we must also accept another conclusion. That the temples both at Heliopolis and Memphis were dedicated to Ptah. About 5300 B.C. we seem almost in the time of the divine dynasties, and begin to understand how it is that in the old traditions Ptah precedes Rā and he is called "the father of the beginnings, and the creator of the egg of the Sun and Moon.[1]

What, then, was this worship which had been absent from Thebes, but which had held its own to the north to such an extent that Amen-hetep IV. went back to it so eagerly? It could not have been the worship of Capella as a star alone, for such worship had been provided for by Thotmes III. by building temple G. Nor could it have been the worship of Spica as a star alone, for in that case the precedent of On would not have been appealed to. We are driven to the conclusion that it was the worship of the sun's disc when setting, at the time of the year heralded by these stars, when it had the declination of 10° north. The dates on which the sun had this declination were, as already stated, about April 18 and August 24 of our Gregorian year. The former, in Egypt, dominated by the Nile, was about the time of the associated spring and harvest festivals.

So much for the Ptah mummy form of the Sun-God, to which the Theban priests erected no temples. There was still another, the worship of which existed at Thebes, but which they did their best to abolish by the intensification of the worship of Amen-Rā. I refer to the worship carried on in the temple oriented to Spica. This, there can be no doubt, was the worship of Min, Khem in ithyphallic mummy form. This was associated with the harvest home festival on May 1. (Amplitude of temple, 17½ north of west, declination 15° = sun's declination on May 1.)

It seems, then, that the suggestion that *possibly* sun-worship existed before the solstitial solar worship is amply justified.

Now so far as my inquiries have yet gone, there is not above Thebes, with the single exception of Redesieh, any temple resembling the On-Thebes ones to which I have directed attention as having a high north-east amplitude.

Similarly, with one or two exceptions which may be late, there are no temples facing the south-east below Thebes.

In short, in Lower Egypt the temples are pointed to stars rising near the north point of the horizon or setting west of north. In Upper Egypt we deal chiefly with temples directed to stars rising in the south-east.

Here again we are in presence of as distinct differences in astronomical thought and methods of observation as we found among those who directed temples to the sun at the equinox, as opposed to those who worshipped that luminary at some other time of the year.

Now with regard to the northern stars observed rising in high amplitudes we have found traces of their worship in times so remote that in all probability at On

[1] New Gizeh Catalogue, p. 61.

[1] Brugsch, "Religion and Mytologie," p. 111. Pierret, "Salle Historique de la galerie Égyptienne" (du Louvre), p 199.

and Denderah *a* Ursæ Majoris was used before it became circumpolar. We deal with 5000 B.C.

Since undoubtedly *new* temples with nearly similar amplitudes (such as that denoted by M at Karnak) were built in late times, we find so long a range of time indicated that the utility of the stellar observations *from the yearly point of view* could scarcely have been in question.

It may be suggested therefore that the observations made in them had to do with the determination of the hours of the night; this seems probable, for in Nubia at the present day time at night is thus determined.

It may be that such stars as Canopus were used by the southern peoples for the same purpose as *a* Ursæ Majoris first and then γ Draconis were used by the northerners. In other words, the question arises whether the extreme north and south stars were not both used as warners of the dawn all the year round.

It is well known that in quite early times means had been found of dividing the day and night into 12 hours. In the day shadows cast by the sun, or sundials, might have been used, but how about the night?

We have seen that the Egyptians chiefly, if not exclusively, observed a heavenly body and the position of other bodies in relation to it, when it was rising or setting, so that it was absolutely essential that the body which they were to observe should rise and set. Everybody knows that as seen in England there are many stars which neither rise nor set. The latitude of London being 51°, the elevation of the pole therefore is 51°.

Hence, any star which lies within that distance from the pole cannot set, but sweeps round without touching the horizon at all. The latitude of Thebes being 25°, the distance from the pole to the horizon is much smaller, and so the number of stars which do not rise and set is much smaller. The stars which do not rise or set are stars near the pole, and therefore stars which move very slowly, and the stars which rise most to the north and most to the south are those bodies which are moving most slowly while they yet rise or set. Can this slow rate of motion have had anything to do with such stars being selected for observation, the brightest star to the north, most slowly moving, the brightest star to the south most slowly moving? It is possible that observations of these stars might have been made in such a way that at the beginning of the evening the particular position of γ Draconis, for instance, might have been noted with regard to the pole star: and seeing that the Egyptians thoroughly knew the length of the night and of the day in the different portions of the year, they could at once the moment they got the starting point afforded by the position of this star practically use the circle of the stars round the north pole as the dial of a sort of celestial clock. May not this really have been the clock with which they have been credited? However long or short the day, the star which was at first above the pole star, after it had got round so that it was on a level with it, would have gone through a quarter of its revolution.

In low northern latitudes, however, the southern stars would serve better for this purpose, since the circle of northern circumpolar stars would be much restricted. Hence there was a reason in such latitudes for preferring southern stars. With regard both to high north and south stars then, we may in both cases be in presence of observations made to determine the time at night. So that the worship of Set, the determination of the time at night by means of northern stars, might have been little popular with those who at Gebel Barkal and elsewhere in the south had used the southern ones for the same purpose, and this may be one reason why the Theban priests, representing Nubian astronomical culture and methods, were pledged to drive the cult of Sutech out of the land.

Since then the observations of γ Draconis might be used to herald the sunrise almost all the year round, and since the modern constellation Draco is the old Hippopotamus, we can readily understand Plutarch's statement that "Taurt presides over the birth of the sun," and why Taurt or Maut should be called the Mistress of Darkness.[1]

It does not seem too much to hope that the continuation of such inquiries may ultimately enable us to solve several points connected with early Egyptian history. We read in Brugsch:—[2]

"According to Greek tradition, the primitive abode of the Egyptian people is to be sought in Ethiopia, and the honour of founding their civilisation should be given to a band of priests from Meroë. Descending the Nile, they are supposed to have settled near the later city of Thebes, and to have established the first state with a theocratic form of government."

"But it is not to Ethiopian priests that the Egyptian Empire owes its origin, its form of government, and its high civilisation; much rather was it the Egyptians themselves that first ascended the river to found in Ethiopia temples, cities, and fortified places, and to diffuse the blessings of a civilised state among the rude dark-coloured population."

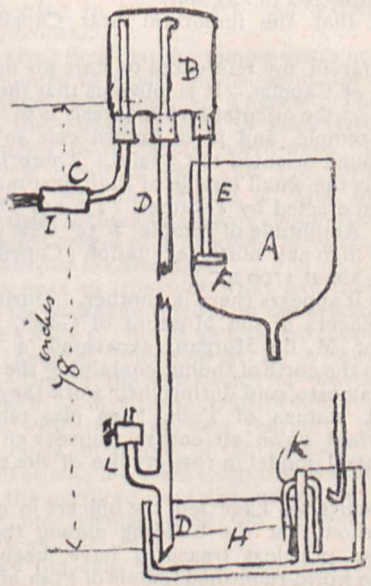
. . . "Strange to say, the whole number of the buildings in stone, as yet known and examined, which were erected on both sides of the river by Egyptian and Ethiopian kings, furnish the incontrovertible proof that the long series of temples, cities, sepulchres, and monuments in general, exhibit a distinct chronological order, of which the starting point is found in the pyramids, at the apex of the Delta."

J. NORMAN LOCKYER.

(*To be continued.*)

A PERIODIC MERCURY PUMP.

I HAVE designed and constructed the instrument described in the following lines to reduce the labour of working pumps of the Sprengel class. It has proved itself to be so serviceable in our laboratory that I believe a short descripion of it may be useful to those who



are engaged in work in which the mercurial pump is employed.

A is the cistern of the Sprengel pump (not shown), B is a bottle having three necks: it is furnished with three tubes, C, DD, EF; C, which has a valve at I, is attached

[1] Rawlinson, i. 337.
[2] "Egypt under the Pharaohs," ed. 1891, p. 3.

to an ordinary water-pump through a wash bottle containing sulphuric acid (I find that which is known as the University College pump the best); EF dips into the cistern A, and is closed at its end F by a small glass ball fitting the ground out end of the tube which acts as a valve. The tube DD dips in the cistern H into which the mercury from the Sprengel pump is discharged. The siphon K causes the supply of mercury to be periodic; upon this the action of the pump depends. By means of a stop-cock L air is admitted to the tube DD. The mercury is raised thus: A partial vacuum is formed in B by the water-pump; this raises the mercury to the point where L joins DD; a piston of mercury is then formed, and it is at once carried up into B; this goes on till all the mercury in H is raised to B, then air is drawn through DD and the vacuum ceases in B, and the mercury falls through EF; in a short time H refills, and the operation is repeated.

The instrument at work in my laboratory raises 90 lbs. of mercury 6·5 feet high in one hour. The pump requires no attention after it has been started. The valve I stops the tube C, should the supply of water to the water-pump be accidentally cut off when the pump is lifting. I have made many experiments with mercury elevators, and from these it appears that the periodic supply of mercury to the cistern from whence it is drawn greatly contributes to the certainty of the action of the instrument.

FREDERICK J. SMITH.

THE LATE DR. JOHN RAE.

DR. JOHN RAE, F.R.S., whose death we announced last week, was perhaps the most persevering and successful of the Arctic travellers by land whose journeys called forth the admiration of the world forty years ago. He was a native of Orkney, born in 1813, and studied medicine at Edinburgh, where he qualified in 1833. Rae was early brought face to face with his life-work, his first engagement on leaving college being as surgeon to the Hudson Bay Company's ship which carried supplies to the fur-forts in Hudson Bay. He entered the service of the company, and for ten years lived at Moose Factory, gaining familiarity with Arctic life during the severe winters. In 1845 his true career as an Arctic explorer began in his undertaking the leadership of a small expedition to explore a considerable extent of the coast-line of the Arctic Sea. In June, 1846, he set out on this expedition from York Factory, coasted along the west side of Hudson Bay, and wintered on the shore of Repulse Bay. Early in 1847 he made an extensive land journey to the north and west, with the result that 700 miles of new coast were surveyed, almost filling the gap between Ross's work in Boothia and Parry's at Fury and Hecla strait. In 1850 Dr. Rae published an account of this expedition in the form of a book of 250 pages. This was, curiously enough, his only permanent contribution to geographical literature, his subsequent journeys being recorded merely in formal reports published in the *Journal* of the Royal Geographical Society. After this journey Rae came to London, but was almost immediately induced to join the first land expedition sent to seek for Sir John Franklin, under the leadership of Sir John Richardson. The expedition was unsuccessful as to its primary purpose of finding traces of Franklin, but it effected a satisfactory survey of the whole coast between the Mackenzie and Coppermine rivers. In 1851 Rae received the command of another boat expedition for the Hudson Bay Company, in the course of which he thoroughly explored and mapped the south coast of Wollaston Land and Victoria Land, still searching vainly for traces of Franklin's party. On his return from this arduous undertaking, which he conducted throughout with conspicuous daring and sagacity, he had to travel on snow-shoes, and himself dragging a sledge, across the whole length of Canada from the Arctic Sea, through Fort Garry (now Winnipeg) until he reached United States territory. His total walking on this expedition was over 5000 miles, of which 700 miles were traversed for the first time. On returning to England in 1852 the gold medal of the Royal Geographical Society was presented to him by Sir Roderick Murchison in a speech, the cordial terms of which showed how fully Dr. Rae's genius for Arctic travel with the minimum of equipment and at infinitesimal expense was appreciated by the highest authorities. In no wise deterred by the hardships of his earlier campaigns, Rae left England early in 1853 to continue his work in the far north; the Hudson Bay Company equipping an expedition on condition that he would lead it personally. He completed the survey of King William's Land on this occasion, proving it to be an island; 1100 miles of sledging were accomplished in the process, of which 400 miles were new discovery. But the really important result of this expedition was Dr. Rae's meeting with the first evidence of Sir John Franklin's fate, from the story of a party of wandering Eskimo. The tribe encountered were in possession of many personal relics of members of that ill-fated expedition, which Rae secured and brought home. When he returned to England with the news so long searched for and so anxiously awaited, the Admiralty, which had spent large sums in fitting out successive expeditions, concluded that the fate of Franklin was decided beyond a doubt, and accordingly awarded to Dr. Rae the sum of £10,000 offered by Government to the first who brought back decisive information. The justice of this award was at the time strongly objected to by Lady Franklin, and although no further action was taken by Government she continued to organise private expeditions, which, while proving in effect the correctness of Dr. Rae's information from the Eskimo, served in no small degree to advance the geographical survey of the polar area.

In all his expeditions, Dr. Rae made collections of characteristic plants and animals as well as physical and meteorological observations. The material, described by other workers, went to swell the sum of our knowledge of the general conditions of climate and life in the Arctic basin.

In 1860 and subsequent years Dr. Rae made a series of interesting journeys in Iceland, Greenland, and in North America with the object of exploring and arranging routes for telegraph lines. His later years were spent in this country, where he made himself conspicuous by his zeal in forwarding the volunteer movement, being himself an excellent shot. The feeling which grew upon him to a painful extent as he became older, that his brilliant explorations were not adequately recognised and acknowledged on the Admiralty charts, unfortunately somewhat embittered his last years. But to the end he took the keenest interest in Arctic travel and was ever ready to take part in discussions bearing on the region in which he had lived so long and suffered so much. He was a regular attendant at meetings of the Royal Geographical Society and Colonial Institute, and for many years attended the gatherings of the British Association.

NOTES.

THE Senate of Edinburgh University has conferred the honorary degree of Doctor of Laws upon Prof. Arthur Auwers, in recognition of his astronomical labours. The same honour has been given to Dr. Littlejohn, the President of the British Institute of Public Health.

A Reuter's telegram states that a cloud-burst occurred at Pueblo, Colorado, on July 28, and destroyed property to the

value of 25,000 dols. Seven lives were lost. The Arkansas River for many miles was turned into a raging torrent. The buildings along the river, comprising small boarded shanties, tents, and houses occupied by workmen, proved an easy prey to the rising waters. The storm extended over a large area, and at Denver the electric street cars were prevented from running by the electrical disturbances.

WE are glad to see that an attempt is being made to bring together members of the Royal and learned societies by the formation of a club in which membership will be limited exclusively to presidents, members of council, fellows, and members of the principal Royal and learned societies of the United Kingdom, India, and the colonies, academicians and associates of the Royal Academies, together with the presidents, members of convocation, council, and professors of the Universities and various Royal institutions. The club has already been joined by many distinguished men in science, art, and literature, and forty societies are represented either by past presidents, vice-presidents, presidents, and members of council. Premises comprising the whole of the block No. 63, St. James's Street, have been secured for the club house, which is expected to be ready for occupation early in October. The temporary offices are at 3, Waterloo Place, Pall Mall. Colonel W. P. Hodnett is the hon secretary.

THE sixty-first annual meeting of the British Medical Association commenced at Newcastle-on-Tyne on Tuesday. The committee on hypnotism presented a report stating that they had satisfied themselves of the genuineness of the hypnotic state, but, after a discussion, the congress decided to receive the report without adopting it. In the evening Prof. Philipson, of Durham University, delivered an address, in which he described the diseases prevalent among mining populations, and suggested means by which to improve the machinery for guarding public health.

THE Congress of the British Institute of Public Health met on July 27 at Edinburgh, and the Presidential address was delivered by Dr. Henry D. Littlejohn. On the following day Mr. Ernest Hart read a paper on "Cholera Nurseries and their Suppression." Mr. Hart claims to have established on a basis of evidence collected from every part of Europe the dicta—founded upon the original investigations by Snow and Simon on the British epidemics of 1848 and 1854, and by himself and Radcliffe of the East London epidemic of 1866. 1. "That cholera is a filth disease, carried by dirty people to dirty places, and diffused by specifically poisoned water." 2. "That you may eat cholera and drink cholera, but you cannot catch cholera." 3. "That cholera may be considered for all practical purposes as an exclusively water-carried disease, and that it is carried only by water poisoned by human discharges." Mecca is the nursery of cholera, holds Mr. Hart, and is the place in which to stop it. He formulates the following steps which ought to be taken to save the Mohammedans from the danger caused by their pilgrimages, to save the world from the danger caused by Mecca. 1. The Indian sanitary services should be re-organised. 2. A complete sanitary regulation of all Indian fairs should be undertaken, the precautions so successfully instituted at Hurdwàr in 1891 being taken as a type. 3. A rigid system of medical inspection of all pilgrims should be instituted at the ports from which they start, the sick being detained and the healthy alone allowed to proceed. This, it may be added, would be all the more effectual in regard to Indian ports from the fact that a second weeding out of the infected can take place at Camaran. 4. The medical inspection at Camaran should be so conducted as to ensure its complete efficiency. A large number of communications were read in the various sections, but the majority of them were not of general scientific interest. The congress was brought to a close on the afternoon of July 31.

IN the August number of the *Entomologist's Monthly Magazine* Lord Walsingham gives a description of the manner in which the late Mr. Stainton's collection of *Lepidoptera* have been disposed by the Trustees of the British Museum to whom they were presented. The collection is now accessible to students at the Natural History Museum. With regard to a large cabinet containing a great number of European and exotic *Tineidae*, Lord Walsingham writes: "It has been determined, after making an inventory, to keep the contents of this cabinet for the present undisturbed, although it is hoped that they may be incorporated from time to time in the future together with other material: for instance, my own collection (including that of the late Prof. Zeller) left by my will to the Museum; the *Grote* collection, still untouched as regards the *Tortricidae* and *Tineidae*; and the Frey collection, lately purchased by the trustees."

IN a letter to the *Times* the Vicar of Selborne solicits subscriptions in order to supply water to the village from the well-head eulogised by Gilbert White. The sum required to do this is only £300, of which about £30 has been collected. A Selborne water supply would be an excellent memorial to White, and there should be little difficulty in raising the modest amount which would lead to its realisation.

THE Institution of Mechanical Engineers opened its summer meeting, on Tuesday, at Middlesbrough, under the presidency of Dr. W. Anderson, and a discussion took place on recent developments in the Cleveland iron and steel industries.

A MEETING of the Yorkshire Naturalists' Union will be held at Hellifield on August 7, for the investigation of the valley of the Ribble from Gisburn to Sawley Abbey.

IT must be gratifying to writers in English journals of science to know that their literary labours are read and appreciated on the other side of the Channel. The current number of a French scientific journal of some standing contains translations of two articles that have appeared in these columns, running altogether into nearly six pages. There are also eight notes which have the same derivation. Every one knows that the code of journalistic ethics is more respected in the breach than the observance, yet it is rarely that one journal reprints an article which has appeared in another without acknowledging the original source. However, even the briefest form of acknowledgment is omitted in the case of the articles and notes to which we have referred. This is probably unintentional, for no editor with any regard for the reputation of his journal would purposely omit reference to his contemporary, though he might, of course, overlook the omission.

THOUGH the feathered tribe of St. James's Park pass an existence remarkably free from danger, their lives are not without vicissitudes, if one may judge from a letter by Mr. T. Digby Pigott to the *Times*. It appears that on July 8 a dabchick's nest broke from its moorings in the dipping boughs of a black poplar, and drifted into the open. For twelve days the hen bird, who was sitting on the nest at the time of the accident, was buffetted about on the waters, yet she remained at her post. Her constancy received a reward which she doubtless regarded as sufficient recompense for all the anxiety, for she floated safely back to the place where her raft was built with two newly-hatched balls of down on her back. Was there ever a dabchick that had such a happy return from so long and adventurous a voyage

A VIOLENT sandstorm occurred at Bärwalde, Pomerania, in the afternoon of April 30 last. A correspondent writing to *Das Wetter* for June states that after a fairly bright morning, with a

light wind from south-east, the wind suddenly shifted to south-west, accompanied by heavy rain clouds. At about 2 p.m. some reddish-grey bands, such as are usually seen with hail-storm clouds, were observed, and rapidly spread over the sky. The whole air was literally filled with sand which the storm had apparently carried from a mountain about half a mile distant, and objects a hundred paces off were almost invisible. The phenomenon only lasted five minutes, after which time rain fell and cleared the atmosphere.

ALTHOUGH some large amounts of rain have fallen in part of these islands during July, the month, as a whole, has not been exceptionally wet. The greatest excess has been in the south of England, where the fall amounted to about 2·5 inches above the average; at Cambridge the excess was 1·4 inch, and in the north of Scotland 1·3 inch. In parts of the country, however, the stations reporting to the Meteorological office showed a considerable deficiency, amounting to 1·11 inch at Holyhead, 1 inch at Leith, and 0·9 inch at Yarmouth and Valencia, while in the neighbourhood of London the deficiency was about 0·3 inch. The temperature recorded at Greenwich for the month was 2° above the average of the last 50 years; on five days the readings exceeded 80°.

THE Royal Meteorological Institute of the Netherlands has issued the second part of an atlas of observations made in the Indian Ocean, for the months of March, April, and May, the part for the first quarter having been published about three years since. The work has been drawn up with great care, the observations having been carefully examined for instrumental errors, and the data supplied by their own observers have been supplemented by observations from the London Meteorological Office, so that the results are both reliable and fairly complete. Among the principal charts we may mention those of the surface temperature of the sea, in which the limits of the warm and cold currents are clearly marked, especially to the south of the Cape of Good Hope. The currents of the ocean are represented by six charts, showing in two colours the observations plotted in position, and also arrows showing the general drift. The isobaric curves show a certain regularity in the monthly changes; for instance, there is a small centre of high pressure, 30·2 inches, in March, between 33° and 38° S. lat., and 87° and 91° E. long., while the isobar of 30·1 inches only extends from long. 82° to 102° E. In April this isobar extends over the whole Southern Indian ocean, from Africa to Australia; that of 30·2 inches also extends over the same area, while a centre of 30·3 inches is found at lat. 30° S., between 90° and 95° E. long. In the month of May the conditions are nearly similar to those of March; the centre of 30·3 inches has disappeared, the isobars of 30·2 inches and 30·1 inches lie more to the north, and another centre of 30·1 inches is formed, which extends from the coast of Africa to 75° E. long. The charts of air temperature are very similar to those of the sea-surface temperature, the temperature of the air being rather lower than that of the water.

THE success which followed Loeffler's attempt to root out the mouse plague in Thessaly by means of his *bacillus typhi murium* has not apparently been so uniform in other and similar epidemics. But Loeffler, although quite recently acknowledging its failure in some cases, does not attribute this to any shortcomings in his bacillus, but rather to the lack of care and intelligence in those entrusted with the carrying out of the plan of campaign. The question has been reopened quite lately by the publication in a Stuttgart paper of some investigations made by Lüpke on the efficacy of Loeffler's microbe. According to these researches, the bacillus in question is not endowed with all the virtues which have hitherto been ascribed to it, and Lüpke states that although in his experiments weakly mice succumbed, some rapidly, and some only at the end of fifteen days after being fed with it, vigorous specimens invariably resisted its action, and, further, were rendered immune, so that even subcutaneous inoculations of the bacillus failed to destroy them. In consequence of these results Laser (*Centralblatt f. Bacteriologie*, vol. xiii. May, 1893) has brought forward an organism, *bacillus der Mäuseseuche-Laser*, which he isolated during an epidemic which broke out amongst the mice kept for experimental purposes in the hygienic laboratory at Königsberg. This bacillus threatens to become a formidable rival to Loeffler's microbe, for, apparently, whilst its action on field mice is more rapid and more certain than the latter, it is quite as harmless to other animals such as horses, guinea-pigs, pigeons, cats. The experiments require, however, further expansion and confirmation, and it is to be hoped that Laser will pursue his investigations, which may lead to the discovery of a satisfactory means of suppressing the farmers' *bête-noire*.

IT has been proved during the last few years that at depths of more than 100 fathoms, the water of the Black Sea contains so much sulphuretted hydrogen that it is totally unfit for organic life. The amount of sulphuretted hydrogen increases with depth, and attains 655 cubic centimetres in one hundred litres at a depth of 1185 fathoms. In order to determine whether this gas is a product of micro-organisms, samples of ooze, which had been brought to the surface by Thomson's apparatus from various depths of 16, 40, 389, 870, and 1207 fathoms, have been carefully analysed at the Odessa bacteriological station. The analyses show that the ooze contains several different species of micro-organisms, all of which are capable of producing sulphuretted hydrogen. One of these is endowed with this capacity to a high degree. Its dark coffee-coloured pigment gradually becomes black when the microbe is cultivated on agar-agar with free admission of air; but its elongated, mobile rods an live under anaërobic conditions as well, and in such a case the exhalation of sulphuretted hydrogen is increased. The name of *Bacillus hydrosulfuricus Ponticus* has been given to the microbe. Further research has proved that the bacillus remains active, not only in cultures of albumen substances, but also in such as contain no sulphur of organic origin, but only mineral sulphates (gypsum), and sulphites. The multiplication of this bacillus thus does not require an accumulation of considerable amounts of decaying animal matters at the bottom, for it lives chiefly upon the cellulose of vegetable remains, and breathes the oxygen of the sulphates of mineral origin which it decomposes.

SIX samples of ice obtained from London depôts and restaurants have been subjected to chemical and bacteriological analysis in the *Lancet* laboratory. The outcome of the inquiry is stated as follows:—"(1) By far the greater proportion of ice supplied in London is natural (generally Norwegian). Of the specimens procured only one had been produced artificially, and this specimen gave indifferent results on chemical analysis, but results of an eminently satisfactory kind in the light of bacteriological inquiry, practically no development of colonies of organisms taking place on culture. (2) Two out of five specimens of ice imported into this country from Norway, whilst yielding a satisfactory chemical analysis, were decidedly bad according to bacteriological examination, the number of colonies of organisms counted on culture varying from 400 to 700 per cubic centimetre of the melted ice. (3) Three out of five specimens of imported ice, though furnishing no condemnatory evidence on chemical examination, yielded bacteriological results such as might under certain circumstances give rise to suspicion, though they may be regarded as of fairly good quality." It is therefore urged that ice for table use should always be produced by the artificial freezing of freshly-distilled or sterilised water.

IN the "Monthly Report of the Maryland State Weather Service" for May, 1893, Prof. W. B. Clark again refers to "The Leading Features of Maryland Climate" (see NATURE, vol. xlvii. p. 585), giving tables of temperature, rainfall, &c. The same parallels of latitude show great variations in climate due to the complexity of the surface configuration.

IN the same Report Prof. Clark describes "The Available Water-power of Maryland," only a small portion of which is at present utilised. Most of this occurs in the Piedmont Plateau, the central area of Maryland bounded by the Coastal Plain and the Appalachian Region. The north fork of the Potomac, draining an area of about 1300 square miles, has a maximum discharge of over 700 times its minimum. This great variability, which is nearly fatal to the extensive use of water-power on this river, is attributed to the absence of lakes, the steepness of the mountain-sides, and the narrowness of the valleys. Some of the tributaries of the north fork are fairly constant in flow.

WE learn from the *Botanical Gazette* that the University of Minnesota has established an inland biological station at Gall Lake, in Minnesota. The laboratory of marine biology of the University of Pennsylvania, at Sea Island City, New Jersey, is now open for its third summer session. The same journal informs us that Baron von Müller is intending to publish a volume which shall complete Bentham's "Flora Australiensis."

MESSRS. KRIGAR MENZEL AND RAPS have contributed another instalment of their work on the motion of vibrating strings to the Prussian Academy of Sciences. Their beautiful experiments on the continued vibrations of bowed strings have been supplemented by the photographic study of the peculiar motions exhibited by plucked strings. To confine the vibrations strictly to one plane, and also to control the instant of exposure, a special plucking apparatus was designed. The string was kept resting against a small plate in the vertical plane by means of a hook which could be released by pressing upon a lever. The motion of the lever also closed a circuit which released the instantaneous shutter of the camera. The wire vibrated in front of a slit illuminated by an arc light, an image of the slit being projected upon the wire so that the screen of the camera showed a well-defined bright slit interrupted by a dark spot where it was crossed by the wire. This dark spot would vibrate during the oscillation of the string, and a trace of its motion was obtained by receiving the image upon a revolving drum covered with bromide emulsion paper. The point at which the string was plucked was determined by observing the interval between the sounds emitted by the two parts on either side of the hook. Different vibrating points along the string were photographed, and beautiful white-on-black traces were obtained. The general type of these is represented by a zig-zag line with straight flat portions at the top and bottom of each wave. All the component lines are straight, showing that the point of the string moved from one extreme of displacement to the other at constant velocity, then had a period of complete rest, and afterwards returned to the first position, again at constant velocity. As the vibrations succeeded each other, the top and bottom portions gradually slanted towards the middle, some of them showed ripples, and the up and down lines exhibited a slight convexity towards the left, *i.e.* the past. The authors further showed that all these observations are to be explained by the accepted theory of the vibration of strings, as worked out by Kundt and others.

THE last number of the *Journal* of the Institute of Electrical Engineers contains an important paper by Mr. W. B. Sayers on the prevention and control of sparking; continuous-current dynamos without winding on the field magnets, and constant-pressure dynamos without series winding. Both Mr. Swinburn and Mr. Esson have given expressions for the maximum load, which can be carried without sparking, in terms of the ampere-turns upon the armature, the length of the air-space, the angle subtended by the polar surfaces of the field magnets, and the forward induction. Thus in ordinary ring and drum armature machines the considerations of sparking limit some of the most important elements in the design of the machine. So that the lightening of machines by putting the conductors in tunnels, reducing the air-space to a mere clearance, which is the condition in which minimum exciting force is required, has not been hitherto practicable. In order to secure the sparkless reversal of the commutator section under the collecting brush at any desired place between the horns of the pole-pieces, the author has designed a machine whose chief peculiarities are as follows:—The air-space is a mere clearance—one millimetre. The reversal of the sections is effected by inductors, or coils, which he calls commutator coils, and are independent of the winding. These commutator coils are not inserted in the closed or re-entrant circuit of the ring or drum, but are inserted in the connections that run at intervals from the re-entrant winding to the several bars of the commutator. The function of these coils is to furnish electromotive forces that will balance those due to back-induction and self-induction in the sections as they are successively reversed. These commutator coils are so arranged as to be acted on by the pole-tip which is strengthened by the armature current, and the brushes of the machine when run as a generator are set with a backward lead instead of a forward one. These auxiliary coils also permit of the reversal of the armature sections just after they have emerged from under the strengthened pole, the result being that those turns of the armature which have hitherto been called back turns become forward turns, and the effect of the cross induction is to increase the reversing field instead of to diminish it. The machine is self-exciting by means of the armature windings only, that is, it generates a current without any winding on the field magnets, which may, therefore, more properly be called keepers, and runs absolutely without sparking at the brushes.

APPARENTLY Humboldt's description of the combats designedly brought about between wild horses and electric eels, in order to effect the capture of the latter, has to go the way of many others. A writer in the *Spectator*, who has travelled on the llanos of Caraccas—the scene of Humboldt's account—says that he failed to find any confirmation of this method of capture. He adds that those who have investigated the matter have come to the conclusion that *trembladores*, as the eels are termed, could not be taken with the help of horses. The method of capture usually adopted is by nets, and it is found that by wearing indiarubber gloves, the fish can be handled with impunity.

THE *Photographic Annual* for 1893, edited by Mr. Henry Sturmey, has been published by Messrs. Iliffe and Son. It is a remarkably fine production, and contains a vast store of information of interest to all concerned with photography and its various applications. Among articles of bibliographical importance we note one on the progress of photographic chemistry during 1892, by Mr. C. H. Bothamley, and Mr. Albert Taylor's concise description of all that was done in astronomical photography during the same year. Photography in relation to meteorology is the work of the late Mr. G. M. Whipple; and Mr. Chapman Jones is responsible for a portion of the volume devoted to photographic optics. In addition to this section on the making of photographic history, there is one containing articles on "Practical Subjects by Practical Men," which consists chiefly of "dodges" devised by devotees of the art. Numerous excellent specimens of half-tone engravings embellish the pages

of the book, and render it one of the best publications of its kind. Another excellent work of the same kind as the preceding is the "Annuare Général de la Photographie," published under the auspices of the International Union of Photography and the National Union of Photographic Societies in France. Some of the illustrations in it are marvellous examples of photographic reproduction.

MESSRS. SIMPKIN, MARSHALL, AND CO. have published a pamphlet by Mr. John Sime containing an account of the work of Sir Francis Ronalds, F.R.S., in connection with electric telegraphy. In an essay, entitled "Descriptions of an Electrical Telegraph," published as early as 1823, Ronalds gave an account of his experiments in sending signals through a line of overhead wires erected in 1816 in the garden of the house at Hammersmith now occupied by Mr. William Morris, the distinguished poet. A tablet commemorating the fact has been placed on a wall of the house. Says Mr. Sime—"Twenty years before Wheatstone and Cooke or Morse had patented their improvements in the telegraph—indeed, while the first two were respectively lads of twelve and fourteen years of age—Ronalds had sent messages over *eight miles* of overhead wires of his own construction, and had laid and worked a serviceable underground line of telegraph of sufficient length to demonstrate the practicability of communication by telegraph between long distances."

THE first part of "A Study of the Languages of Torres Straits," with vocabularies and grammatical notes, was read before the Royal Irish Academy two years ago by Mr. Sidney H. Ray and Prof. A. C. Haddon. The paper has been reprinted, and is published by the Dublin University Press. It is of scientific importance, because a study of the languages in the neighbourhood of Torres Straits must throw some light on the relations between Papuans and Australians. The three Papuan languages of the district with which the authors deal are (1) the Miriam; (2) the Saibai; (3) the Daudai.

MR. AUBREY RICHARDSON, a son of Sir B. W. Richardson, F.R.S., has brought together the ancient and modern law relating to cremation, together with the rules and regulations of various cremation societies at home and abroad, in a book entitled "The Law of Cremation," published by Messrs. Reeves and Turner. All interested in the legal aspect of cremation would do well to obtain it.

TWO more volumes of the excellent series of reprints being published by Engelmann, of Leipzig, have been issued. No. 41 is Dr. Kölreuter's "Preliminary notice of some experiments and observations on the Sex of Plants" (1761–1766), and No. 42 contains a communication made by Humboldt and Gay-Lussac in 1805 on "The Volume Law of Gaseous Compounds."

THE annual report of the Connecticut Agricultural Experiment Station for 1892 has been received. Among the investigations carried on during the year, was one dealing with the chemical composition of different parts of the tobacco plant in different stages of growth, and another on the chemical changes which take place in tobacco during the fermentation in the case.

MESSRS. W. COLLINS, SONS, AND CO. have issued an "Acoustics," by Mr. W. Lees. It is an extension of the portion devoted to sound in the author's book on "Sound, Light, and Heat," and is adapted to meet the requirements of the new syllabus of the Science and Art Department.

"ELECTRICAL ENGINEERING"—an illustrated monthly magazine published in Chicago—gives in each number an excellent synoptical index of current electrical literature.

A NEW edition of "Practical Solid Geometry," by Mr. J. Payne, that has just been published by Mr. Thomas Murby, contains, in addition, a section on graphic arithmetic and statics by Mr. J. J. Prince.

MESSRS. CHARLES GRIFFIN AND CO. have issued a second edition of Prof. Grenville A. J. Cole's useful book, "Aids to Practical Geology."

WE have received the second volume of "Faunæ Mediterraneæ," in which Mr. J. C Carns continues his descriptive lists of animal life in the islands of the Mediterranean Sea.

THE Museum and Laboratory report of the Colonial Museum and Geological Survey of New Zealand has been issued.

AN interesting memoir upon the action of liquefied ammonia on the anhydrous chlorides of chromium and iron is contributed by Prof. Christensen, of Copenhagen, to the *Zeitschrift für Anorganische Chemie*. The products of the reaction in the case of chromium are two of the best known of the remarkable ammoniacal compounds of that metal, namely those to which the somewhat formidable names of purpureo- and luteo-chromium chloride have been given, which compounds have consequently now for the first time been obtained by direct synthesis. Purpureo-chromium chloride may be represented empirically by the formula $CrCl_3 . 5NH_3$; its constitution, however, is usually represented as $ClCr . 5NH_3 . Cl_2$, inasmuch as two of the chlorine atoms are much more readily replaceable than the third. The compound crystallises in small carmine-red octahedrons. Luteo-chromium chloride contains one more molecule of ammonia in its composition; it is represented empirically by the formula $CrCl_3 . 6NH_3$. It is a very soluble substance, but yields a precipitate of the nitrate with nitric acid, which takes the form of lustrous yellow plates. The synthetical experiments of Prof. Christensen were briefly as follows:—A small quantity of violet chromium chloride, previously thoroughly dried at 100°, was placed in a small glass beaker immersed in a freezing mixture consisting of solid carbon dioxide and ether, and liquid ammonia (NH_3) was slowly added to it. No reaction was found to occur at this temperature, but upon removing the beaker and contents from the freezing mixture and warming it with the hand, at the moment when the temperature approached that of the boiling-point of ammonia (− 38°·5), a sudden interaction took place, accompanied by a hissing noise, and resulting in the conversion of the chromium chloride into a red mass largely consisting of the purpureo-chloride. The excess of ammonia was usually eliminated as gas, but if a very large excess was employed a portion of it remained as unchanged liquid capable of reacting with a further quantity of chromic chloride. At the conclusion of the reaction the product was washed with cold water and hydrochloric acid, finally dissolved in water and the solution allowed to fall into concentrated hydrochloric acid, in which the purpureo-chloride is insoluble, when the small red crystals of the pure salt were precipitated. The first aqueous washings of the product of the reaction were always yellow and yielded a yellow crystalline precipitate of the luteo-nitrate upon the addition of concentrated nitric acid. Hence the product of the action of liquid ammonia upon anhydrous chromic chloride would appear to consist of both purpureo- and luteo-chromic chloride, the latter, however, in smaller quantity than the former. The reaction between anhydrous ammonia and chromic chloride occurs only between comparatively narrow temperature limits. At the ordinary temperature gaseous ammonia is without action. If the chloride is cooled by a mixture of ice and salt, there is a minute quantity only of purpureo-chloride produced after a considerable length of time. Even when a freezing mixture of crystallised calcium

chloride and ice is employed, the amount of interaction is but insignificant. It is only in the neighbourhood of the boiling-point of ammonia (−38°·5) that the vigorous reaction above referred to occurs, and the action practically ceases immediately above and below this point.

PROF. CHRISTENSEN has made the further interesting observation that anhydrous ferric chloride, $FeCl_3$, likewise reacts with liquefied ammonia. The reaction occurs the moment the liquid touches the chloride, even when surrounded by a freezing mixture of solid carbon dioxide and ether. The product of the reaction is an orange compound probably consisting of an ammoniacal compound analogous to purpureo-chromic chloride. It is, however, more unstable than the latter compound, rapidly evolving ammonia at the ordinary temperature, and it is completely decomposed by water, even the moisture of the air rapidly converting it into a mixture of ferric oxide and sal-ammoniac.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include the Polyclad *Prostheceræus vittatus*, the Crustacea *Idotea linearis*, *Schistomysis spiritus*, *Crangon trispinosus*, *Polybius Henslowii* and *Portunus holsatus*, and the Mollusca *Calyptræa chinensis*, *Polycera Lessonii* and *Galvina Farrani*. In the floating fauna there has been a marked increase in the numbers of the Siphonophore *Muggiæa atlantica*, which has been present in the townettings from time to time for several weeks past. The larvæ of the Polychæte *Chætopterus insignis* have made their first appearance for the year, and numbers of the Dinoflagellate *Peridinium* and of Echinoid *Plutei* have also been taken. The following animals are now breeding:—The Polychæte *Chætopterus insignis*, the Isopod *Idotea linearis*, the Schizopoda *Mysidopsis gibbosa* and *Schistomysis spiritus*, and the Decapod *Crangon trispinosus*.

THE additions to the Zoological Society's Gardens during the past week include a Yaguarundi Cat (*Felis yaguarundi*), a Brazilian Hare (*Lepus brasiliensis*) from Brazil, presented by Mr. J. E. Wolfe, C.M.Z.S.; a Common Paradoxure (*Paradoxurus typus*) from India, presented by Mrs. Oswald Walmesley; two Azara's Foxes (*Canis azaræ*), a Crab-eating Raccoon (*Procyon cancrivorus*) from South America, presented by Lord Lilford, F.Z.S.; two Common Foxes (*Canis vulpes*) British, presented by Mr. Reginald Chandos Pole; a Red Deer (*Cervus elaphus*, ♀) British, presented by Mr. C. J. H. Tower, F.Z.S.; a Spotted Eagle (*Aquila clanga*) from India, presented by Lord Lilford, F.Z.S.; a Golden Eagle (*Aquila chrysaëtus*) from Scotland, presented by Mr. Hugh Cameron Ross; a European Pond Tortoise (*Emys europoea*), European, presented by Mdlle. Lajeunesse; four Midwife Toads (*Alytes obstetricans*) from Belgium, presented by Prof. Gustav Gilson; a Crab-eating Opossum (*Didelphys cancrivorus*) from Tropical America, an Australian Cassowary (*Casuarius australis*) from Australia, an American Tapir (*Tapirus americanus*), an American Jabiru (*Mycteria americana*) from British Guiana, a Wild Cat (*Felis catus*), European, deposited.

OUR ASTRONOMICAL COLUMN.

METEOR SHOWERS.—In the following list of radiant-points of meteor showers, which we owe to Mr. Denning (*Companion to Observatory*, 1893), that dated for August 10 is stated as being the radiant of a most brilliant shower.

1893.		*Radiant.* α.	δ.	Meteors.
		°	°	
August 4	...	30 ...	+ 36 ...	Swift: streaks
10	...	45 ...	+ 57 ...	Swift: streaks
16	...	61 ...	+ 48 ...	Swift: streaks
21	...	73 ...	+ 41 ...	Swift: streaks
22	...	291 ...	+ 60 ...	Slow: bright
23	...	70 ...	+ 50 ...	Swift: streaks
25	...	5 ...	+ 11 ...	Slow: short

COMET FINLAY, 1893.—The following is the ephemeris for this comet for the ensuing week:—

12h. M.T. Paris.

1893		R.A. app. h. m. s.		Decl. app. ° ′ ″
August 3	...	5 30 9·0	...	22 37 54·4
4	...	34 9·4	...	22 43 18·4
5	...	38 7·9	...	22 48 17·3
6	...	42 4·4	...	22 52 51·7
7	...	45 58·9	...	22 57 2·1
8	...	49 51·4	...	23 0 48·9
9	...	53 41·8	...	23 4 12·8
10	...	5 57 30·2	...	23 7 14·3

RORDAME-QUÉNISSET COMET, 1893.—In *Astronomischen Nachrichten*, No. 3174, several observations of this comet are inserted. Prof. E. Lamp, July 10, describes the comet as 0′·6 diam., brighter in centre, but no proper nucleus. Dr. F. Restenpart for the next day gives the diameter as 4′, the nucleus being of the 5· magnitude with a shining nebulous envelope. Prof. Schen, for the same day (July 11), estimates the diameter as 2′, and says, that by the 12th the brightness had distinctly increased. On the 13th Herr. Archenhold describes the comet as nearly one-half a magnitude dimmer than λ Ursæ Majoris, of an intense blue colour, and a nucleus 1′ in diameter. M. Bigourdan (*Comptes Rendus* for July 17, No. 3) describes the comet (July 16) as a round nebula of 3′·5 diam., with a small stellar nucleus of 2″ to 3″ diam., surrounded by a brilliant nebulosity. This nebulosity had a diameter of about 20″.

EARTH MOVEMENTS.—In the account of the pendulum observations made by Herr E. von Rebeur-Paschwitz, attention was frequently drawn to the fact that in several cases of earth motions or disturbances, the records indicated that sometimes one followed the other in a short space of time, such as two to three hours, a hint being thrown out that these double perturbations originated from one shock. Happening to examine one of the volumes of the "Transactions of the Seismological Society of Japan," Herr Paschwitz was surprised to find that the earthquake at Kumamato, a town on the west coast of the Island of Kiusiu (lat. 32·°8, long. E. 130·°7), which occurred on July 28, 1889, was the severest that had taken place in Japan in that year, and its time of occurrence coincided with the double perturbation that was recorded at Potsdam and Wilhelmshaven (*Astronomischen Nachrichten*, No. 3174.) Deducing the most probable times for the arrival of the chief disturbance at a mean place (long. 10·°61 E., lat. + 52·°97) he obtained the hours, 3·47h. and 6·10h. M.T. Greenwich. From this point the distance of Kumamato, reckoning on a great circle, is about 8860 kilometres, the complement of this great circle amounting to 31,140 kilometres. Taking into consideration the difference of time of 9h. 19·3m., and that the earthquake occurred at 3h. 28·2m. M. Greenwich time, he deduced the time difference of 67·5m. and 225·3m., or velocities of movement of the wave, as 2·188 and 2·304 kilometres, or about 2·3, taking into account the time inaccuracies. This value was obtained approximately also from the Japan earthquake of April 18 of the same year, the distance being 9000km., the time-difference 64·3m., the velocity of propagation resulting 2·334km.

OBSERVATIONS MADE DURING THE ECLIPSE OF APRIL, 1893.—In the *Memorie della Società degli Spettroscopisti Italiani* for June, 1893, several communications are made concerning observations made at the time of the last solar eclipse. Lona at Palermo, Eugenio, Garibaldi, and Tacchini all give their time observations, while Fenyi, in addition to these, gives a list of the prominences observed at a height of at least 30″ at the epoch of the total eclipse at Chili and Brazil. The following is the list referred to:—

M.T. Greenwich. h. m.		Position. ° ′	N. by E. ° ′	Latitude. Mean heliographic. °	Height. ″
0 55	...	201 4-	169 30	−59 W. ...	103
1 12	...	130 50-	124 32	−64 E. ...	54
25	...	75 48-	73 34	−11 E. ...	33
27	...	60 6-	53 16	+ 9 E. ...	51
31	...	33 24-	28 30	+33 E. ...	44
—	...	295 24-	294 26	+51 W. ...	54
—	...	292		+48 W. ...	59
—	...	287 8-	286 30	+42 W. ...	41
1 47	...	233 48-	229 22	−13 W. ...	34

Father Fenyi gives also a very exhaustive table, or rather diagram, of all the minor disturbances at this time, showing how they were situated with respect to the axis of the sun at the time of the eclipse.

THE OBSERVATORY OF YALE UNIVERSITY.—Dr. Elkin reports as follows to the Board of Managers of the Observatory of Yale University:—"The work with the heliometer has been carried forward during the past year in the directions outlined in my last report. We have examined so far fifty-one stars of large proper motion making in general three sets of measures at each parallax maximum. We have not, however, been able to keep the reductions quite up to date, so that I cannot at this moment give any definite results of our search for large parallaxes. I have also continued the series of parallax measures on the first magnitude stars—Aldebaran, Procyon, Regulus, Arcturus, and Vega having been followed up this year. Dr. Chase has continued the work on Algol, and has commenced a series on β Cygni to test the large parallax deduced by Mr. Jacoby from the Rutherfurd photographic plates. He has also been engaged upon and nearly completed the reduction of his measurements in Coma Berenices. Miss Palmer has been mainly occupied with the computations of our series on Jupiter's satellites, a work of considerable extent." The record is one which Dr. Elkin must regard with the satisfaction that comes to all who make a good use of time.

ASTRONOMISCHEN GESELLSCHAFT.—The following are the articles contributed to the first and second parts of the *Vierteljahrschrift der Astronomischen Gesellschaft* for 1893:—H. Gyldén, "Untersuchungen über die Convergenz der Reihen welche zur Darstellung der Co-ordinaten der Planeten angewendet werden," and "Nouvelles recherches sur les séries employé dans les Théories des planètes;" E. Anding, Lambert's Photometrie, "Photometria sive de mensura et gradibus luminis, colorum et umbræ; Robert Grant, Second Glasgow Catalogue of 2156 Stars for the Epoch 1890; J. G. Porter, a Catalogue of 1340 Proper Motion Stars; and Charles Pritchard, Researches in Stellar Parallax by the Aid of Photography. There is a list also of all the planet discoveries and comet appearances of the year 1892.

GEOGRAPHICAL NOTES.

DR. H. R. MILL has recently made a systematic bathymetrical survey of the larger lakes of Cumberland and Lancashire, the cost being defrayed by a grant from the council of the Royal Geographical Society. The soundings designed to delineate the general configuration of the various lake basins, were made at close intervals along a series of lines crossing the lake at right angles to its axis, and never more than half a mile apart. These tranverse sections were connected by oblique sections, along which the soundings were more widely spaced, and in addition longitudinal sections were made whenever it was practicable to do so. In Derwentwater the greatest depth found was 72 feet, but the surface of the lake was much below its usual level, being lower, probably, than has ever previously been recorded. Bassenthwaite Lake, though simpler in configuration, was found to have about the same maximum depth. Ullswater, the largest lake in England except Windermere, was found to have a depth of 208 feet, but it is quite possible that deeper soundings might be obtained. This lake was remarkably interesting on account of its division into a series of deep basins separated from each other by wide bars, from the most pronounced of which a rocky islet rises showing the characteristic marks of ice-erosion very clearly. Coniston Lake is simpler, being one practically straight deep trough, the deepest part of which is at least 184 feet below the surface. Wastwater was similar in configuration, though of much greater depth, an area one mile long and a quarter of a mile wide being deeper than 250 feet. The flatness of the floor of this depression may be judged by the fact that 258 feet was the greatest depth found in it. Samples of the deposit from different parts of each lake were secured, and will be examined by a specialist. Temperature observations were also made. It is probable that a similar survey of Windermere will be undertaken in the beginning of September.

MR. F. G. JACKSON sailed last week with a complete equipment for Nova Zembla, where he intends to spend next winter alone, exploring the island and thus gaining practical experience to aid him in his ultimate attempt to reach the North Pole by Franz Josef Land.

THE Paris Geographical Society promotes the study of geography amongst its members by conversational meetings for the discussion of various geographical problems. There are three groups of subjects: (1) mathematical and physical geography; (2) ethnography, anthropology, and the geographical distribution of plants and animals; and (3) historical and economic geography. Those willing to read papers or take part in the discussions at any group enter their names, and are notified of the meetings of their particular section by the general secretary. The importance of this method of promoting an active interest in geography is very considerable, and might well be introduced in this country, where the advantages of informal discussion are rarely recognised.

THE authorities of Owen's College, Manchester, have decided that Mr. Yule Oldham may continue his duties there concurrently with those of the lectureship of geography at Cambridge University to which he was recently appointed.

CELEBRATION OF THE ROTHAMSTED JUBILEE.

THE weather fortunately permitted the celebration on July 29 to take place, as originally intended, in the open air. The lawn in front of the laboratory was filled by the subscribers to the jubilee fund, while, on the common adjoining, a large crowd of spectators was assembled.

The memorial erected in front of the laboratory consists of a natural boulder of Shap granite, weighing nearly eight tons, standing on a rough granite base. On one side of the boulder a part of the surface has been dressed and polished, and bears the following inscription:—

To commemorate
the completion of
Fifty years
of continuous experiments
(the first of their kind)
in Agriculture
conducted at
Rothamsted
by
Sir John Bennet Lawes
and
Joseph Henry Gilbert
A.D. MDCCCXCIII.

The chair was taken by the Right Hon. Herbert Gardner, M.P., Minister of Agriculture, at 3 p.m.

The Secretary of the Jubilee Committee, Mr. Ernest Clarke, then read a list of names of persons who had sent letters or telegrams regretting their absence on the occasion. The list was a long one, and included H.R.H. the Prince of Wales, H.R.H. Prince Christian, the Marquis of Salisbury, Lord Kelvin, Mr. Chaplin, Sir G. Stokes, Prof. Huxley, L. Pasteur, P. Dehérain, E. Tisserand, E. Wolff, F. Nobbe, the Association of Agricultural Colleges and Experiment Stations in the United States, and many others.

The Chairman said they had met to do honour, as far as lay in their power, in the name of agriculture and of the agricultural classes, to two distinguished men, who had rendered invaluable services to our great national industry, and to dedicate that day an outward and enduring memorial of the admiration which the agricultural world felt for the work which they had accomplished. Nothing could be more appropriate for such a purpose than the massive granite boulder which they saw before them. It had already witnessed many of the experiments of nature; they hoped it might stand for many generations to come, as an outward and visible sign of the manner in which the life-long work of Lawes and Gilbert had been appreciated by the men of their time.

He believed, although Sir John Lawes commenced the work of his life as far back as about 1834, it was only in 1843 that the actual field experiments, on which our reliable records were founded, were begun, and in which he was joined by Dr. Gilbert, who had since been the partner of the labours of his life; they were, therefore, commemorating the jubilee of both gentlemen. It must be interesting to all at such a

moment to recall the varied succession of agricultural prosperity and depression those two had seen during the past fifty years. During that period their friends had seen wheat rise as far as 78*s*. He thought that was in 1855; and, he regretted to say, since he had had the honour to be President of the Board of Agriculture, it had fallen as low as 24*s*. 8*d*. in May last, making a difference of 50*s*. per quarter. In a meeting like the present, so interested in agricultural subjects, he might say that he thought the development of steam ocean traffic had done more than Free Trade to bring down the price of wheat. There was one ray of hope—he admitted it was a very small one—with regard to the present low and phenomenal prices of wheat. There seemed little doubt, from a calculation he had made, that the extremely low prices were partly due to the extraordinary reserves of that article they had in the country since this 1891. The normal reserve of wheat in this country was calculated to be about 2,000,000 quarters, but since 1891 that reserve, following upon the scare of Russian famine, rose at a bound to over 6,000,000 quarters. At the present moment it had fallen again by something like 2,000,000, and as there was every reason to expect there would not be the same influx of wheat into our country in the present year as there had been in the past, it was possible, when the reserve reached the normal standard again that prices might recover.

A memorial more enduring than the granite boulder before them was furnished by the published records of the experiments. It would always be a pleasant recollection to him to know that since he had occupied his present position he had been able to place some fifty memorials of Sir John Lawes and Dr. Gilbert over the country amongst agricultural institusions—he alluded to copies of their works, which, with the sanction of the Treasury, he had been able to purchase at the public expense.

Mr. Gardner, in conclusion, said it was with the sincerest pleasure and profoundest respect he expressed to Sir John Lawes and Dr. Gilbert, in the names of the agriculturists of this country, their felicitations on their jubilee, and their hopes that they might long enjoy the honour and admiration of all classes of their fellow-countrymen.

The Duke of Westminster said he owed the agreeable position he occupied on that occasion to the fact that he was the ex-President of the Royal Agricultural Society of England, and that during his year of office he had been chosen President of the Rothamsted Jubilee Fund. He had the pleasure of asking Sir John Lawes to accept his own portrait, painted by Mr. Herkomer, and he hoped Lady Lawes, their children, and grandchildren would consider it worthy alike of the subject which it represented and of the old walls which it was destined to adorn. He had further to present both to Sir John and to Dr. Gilbert an illuminated address, signed on behalf of the subscribers by the Prince of Wales, and couched in the following terms.—

"To Sir John Bennet Lawes, Bart., D.C.L., LL.D., F.R.S., &c.

"On behalf of the Committee of the Rothamsted Jubilee Fund and of the numerous subscribers to that fund in all parts of the world, I offer you the most hearty congratulations on the completion of half a century's uninterrupted investigation of agricultural problems of the highest practical value and interest."

"These investigations, which originated with you, relate not only to the growth of cereal and other crops under the most varying conditions, but also to the economic effect of different foods on the development of the animals of the farm. They have embraced, moreover, most important researches concerning the chemical constituents of soils, the rainfall, drainage waters, and the sources from which plants derive their supply of nitrogen."

"During the whole of this period of fifty years you have had the zealous co-operation of your lifelong friend Dr. Joseph Henry Gilbert, whose name will ever be associated with yours, and whom jointly with you we desire on the present occasion to congratulate."

"For the continuance of the experiments and investigations which have already extended over so long a period, you have munificently provided by the establishment of the Lawes Agricultural Trust, so that our successors will profit even more, if possible, than we of the present day have done by your enlightened labours."

"The Memorial which is now erected will, it is hoped, preserve your joint names in honoured remembrance for centuries to come, while the portrait that is presented to you herewith will hand down to future generations the likeness of one of the most disinterested as well as the most scientific of our public benefactors." "Albert Edward P."

"July 29, 1893."

"To Joseph Henry Gilbert, M.A., Ph.D., LL.D., F.R.S., &c.

"In celebrating the Jubilee of the Rothamsted Agricultural Experiments, it is impossible to dissociate your name from that of Sir John Lawes, and on behalf of the subscribers to the Rothamsted Jubilee Fund in all parts of the world I offer you the most hearty congratulations on the completion of your fifty years of continuous labours in the cause of agricultural science."

"The nature and importance of those labours are so well known that it is needless to dilate upon them; but if the institution of the various investigations and experiments carried out at Rothamsted has been due to Sir John Lawes, their ultimate success has been in a great measure secured by your scientific skill and unremitting industry. Moreover, by your lectures and writings, you have been a leading exponent in this and other countries of the theoretical and practical aspects of the researches that have been undertaken at Rothamsted."

"A collaboration such as yours with Sir John Lawes, already extending over a period of upwards of fifty years, is unexampled in the annals of science. I venture to hope for an extended prolongation of these joint labours, and trust that the names of Lawes and Gilbert, which for so many years have been almost inseparable, may survive in happy conjunction for centuries to come."

"July 29, 1893." "Albert Edward P."

Continuing, the Duke said it was also his pleasing duty to ask Dr. Gilbert to accept, on behalf of the subscribers, the handsome silver plate which was before them, and which bore the inscription—"Presented by the subscribers to the Rothamsted Jubilee Fund to Dr. Joseph Henry Gilbert, F.R.S., in commemoration of the completion of 50 years of unremitting labour in the cause of agricultural science, 29 July, 1893."

M. Johannet then read an address from the Société des Agriculteurs de France, and M. Aubin, from the same Institution, followed with a congratulatory speech delivered in French.

The Duke of Devonshire, President of the Royal Agricultural Society, said they had not come there to make speeches, but to do honour to the benefactors of their country. He appeared that afternoon, in the name of the 11,000 members of their great Society, to present to Messrs. Lawes and Gilbert the illuminated addresses which were upon the table, and to offer them their most hearty congratulations on the completion of half a century's investigations at Rothamsted. The Rothamsted experiments were a model of what all experimental inquiries ought to be; they had stimulated the carrying out on a lesser scale of other experiments, as those at Woburn and those of numerous local societies. "Practice with Science" was the motto of their Society; it might well be applied to Rothamsted work, which had shed light on many of the vexed questions of practical agriculture. For forty-five years the Society had had the advantage of the personal advice and assistance of Sir John Lawes as a member of its council, and it was proud to recognise in Dr. Gilbert one of the most distinguished of its honorary members. Their contributions to the Society's *Journal* from 1847 to the present time constituted the most valuable series of papers which had appeared in its pages, and they alone would have made the *Journal* famous. For this and all the Society offered to Sir John Lawes and Dr. Gilbert their hearty thanks, hoping that they might long be spared to continue their labours, which, in the words of the Society's charter, were for "the general advancement of agriculture."

Prof. Michael Foster, as senior secretary of the Royal Society, presented two addresses from the Society, and with their hearty congratulations, expressed the hope that the Rothamsted Station might be as fruitful of scientific results in the future as in the past.

Dr. H. E. Armstrong, the President of the Chemical Society, presented an address from that body. He remarked that Rothamsted work was appreciated by none more than by the Fellows of the Chemical Society.

Prof. Stewart, the President of the Linnean Society, pre-

sented an address on behalf of the Society. They regarded the Rothamsted experiments as the highest contribution that had ever been made to the science of agriculture.

Prof. E. Kinch presented an address from the Royal Agricultural College, Cirencester. He alluded to the great educational value of the Rothamsted experiments, to the kind reception of the students at their annual visit to the Station, and to the debt of gratitude they owed to Dr. Gilbert for his services as honorary professor at the College.

Mr. Ernest Clarke, in the absence of M. Tisserand, then read an address from the Société National d'Agriculture de France. Mr. Clarke mentioned that several other addresses were on their way to this country.

Sir John Lawes, who, on rising to reply, was received with hearty cheering, said that it was only a very few months since he and his wife received the congratulations of many friends on having attained fifty years of married life, which was occasionally called a golden wedding. That afternoon he had to return thanks to that distinguished company for congratulating himself and Dr. Gilbert on the work they had carried on together for fifty years. When two persons were joined together in marriage they could not part—they were bound together by a solemn tie. Dr. Gilbert and himself were bound by no ties. During the whole of the fifty years Dr. Gilbert had been perfectly at liberty to leave him, and he to leave Dr. Gilbert; they had remained together from their mutual love of the work they had undertaken. He had given to this work all the time that he could spare consistently with other duties; but Dr. Gilbert had given his whole time to it, and had it not been for the labours of Dr. Gilbert, the affairs of Rothamsted would have been in a different state to that in which they now were. Dr. Gilbert had given his life to the experiments—had given the most arduous part of his life—had given his holidays, and this very year he was going to Chicago to deliver a course of lectures on the work at Rothamsted.

He had now had sixty years' experience of agriculture. When he began farming in 1834 the country was suffering from agricultural depression, the crops were so large that they more than supplied the wants of the nation; now our wheat crop only sufficed for one-third of our consumption, and the rest had to be furnished by other countries. He was afraid that their investigations had been of more use to the foreigner than to the English farmer, for the latter had always grown good crops, and thus could not meet lower prices by an increased production, while the foreigner had been able to do this.

Sir John Lawes expressed his cordial thanks for the various presentations made to him that day, and especially for the granite boulder, which he playfully said would probably still be in existence when the portrait had been transferred from the drawing-room to the bedroom, and from the bedroom to the garret, and people had forgotten whom it represented, and who painted it.

Dr. Gilbert expressed himself as unable to return thanks adequately for the ovation of that day. Referring to the early years of their investigations, he said that they commenced with orthodox views; but that, as they could not alter the laws of nature, they presently found that they were at variance with received opinion, and their scientific friends looked on them with pity. Their first paper was subjected to merciless excision by the editor of the journal to which it was sent, and they with difficulty secured its publication. Those who opposed became, however, finally their firm friends, and they had since published in that very journal papers occupying about 2,000 pages. The reason they had been able to steer clear of error in their numerous experimental inquiries at Rothamsted was that they had adhered resolutely to the motto of the Royal Agricultural Society, and had associated practice with science throughout the whole course of their researches. Agriculture, more perhaps than any other art or industry, was dependent upon the intelligent application not of one but of many branches of science, and hence it was that the experimental agriculturist found himself in contact at one time with the botanist, at another time with the physiologist, and again with the chemist and the geologist, the statistician and the economist. He mentioned that he had in preparation a jubilee edition of the memorandum sheet on the Rothamsted experiments, and concluded by expressing his warmest thanks for the sympathetic kindness which his friends had shown him that day.

Sir Joseph Hooker, in proposing a vote of thanks to the executive committee of the Jubilee Fund, said that he had never seen chemistry and botany united to such good purpose as in the investigations of Lawes and Gilbert.

Sir John Evans, treasurer of the fund, in responding, said that the boulder of Shap granite which they saw before them weighed nearly eight tons, and had twice broken down on its way to Harpenden. He need hardly say that a considerable weight had been taken off his mind when he at last had the satisfaction of seeing the huge monolith firmly planted in the place it now occupied.

The Earl of Clarendon proposed a hearty vote of thanks to the Chairman, which was carried by acclamation, and the formal proceedings terminated.

The portrait of Sir John Lawes, by Hubert Herkomer, R.A., was afterwards on view in the laboratory.

A garden party at Rothamsted was held later in the afternoon, which was attended by most of the visitors.

THE GEOLOGISTS' ASSOCIATION IN IRELAND.

THE visit of the Geologists' Association to the counties of Dublin and Wicklow, under the direction of Profs. Sollas and Cole, extended officially from July 24 to July 29; but a number of members arrived in Dublin for Sunday, July 23, and visited the cathedrals and places of historic interest in the city, under the guidance of Rev. Denis Murphy, S.J. On Monday the full party examined the grits and *Oldhamia*-slates of Bray Head. The Rev. Dr. Haughton, F.R.S., delivered a speech of welcome, standing on the rocks of the headland, and Prof. O'Reilly and Prof. Sollas, F.R.S., explained the structure of the mass, showing how the more resisting grits have caused a wrinkled flow of the shales and slates between them. The excursion was continued to the fine intrusive junction of the Leinster granite and the Ordovician rocks at Killiney, the latter being metamorphosed into mica-schists with abundant andalusites and some garnets.

On Tuesday, July 25, the promontory of Portrane was visited, under the direction of Prof. Grenville Cole. The basal carboniferous conglomerates ("Old Red Sandstone") were seen above the Bala series, which is here finely fossiliferous. The igneous rocks, ashes, agglomerates, and some lavas, associated with the great volcano of Lambay, are well seen upon this coast, and a true conglomerate of volcanic blocks and of pebbles, worn from the contemporaneous coral-reefs is one of the most interesting exposures. The brecciation, under pressure, of the alternating layers of shale and limestone produces, near the Priest's Cave, a rock resembling a coarse conglomerate of limestone-pebbles in a matrix of black clay.

On Wednesday, Howth was visited; Prof. Sollas conducted the party, and Dr. V. Ball, Mr. G. H. Kinahan, and Mr. A. B. Wynne were also present. The glacial drift on striated surfaces of Carboniferous Limestone, the dolomitisation of the limestone, the Ordovician dykes of diabase in the quartzites, and the quartzites, grits, and many-coloured shales, of the Howth and Bray series, were studied along the southern shore. Casts of worm-burrows were pointed out in some of the sandstones near the Needles.

On Thursday, July 27, an early start was made for Rathdrum, and cars were taken to Glendalough and the Seven Churches. Prof. Sollas and Prof. Cole led the party to the high ridge above the upper lake to examine the amphibolite in the Ordovician slates. Prof. Sollas showed how the slates had been converted into schists by contact with the Leinster granite, and how pressure has produced a foliated structure even in the intrusive mass; but the amphibolite has converted the schists locally into a "Desmosite," consisting of quartz, garnet, and dark mica, the latter lying in planes across those of the first foliation.

On Friday the Rev. Maxwell Close acted as guide to the shell-bearing sands and gravels, 1,000 feet up on the slope of Two-rock Mountain, near the house called Ballyedmondduff. Small fragments of marine shells were freely found in the upper pit. The party then descended into Glencullen, where Prof. Cole pointed out how the valley had been at one time choked with "drift," full of striated blocks of limestone and *débris* of granite and Ordovician rocks, and how the river has now cut down into this mass, as is the case in so many valleys of the southern and eastern Alps. From Enniskerry the geologists drove through the Scalp, a bold notch in the granite ridge, with an exposure of the junction with contorted Ordovician rocks.

On Saturday a joint excursion was carried out with the Dublin Naturalists' Field Club; some members of the Belfast Field Club being also present by invitation. The whole party drove from Bray up Ben Cree to Loughs Bray, the Rev. Maxwell Close explaining the glacial dam that separates the two lakes, and the moraines in the mountain-hollows round them. The descent was made by the romantic grounds of Luggela, which were kindly thrown open by Mr. Stepney. Here the granite abuts on the metamorphosed Ordovicians, and displays, on Lough Tay itself, a fissile foliated structure of unusual delicacy. On climbing out of the deep hollow to the main road, abundant large erratics of granite, resting on Ordovician schist, were seen on all the moorland slopes.

On Sunday, July 30, Dr. V. Ball, F.R.S., conducted the party over the geological and antiquarian collections in the Museum of the Science and Art Department, Dublin, Major M'Eniry pointing out the treasures of the Royal Irish Academy collection.

THE DEVELOPMENT OF ECHINOCYAMUS PUSILLUS.[1]

THE year 1891 will remain memorable to echinologists for the richness of its products upon the morphology of the class with which they deal, not the least brilliant and far-reaching of which is the discovery by Brooks and Field of the primary bilateral symmetry of the water-vascular system of *Asterias*; but the following year will not pale beside it, if only on account of the magnificent treatise to which we now call attention. The amount of solid work which the author has compressed into his fifty-seven pages is little short of astonishing. The monograph is written in excellent English, and illustrated by nine plates well worthy of the text; and from whatever standpoint it is judged, a verdict of unstinted praise must be given.

After a short introduction, the author furnishes an account of his methods, incidentally alluding to a remarkable result obtained by fertilising ova derived from females reared in a dirty locality with spermatozoa obtained from males dredged in the open sea; and he next proceeds to the detailed consideration of the sexual elements and fertilisation, in the course of which evidence pointing to a possible chemiotaxis is adduced, in what is termed the "attractive forces" of the ova and spermatozoa. The segmentation of the oosperm is next considered. The author remarks that he has more than once seen very delicate connective filaments crossing the cleavage-cavity from one segment to another at the earliest stages in the formation of the former; and later on, in dealing with the phenomena of mesenchyme formation, he calls attention to the significant fact that in young gastrulæ it is common to find mesenchyme cells "attached by one pseudopodium to the ectoderm, and by another to the archenteron," giving the impression "that they facilitate the process of invagination." Interesting as are these facts in their bearing upon the general question of protoplasmic continuity in the animal body, they fall into insignificance beside that portion of the work which deals with the vital phenomena of segmentation itself. In the course of it the author remarks that when studying the phenomena alluded to "one gets the impression that the segments alternately attract and repel each other, and that the highest degree of attraction occurs when the nuclei after a completed segmentation have obtained their rounded distinct form and are in a state of repose." This conclusion is reached after extensive and careful observation, and the tendency of current research in cytology appears to us to suggest that the near future may show the author to have herein formulated a general law.

Dealing next with the blastula and gastrula stages, an apical disc bearing a tuft of long cilia, akin to that of the annelid larva, is described; and the author, having proved that it has nothing to do with locomotion, provisionally suggests that it may be a larval sensory organ. The formation of calcareous deposits is recorded to first occur during the blastula stage, and the spines, interradial plates, and spherids of the young urchin, are alike traced to a "first indication" in the form of a minute tetrahedron originated by the agency of mesenchyme cells; and the author, after full consideration, inclines to the belief the "teeth" also "originate as small tetrahedrons." The detailed observations incorporated in this section of the work are of intense interest, especially in their bearing upon the attempt of Dreyer to reduce the skeletogenesis of the echinodermata and certain other invertebrated animals to a common principle of purely mechanical origin.

The young urchin is traced to a "first indication" in an ectodermic invagination of the Pluteus, as previously described by Agassiz and Mentschnikoff, and the author observes that the disc-like sac thus formed becomes differentiated into a "thick-walled bottom," which plays an important part in the development of the young urchin, and a remaining portion which "only serves as a kind of amnion."

One very curious and interesting discovery which is announced is that of a choano-flagellated condition of the cells of the ciliated band of the Pluteus, which, in the author's words, "curiously remind one of collar-cells in the Porifera;" and it is not a little remarkable that this observation should have been closely followed by that of Franzé that Bütschli's so-called "*mund vacuole*" of the Choano-flagellate Infusoria (*Codosiga botrytis*) is in reality a delicate membrane connecting the collar with a specialised sucking vacuole.

In his introduction the author confirms the surmise of Johannes Müller that certain of his (now classical) descriptions of Echinoid larvæ were those of *Echinocyamus pusillus*, and in so doing points out that nobody has in the meantime published anything on the development of that animal. Our appreciation of the excellence and value of the author's work may, perhaps, be best expressed in the assertion that it appears to us in every way worthy of this unique association with that of the great founder of our modern comparative anatomy.

[1] A Monograph, by Prof. Hjalmar Théel, Nova Acta Reg. Soc. Sci. (Upsala: Ser. iii. pp. 1-57. 1892.)

FRANCE AND INTERNATIONAL TIME.

THREE years ago M. W. de Nordling made a communication to the French Geographical Society with regard to a universal hour. In a further communication to the same society, on April 7, he traces the changes that have been made since 1889. The state of things at the present time are summarised as follows:—

(1) The time of eastern Europe, which differs by only one minute from that of St. Petersburg, is employed in Russia, Roumania, Bulgaria, and Roumelia, to Constantinople.

(2) The time of Central Europe prevails in Sweden, Germany, Austria, Hungary, Bosnia, Servia; and its adoption is assured in Switzerland, Italy, and Denmark.

(3) The time of Western Europe (Greenwich time) is in use in Great Britain, Holland, and Belgium, and, to complete its European domain, needs the addition of France, Spain, Portugal, and Ireland.

With regard to France, M. de Nordling dwelt on the fact that while civil time is referred to the Paris meridian, the railway service runs according to Rouen time, which is five minutes behind Paris time. The French Commission of 1891 remarked upon the absurdity of this system in the following words:—

"In order that there should be no ambiguity in the use of the uniform hour adopted, it will be necessary to put an end to the curious habit that exists only in France, where two timepieces are seen at all railway stations having between them a constant difference of five minutes.

"It is useless for the railway companies to say that the interior time of their stations concern them particularly, and only refer to their service; only error and confusion can result from the system. The hours of departure being regulated by the interior clock, there must always be a tendency to consider these indications as the most exact.

"To our knowledge, in no other country outside our own, is this peculiarity found, which perpetuates an error, and, in fact, puts the trains behind by five minutes."

"It is said," remarked M. de Nordling, "that the five minutes retardation are regarded with approval by travellers.

"This was probably true in 1840, when one would only go to Saint-Germain and Versailles, but to-day, when everybody discounts the five minutes, they have lost their virtue, and only force the passenger to make incessant calculations. The uncertainty is increased in the buffets, where it is doubtful whether the clock on the wall indicates interior or exterior time.

"It is not only from a national point of view that this dual hour is vexatious, but also from an international point of view. In fact, it renders our hour absolutely inappropriate to all international usage. Suppose Switzerland had adopted Paris time;

its railways would not be less in discord than our own, ruled by Rouen time, and the principal object of the pretended unification would be lost. At the present time, it is true, this consideration is only retrospective, since it is evident to those who have eyes to see, that in the future any international horary amalgamation will be based on the united times of all meridians.

"What sacrifices would a similar amalgamation impose on France? In the first place, it would retard the clocks of our railways by four minutes, and civil time by nine minutes. But, from the experience furnished by the law of March 15, 1891, it can be affirmed that—were it not for the difference between interior and exterior timepieces of the stations—the reform would pass absolutely unperceived by the public.

"It can no longer be said that the change implies a question of national self-respect, since it is not to adopt English or German time, but to take up a universal system already adopted by the greater part of Europe, by all North America, and by a part of Asia (Japan).

"It is true that the new system will be imperfect so long as France will not adhere to it. It is not only by the adherence of France, however, that this system will be crowned. If France wants to justify the provisions of the 1891 Commissioner of the Senate, it will delay the execution for a hundred years. But we do not delude ourselves with views of this kind. During the time of waiting, our horary system will produce in the eyes of Europe—in the eyes of the world—the same effect as an old building out of line, encroaching on the public view, breaking the perspective of a beautiful straight avenue, and from which passers-by will only turn with displeasure. Is this a dignified situation for France?

"The situation is made worse from another cause. It has been said that Spain and Portugal are becoming friends again. If, according to the opinion of to-day, these two countries desire to unite their times, it is probable that, in order to avoid a conflict between the meridians of Madrid and Lisbon, they will take the time of Western Europe. If that occurs the isolation of France will be complete.

"There are two ways of escape from this difficulty. The first is based on the question of legality, and is that the Minister of Public Works shall invite our railway companies to retard their clocks by four minutes, and that the Minister of the Interior shall prescribe in his turn that all the public clocks be put back nine minutes with regard to the meridian of Paris. This international unification would have been made had not the law of March 15, 1891, been violated up to now.

"The other way, and the one altogether more frank and dignified, is this—that France should say to Spain, 'Would you be willing to unite our times? Let us adopt, with Portugal, the time of Western Europe, and agree as to the day when it shall be put in force simultaneously.' If France obtains this understanding, it will have done more for the unification of hours than any other nation; for each nation has only acted on its own account, while France, in bringing its adherence, would bring at the same time that of two companions. This would be at once the crowning of the system.

"I guarantee that France would receive the plaudits of the entire world, both of the old and the new, and in this question we should, at the first onset, have resumed the place which we generally occupy at the head of progress."

The editor of the *Revue Scientifique* remarks, in a footnote to M. de Nordling's article, "It is false patriotism that is willing to remain apart from other lands. Are the English who do not wish to adopt the metric system, and the Chinese who built a great wall at their frontier, good patriots? And are these two examples so worthy of admiration that our ambition should be to imitate them by refusing to accept the unification of hours. The conclusion can be formulated in three simple propositions:—

"(1) Adopt a single time for all France, without having the time in the interior of railway stations five minutes behind.

"(2) Adopt the time known as that of Western Europe—that is, Greenwich time, which is nine minutes behind Paris time, and which is in reality the time of central France (Havre, Le Mans, Tours, Poitiers, Angouleme, Auch, and Oran).

"(3) Urge Spain and Portugal to adopt this time."

It is satisfactory to find that the subject of international time is being seriously considered in France. The changes required to refer the times to the Greenwich meridian are so small that, but for national prejudice, they would doubtless have been made long ago. However, we are not in a position to moralise upon the opinions of our neighbours as to the adoption of the time of Western Europe, for they point to our absurd system of weights and measures, and we are humiliated. There is little doubt that the French will adopt Greenwich time before the metric system is introduced into this country.

OLIGODYNAMIC PHENOMENA OF LIVING CELLS.

AMONG the botanical papers left by the late Prof. Carl v. Nägeli is a very remarkable one bearing the above title, which is now published in the *Denkschrift* of the *Schweizerische naturforschende Gesellschaft* by Prof. Schwendener and Prof. Cramer. The observations referred to occupied the closing years of Nägeli's life since 1880.

By oligodynamic phenomena Nägeli means those produced by excessively small quantities of metallic substances in solution. The experiments were made chiefly on two species of Spirogyra, *S. nitida* and *dubia*. If in water which is previously "neutral," *i.e.* not pathogenic to Spirogyra, a gold coin containing ten per cent. of copper is placed, the water acquires the oligodynamic property of killing the alga, and the poisoning may begin to manifest itself in as short a period as from three to six minutes. Nägeli satisfied himself that this effect is not due to the action of electricity or of any similar force, but is the result of infinitesimally small quantities of copper dissolved in the water, in the form of CuH_2O_2 combined with carbon dioxide. In this way one part of copper in 1000 million parts of water may act pathogenically on the alga. Similar results were obtained with silver, zinc, iron, lead, and quicksilver, while the absolutely insoluble metals gold and platinum were without effect. In this way distilled water is often poisonous to Spirogyra, and it is a remarkable fact that the poisonous metals communicate the property to glass vessels in which they are placed. The poisonous properties of the water may be diminished or entirely neutralised by placing in the water particles of some insoluble solid substances, such as sulphur, graphite, cellulose, wood, coal, silk, wool, &c., which present a large surface on which the metal is precipitated. For the same reason, while the alga will be killed if only a few filaments are present in the water, a much larger quantity will be entirely uninjured.

Oligodynamic poisoning manifests itself in the living cell in a different way from true chemical poisoning. In the former case the cell does not at once lose its turgidity; the protoplasmic uricle remains for a time adherent to the cell-wall, while the spiral band of chlorophyll detaches itself and becomes transformed into a solid mass surrounding the rounded nucleus of the cell. The substance of the band swells up, and presents, on transverse section, a cylindrical or oval form. The phenomena present some resemblances to those produced by electricity.

The very remarkable results here described are confirmed by Prof. Cramer, who has repeated the experiments, and finds, in all essential points, the phenomena to resemble those obtained by Nägeli.

A. W. B.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A COURSE in Naval Architecture has been recently established at the Massachusetts Institute of Technology to provide a thorough training in the theory and methods of designing and building ships, together with a study of the properties requisite for safety and good behaviour at sea. It is intended to cover the same ground and accomplish the same results as the English and French government schools for training Naval Constructors. Like all the courses at the Institute it gives, in addition to professional and technical training and equipment, a good scientific and liberal education. Attention is directed mainly to the construction of merchant steamships; but some attention is given to problems arising in the design of men-of-war, which offer at once the most definite and the most intricate questions presented to the naval constructor. The theory of the construction of sailing vessels is also included in the course.

THE *Westminster Budget* of July 28 contains a record of the scholarships obtained by boys at our public schools during the

scholastic year 1892-93. Though the record cannot be regarded as the best criterion of efficiency, owing to the fact that many of the scholarships are confined to certain schools, and that their values vary considerably, still an indication is obtained of the attention paid by schools to different subjects. The highest number of science scholarships, four, was obtained by Manchester. Epsom and St. Paul's follow with three each, and then Charterhouse, Dulwich, Shrewsbury, and Tonbridge with two each. In mathematics, Clifton, Tiverton, and Merchant Taylor's each obtained three scholarships. The following schools obtained two: Christ's Hospital, St. Paul's, Bristol, Chester, Leatherhead, Liverpool, Wolverhampton, Liverpool Institute, and Wellingborough.

THE vote of £6,200,000 for public education in England and Wales which was agreed to on Monday, is the largest that has ever been requested for that purpose. In his speech on the subject, Mr. Acland referred to the suggestion that the Bethnal Green Museum should be handed over to the London County Council, and said that if the Council should desire to have the site and the building on reasonable conditions for educational purposes, the Government would be glad to meet them in a reasonable way.

MR. R. W. STEWART, Assistant Lecturer and Demonstrator in Physics in the University College of North Wales, Bangor, has just been granted the degree of Doctor of Science by the University of London. Mr. Stewart's thesis contained the results of a series of experimental determinations of the thermo-conductivities of iron and copper, made in the Physical Laboratory of the University College of North Wales. The results are embodied in a memoir which was recently communicated to the Royal Society by the President (Lord Kelvin), and which has been accepted for publication by the Council of the Society.

THE *British Medical Journal* says that several changes have recently taken place in the teaching staff of St. Bartholomew's Medical School. Among them we note that Dr. F. D. Chattaway has been elected to the Demonstratorship of Chemistry; and Mr. Alfred Howard has been appointed to the Assistant Demonstratorship. Mr. J. S. Edkins, at present George Henry Lewis student, and late Senior Demonstrator of Physiology at Owens College, Manchester, has been elected Demonstrator of Physiology.

Mr. D. T. MACDOUGAL has been appointed Instructor in Vegetable Physiology at the University of Minnesota.

SCIENTIFIC SERIALS.

The Quarterly Journal of Microscopical Science, for July, 1893, contains:—On the morphology and physiology of the brain and sense-organs of Limulus, by Dr. W. Patten (Plates 1 to 5). Some two years ago the author published a paper in the *Quarterly Journal of Microscopical Science* calling attention to many striking resemblances between Arachnids and Vertebrates, and maintaining that the latter are descended from a great group of the former, in which he included the Arachnids, Trilobites, and Merostomata. Attention was called to the evidences of relationship as shown in the invaginations which in insects give rise to the optic ganglia, and in scorpions and Limulus become so extensive as to enfold not only the optic ganglia but the eyes and the forebrain as well. A cerebral vesicle is thus formed, from the floor of which arise the forebrain and the optic ganglia, and from the roof a tubular outgrowth, at the end of which lie the inverted retinas of the parietal eye. Such a condition is to be found only in Arachnids and Vertebrates, and the author thinks it affords as trustworthy evidence of relationship as the presence of a notochord or of gill-slits. Other relationships were indicated between the lateral eyes in Limulus and Vertebrates, between the cartilaginous endocranium in Arachnids, and the primordial cranium of Vertebrates, between the subneural rod in scorpions and the notochord, and in the correspondence between the neuromeres and nerves in Arachnids and Vertebrates. To this long array of evidence the author now adds others: identifying nearly all the important lobes and cavities characteristic of the Vertebrate forebrain in the forebrain of Limulus; showing that the coxal sense-organs are gustatory, and correspond to the supra-branchial sense-organs of Vertebrates, and describing a remarkable organ in Limulus, which has all the characteristic morphological features of the olfactory organs in Vertebrates. The author believes that it may now be regarded as beyond any reasonable doubt that the Vertebrates are descended from the Arachnids. The very interesting palæontological aspect of the subject is promised in a separate memoir.—On the structure of the pharyngeal bars of Amphioxus, by Dr. W. Blaxland Benham (Plates 6 and 7), gives a detailed account of the tongue (or secondary) bar in Amphioxus, and institutes a comparison between it and the primary bar, and there is a *résumé* of the observations of recent observers and an account of certain abnormal bars.—On the perivisceral cavity in Ciona, by A. H. L. Newstead, B.A. (Plate 8). The author found (1), that there are no communications between the perivisceral cavity and the atrial cavity (such as were described by Kupffer, though denied by Roule); (2) that definite communications exist between the perivisceral cavity and the pharynx, and as these openings occur in the same position as the orifices described by Kupffer, it is probable that the supposition of van Beneden and Julen is correct, that the orifices observed by Kupffer open into the perivisceral and not into the atrial cavity. The perivisceral cavity is regarded as a specially modified epicardium, which has become greatly enlarged.—On the early stages in the development of *Distichopora violacea*, with a short essay on the fragmentation of the Nucleus, by Dr. Sydney J. Hickson (Plate 9). In this paper we have first an account of the early stages of the development of *Distichopora violacea* from material collected by the author in North Celebes and by Prof. Haddon in Torres Straits; then an account of the formation of the germinal layers in the Cœlenterata. A sketch of the developmental histories, as known up to the present, is given, with the typical invaginate gastrula at one end and the multinucleated plasmodium at the other; and, lastly, the important question of the "fragmentation" of the Oosperm nucleus is very ably and judiciously discussed, the following conclusions from the evidence adduced being drawn: (1) Fragmentation of the nucleus is a normal method of nuclear division, and is not always a sign of pathological change; (2) in many cases where the nucleus is supposed to disappear, there is, as a matter of fact, only a minute fragmentation; (3) that fragmentation only occurs when there is no cell division; and (4) that karyokinetic division of the nuclei is caused by the forces in the cell protoplasm which bring about the division of the cytoplasm. The phenomena of pluripolar mitosis may afford examples of intermediate types.

Bulletin de l'Académie Royale de Belgique, No 5.—On negative hydrostatic pressure (continued), by G. Van der Mensbrugghe. A test-tube is completely filled with water, and another, with thin walls and a little narrower, is plunged into it to about half the depth. On inverting the two tubes the smaller one rises through the water in the other in spite of gravitation, owing to the suction exerted by the water, whose internal pressure is less than that of the atmosphere. If a tube of paper or of waxed silk be substituted for the smaller test-tube, the flexible tube is flattened when plunged down into the other, but regains its circular section on placing the system upside down. Just as it is possible to subject a large vessel to an enormous internal pressure by ordinary hydrostatic pressure, so it is possible, on the other hand, to subject it to a corresponding external pressure by inverting the hydrostatic tube.—Researches on monocarbon derivatives, by Louis Henry (continued). This contains an account of the mono-chloric, mono-bromic, and mono-iodic oxides of methyl.—Contribution to the study of trichinosis, by Dr. Paul Cerfontaine. A study of some cases of the epidemic of Herstal, near Liège, in January, led to the following conclusions. As soon as the infected meat is introduced into the system, the cysts are destroyed, and the larvæ liberated in the stomach, whence they pass after some time into the intestine. There they grow rapidly, and fecundation takes place in the intestine after the second day of infection. The males are then expelled from the system, and many of the females penetrate the walls of the intestine and even enter the mesentery, where they produce offspring after the sixth day of infection. This penetration of the walls of the intestine gives its peculiarly fatal character to trichinosis. The young entozoa are disseminated throughout the system by the lymphatic vessels, which carry them into the blood. Owing to their small size they penetrate into the capillaries, and produce congestion of the blood-vessels and œdema. Death is often due to what amounts

to a maceration of the respiratory muscles, producing asphyxia.

Wiedemann's Annalen der Physik und Chemie, No. 7.—On the specific heats of glasses of various compositions, by A. Winkelmann. The specific heats of the various constituents of different glasses were calculated or experimentally determined, and those of the glasses made up of them were calculated by Wöstyn's law, according to which a specific heat of a compound is obtained by adding together the products of the specific heats, the atomic weights, and the number of atoms of the elements contained in the compound, and dividing by the sum of the products of the atomic weights and numbers of atoms. On comparing the values thus calculated with those found by experiment, it was found that they agreed to within one per cent.—On a surface connected with the electric properties of tourmaline; thermodynamics of tourmaline and the mechanical theory of muscular contraction; and molecular theory of piezo-electric and pyro-electric phenomena, by E. Riecke. The author makes the attempt of formulating a thermodynamical theory of muscular contraction, and investigates its connection with the pyroelectric phenomena of tourmaline. He arrives at a formula in which the state of the muscle can be expressed by two variables only, the temperature and the tension.—Concerning the theory of electric oscillations in wires, by A. Elsas. The author shows that the Hertzian oscillations may be completely explained on the older electromagnetic theory, without reference to Maxwell's amplifications. He does not contend that Maxwell's theory is superfluous, but finds out how far the older theory is capable of proceeding without having recourse to Maxwell's conceptions.—Objective representation of Hertz's experiments, and the high tension accumulator, by L. Zehnder. A collection of practical hints for the performance of oscillation experiments by means of the 600-cell Planté accumulator.—Contributions to the theory of secondary batteries, by Franz Streintz. With comparatively low current densities, the resistance during discharge attains a maximum. As the current increases, the resistance slowly falls to a value equal to that in open circuit, and falls still further at higher current strengths.—On the determination of the length of a solenoid, by F. Himstedt. Contrary to Heydweiler's opinion, the length and radius of a solenoid as determined by its electromagnetic effect are not appreciably different from their geometrically calculated values.

IN the *Botanical Gazette* for June Mr. R. H. True has a paper on the development of the caryopsis, which supports the ordinary view respecting the formation of the fruit in grasses. Prof. Atkinson continues his account of the biology of the organism which causes the tubercles on the roots of Leguminosæ.

IN the *Journal of Botany* for July, Mr. A. B. Rendle describes and figures a case of the production of tubers within a tuber in the potato. Yet two more "species" are added to the long list of British *Hieracia* by Messrs. E. F. and W. R. Linton, *H. enstales* and *orcadense*.

IN the *Nuovo Giornale Botanico Italiano* for July is a paper by Sig. E. Baroni on the anomalous genus *Rohdea*, which he prefers to place in the order Liliaceæ and tribe Asparageæ, rather than in the Araceæ. The minute structure of *Rohdea japonica* is described, and the mode of pollination, which appears to be effected partly by insects, but largely by snails, and even by spiders.

THE *Bulletino della Società Botanica Italiana*, Nos. 5–7, are largely occupied by papers chiefly interesting to Italian botanists. In addition, Sig. A. Baldacci has some observations on the sympodial branching in *Symphytum* and in other Borragineæ, and on the mode of branching in the Apocynaceæ, which appears to be also sympodial. Sig. U. Brizi enumerates the fossil Musci and Hepaticæ found in a locality within the Roman territory. Sig. C. Acqua describes the mode of formation of the wall in the growth of the pollen-tube of *Vinca major*, which presents a strong resemblance to that described by Buscalioni in the aerial hairs of *Lavatera*. Sig. C. Massalongo has several papers on galls.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 1.—"On the Colours of Sky Light, Sun Light, Cloud Light and Candle Light." By Captain W. de W. Abney, C.B., D.C.L., F.R.S., P.R.A.S.

The author has made several comparisons of the above lights throughout the different parts of their spectra, and has been able to verify their correctness by means of templates rotating in the spectrum of electric light, as described in Part II., "Colour Photometry," Phil. Trans., 1889. It seemed, however, that it would be useful if the colours of these lights could be expressed in single wave-lengths, together with the amount of added standard white light, the latter being expressed in terms of the luminosity of the dominant colour, in accordance with the method brought before the Royal Society in Proc. Roy. Soc., 1891.

When measuring light from the sky, a beam from the zenith or other desired part was reflected through a blackened tube into a darkened room in which the colour patch apparatus ("Colour Photometry," Abney and Festing, 1886) was placed, and the image of the end of the tube was focussed on to the front surface of a cube, the front surface of which was coated with zinc white, its background being black velvet. The patch of colour from the apparatus was also thrown on the cube. A rod placed in the paths of the two beams enabled the sky light and the spectrum colour to be examined side by side. The slit in the spectrum was an adjustable one so that any intensity of colour within limits would fall on the cube. A beam of white light reflected from the first surface of the first prism was again reflected from the surface of a thin prism on to the cube, a rod placed in its path cast a shadow on that part illuminated by the sky light, and by suitable adjustment the boundaries of the two shadows were caused to exactly coincide. The colour was thus diluted with white light, and rotating sectors, described in other papers, being placed in the path of the white beam, enabled the dilution to be regulated.

Sky Light.—On June 27, 1892, at 2.30 p.m., the sky was a good blue, but not a dark blue, and perhaps rather milky. The slit was moved into the part of the spectrum which appeared to be near the dominant colour. The colour was diluted to approximately the required amount. The slit was shifted and the dilution altered until the two colours made a perfect match. It was found that on the standard scale of the spectrum the dominant colour was represented by 28·6, which is λ 4800. The mean value of the sector aperture was 32°, and recollecting that the sectors are double sectors the comparison has to be made with 180°. The next operation was to compare the luminosity of the whole beam of white light with that of the colour. The sectors still remained in the white; the sky light was cut off, and the rod altered till the colour and the white were alongside each other with the boundaries of the shadows touching. The luminosities of the two were compared, and it was found that the aperture of the sector was 14°. As it required 32° of white to make the dilution of the colour, it follows that 32/14, or 2·286, parts of white were required to dilute 1 part of the blue. This may be expressed thus—

$$\text{Sky light} = \lambda\ 4800 + 2{\cdot}3\text{W}.$$

On July 4, 1892, at mid-day, the same procedure was adopted, and the dominant wave length was again λ 4800. In this case the amount of added white was thus—

$$\text{Sky light} = \lambda\ 4800 + 3{\cdot}1\text{W};$$

in other words, the sky was more milky.

At 4 p.m. on the same day the sky to the east, and about 30° above the horizon, was evidently slightly greener, and it was found that the colour agreed with scale No. 29·6 or λ 4834, and that it required three parts of white to be mixed with it.

$$\text{Sky light} = \lambda\ 4834 + 3\text{W}.$$

On other days, when the light of the portion of the sky near the zone of maximum polarisation the dominant wave length was found to be between these two limits, and was never found bluer, and the smallest admixture of white light was found to be 1·9.

From these measures it may be concluded that the dominant colour of a blue sky is λ 4800.

Amongst artists it is not uncommon to employ cobalt to render this colour, and in many instances this is mixed with Chinese white.

The dominant colour of cobalt was found to be at scale No. 29, or λ 4812, when illuminated by ordinary day light, whence it seems that, as far as colour is concerned, it is singularly fit for the purpose.

Sun light was compared in the same manner, but the beam

was reflected from the surface of a prism into a dark room, and again diminished in intensity by placing in its path rotating sectors with very narrow apertures.

Near mid-day on July 8 the sun was very clear, the sky being free from clouds, and a strongish wind blowing from the west. Two separate sets of measures were made with an interval of an hour between each. It was found that the dominant colour was λ 4885 in both cases, and in the first set it was diluted with 5·45 of white, and in the other with 5·14 of white. This indicates that sun light contains slightly more green-blue rays than the light emitted from the crater of the positive pole of the electric light. This agrees with the spectrum measures made in "Colour Photometry."

Cloud light was next matched on days in which the sky was overcast. A comparison of the general light of the zenith was all that was attempted, and near mid-day.

It was found that it required 1 part of λ 4864 diluted with 5·5 parts of white to make a match. It will be seen that the dominant colour of cloud light lies between that of the sky and of the sun, as might be expected, and is decidedly whiter than the sky, as might also be anticipated.

Various comparisons of sunset colours have been made, and found to range from λ 6300 up to λ 4800; in some cases it was necessary to match by means of complementary colours.

The light from a paraffin candle it was found could be very closely matched with D sodium light. The equation may be expressed as follows:—

$$\text{Candle light} = \lambda\,5880 + 0{\cdot}4W.$$

The amount of added white varied from 0·1 to 0·5, and it is in this part of the spectrum that a large number of separate observations are required in order to get a good and fairly trustworthy mean.

June 15.—"Some of the Effects and Chemical Changes of Sugar injected into a Vein." By Vaughan Harley, M.D., Teacher of Chemical Pathology, University College, London, and Grocer Research Scholar. Communicated by George Harley, M.D., F.R.S.

When 10 grams of grape-sugar per kilo. of body-weight of a dog are injected into a vein and elimination by the kidneys prevented, the sugar so rapidly disappears from the circulating blood that it reached the normal quantity within six hours. The quantity of glycogen in the liver and muscles is not markedly increased.

The amount of lactic acid in the blood is increased to so marked a degree as in some cases to be more than the quantity of sugar. The greatest amount of lactic acid is found in the liver. Alcohol, acetose, and aceto-acetic acid are also present in the blood after the introduction of the sugar. There is no increase in the quantity of ammonia in the blood.

The introduction of the sugar causes marked disturbance of the nervous system, shown by the appearance of muscular spasms, hurried breathing, and finally coma. These are probably due to some of the products derived from the breaking down of the sugar molecules acting as a poison, which by further breaking up into other substances become harmless and the animals recover.

"Studies in the Morphology of Spore-producing Members. Part I. Equisetineæ and Lycopodineæ." By F. O. Bower, D.Sc., F.R.S., Regius Professor of Botany in the University of Glasgow.

The first pages are devoted to the discussion of points of general morphology of the sporophyte, as it is seen in archegoniate plants, together with a sketch of the history of opinion as to the morphological "dignity" of the sporangia, and their relation to the parts (usually sporophylls) which bear them. The position of Goebel is adopted, that sporangia are as much organs, *sui generis*, as are shoots, roots, &c., no matter where they may be seated.

It is customary to assume that the ontogeny will serve as a guide to the history of descent in plants as in animals. As applied in detail to the sporophyte generation this assumption cannot be upheld: for the conclusions drawn from wide comparison would be directly antagonistic to such a history. The young sporophyte of a fern first forms foliage leaves, stem, and roots; only after a considerable period are sporangia produced. On the recapitulation theory it would be concluded from this that the vegetative system was the first to appear, while sporangia were of subsequent origin, and it might further be held that sporophylls are metamorphosed foliage leaves. But the whole comparative study of the sporophyte of lower forms leads to the opposite conclusion; spore-production was the first office of the sporophyte, and if the lower Bryophyta really illustrate the mode of origin of the sporophyte, the production of spores preceded the existence of a vegetative system of the sporophyte, and has apparently been a constantly recurring event throughout evolution. It must therefore be concluded that the history of the ontogeny does not truly recapitulate the history of the descent as regards the neutral generation; the sporophyte is, in fact, an intercalated phase which has acquired vegetative characters. Comparative study of the Bryophyta leads to the conclusion that the whole vegetative region was the result of progressive sterilisation of potentially sporogenous tissues.

A brief review of the progress of this sterilisation as it has already been recognised among the Bryophyta is next given; it is pointed out that (*a*) the sterilisation may involve the whole thickness of the sporophyte, as in the formation of the seta, or (*b*) it may make itself apparent only in individual cells of the sporogonial head (elaters). But the Bryophyta are clearly marked from vascular plants by two characters: (1) the absence of appendicular organs; (2) the single continuous archesporium.

There are, at least, three possible ways in which plants with numerous separate archesporia may have originated from plants of some Bryophytic type: (1) by branching (chorisis) of a sporogonial head; (2) by formation of entirely new archesporia, having no direct connection by descent from pre-existent ones; (3) by partitioning of a continuous archesporium.

The frequent presence of synangia in eusporangiate Vascular Cryptogams suggests either coalescence accompanying reduction in a descending series, or partitioning by means of septa in an ascending series; the first question in connection with such synangia will be whether in any natural sequence of Vascular Cryptogams the progression from a non-septate to a septate condition can be traced; or the converse. Though the facts at hand do not amount to an actual demonstration, the Lycopodineæ and their allies are believed to be an ascending series, and they are seen to supply important evidence. *Phylloglossum*, *Lycopodium*, and *Selaginella*, *Lepidodendron*, and the Psilotaceæ show natural affinities. To this series *Isoetes* may be added.

As regards the sporangia, there can be no doubt of the homology of the sporangium of *Phylloglossum*, *Lycopodium*, *Selaginella*, and *Lepidodendron*. Within the genus *Lycopodium* differences of detail have been observed analogous to such differences as would result in the production of more bulky sporangia, such as those of *Lepidodendron* and *Isoetes*, though it is true these differences are not so extensive. In these very large sporangia trabeculæ are found, as rods or plates of sterile tissue, which may project far upwards into the sporangial cavity (*Lepidodendron*), or may extend the whole way through it to the upper wall (*Isoetes*). In the latter case it has been shown by Goebel that the trabeculæ are the result of differentiation of a potential archesporium, part of which is sterilised and forms the trabeculæ.

The next step is to the Psilotaceæ; and the first question is that of the real nature of the synangium in these plants. Sections both of *Psilotum* and *Tmesipteris*, show the synangium to originate below the apex of the sporangiophore, and from its upper surface, in a manner very similar to the sporangium of *Isoetes*. The form of the young synangium resembles that of the sporangium of *Lepidodendron*, with which genus also there is extraordinary anatomical similarity. The septum is similar in its origin to the sporogenous masses, and is not at first distinguishable from them; in this respect it also resembles *Isoetes*. It would thus appear that the whole synangium is comparable in origin and position, in the broad lines of development, and in function to the sporangia of other Lycopods, *that is, a septate comparable with a non-septate body*.

Tmesipteris appears to be a variable plant as regards the form and structure of its synangia; there is, however, some method in its irregularities; smaller synangia of simpler form and structure are found at the limits of its fertile zones, while about the middle of it synangia have been found with three loculi, corresponding to those of *Psilotum*. Examination of those of simpler form shows *that they may be only partially septate, or the septum may be absent from the first*. I have been able to prove in young synangia of this type that *the tissue which would normally form the septum may be sporogenous;* this is exactly the converse of what has been proved by Goebel in *Isoetes*, and

the conclusion which may be drawn is that *there is no essential difference between the tissue which will form septum or trabeculæ and that which will form spores, since they can mutually undergo conversion.*

It has already been shown by others that in *Psilotum* the number of loculi in the synangium may vary, being sometimes two, normally three, but occasionally four or five. In *Tmesipteris* it may be one, two, or three ; and as there is no doubt of the homology of these within the Psilotaceæ, we may conclude *that in homologous parts the loculi may vary in number from one upwards.*

We may recognise within the species *Tmesipteris* a correlation of size to number of loculi ; the smallest specimens have no septum, and these are produced at the limits of the fertile zone, where nutrition may be failing ; those which are of normal size have two loculi : occasionally, when of large size and well nourished, as at the middle of the fertile zone, the loculi may be three. Here is illustrated in one species much the same sequence as is seen elsewhere for distinct genera, such as *Lycopodium*, *Isoetes*, *Lepidodendron :* where the sporangium is small there are neither trabeculæ nor septa, the exigencies of nutrition, and perhaps also of mechanical strengthening, not being felt (*Lycopodium*) : where the sporangium is large sterile bands of tissue are present ; these appear as trabeculæ or incomplete septa *Lepidodendron* or *Isoetes*, but as complete septa in the large synangia of *Tmesipteris*. To those who accept the homology of the synangium of *Tmesipteris* with the sporangium of other Lycopodinæ the probability of this will appear specially strong. Such facts as these and their theoretical bearing are discussed at length in the memoir : the opinion is finally expressed that progressive sterilisation and formation of septa are factors which will have to be taken into account in solving the problems of origin of vascular plants.

"Magnetic Qualities of Iron," by J. A. Ewing, M.A., F.R.S., Professor of Mechanism and Applied Mechanics in the University of Cambridge, and Miss Helen G. Klaassen, Lecturer in Physics, Newnham College.

The paper describes a series of observations of magnetic quality in various specimens of sheet iron and iron wire. A principal object was to determine the amount of energy lost in consequence of magnetic hysteresis when the iron under examination was carried through cyclic magnetising processes. Many cycles of B and H were gone through in the case of each of the specimens, the limits between which B was reversed being varied step by step in successive cycles, to allow the relation of the energy expended or of $\int H d I$ to B to be determined. The iron examined was, for the most part, thin sheet metal or wire such as is used in the construction of transformer cores. The experiments show that there are marked differences in the values of $\int H d I$ in different specimens, even when all are nominally soft iron.

In connection with these results a formula proposed by Mr. C. P. Steinmetz $\left(\int H d I = c B^{1\cdot 6}\right)$[1] to express the relation of the hysteresis losses to B is discussed, and it is shown that although such a formula may serve fairly well as an approximate statement of the relation within those limits of B which are important in practice, it fails when applied to the more extreme portions of the curve.

The authors go on to describe a second group of experiments, in which direct measurements were made of the heat developed in magnetic reversals. The method consisted in using two rings, alike in all respects, with divided magnetising coils. One ring had its coils coupled so that the two parts opposed each other, and the core was consequently not magnetised when a current passed. The other ring was active, and its coils (coupled inductively) were connected in series with the non-inductive coils of the inactive ring. Alternating currents were passed through both, and the active ring became heated by the effects of hysteresis and Foucault currents. To balance this a steady current was caused to flow in the core of the inactive ring, and the energy was measured which had to be expended in this current in order that the temperature of the two rings might continue equal. In some cases the rings used were miniature transformers, and no difference was found in the amount of energy consumed in the core when the "load" was taken off or put on the secondary.

In a third group of experiments the magnetic curve tracer was used to examine certain features of the curves of magnetisation. This instrument, invented by one of the authors, draws curves which exhibit the relation of the magnetisation of given samples of iron or steel to the magnetising current. Amongst other points referred to in this connection is the time-lag in magnetisation, which is shown by the curve tracer to be immensely great in soft thick bars. The work spent per cycle is a maximum at a particular frequency, which in such bars is very low.

The fourth and last section of the paper relates to the molecular theory of magnetisation, and describes experiments made with groups of small pivoted magnets. Results are given which tend to confirm the theory.

The particulars of the observations are set out in about forty sheets of curves which accompany the paper.

[1] "Trans. American Inst. of Electrical Engineers," vol. ix. No. 1.

SYDNEY.

Royal Society of New South Wales, May 3.—Annual Meeting.—Prof. Warren, President, in the chair.—The report stated that thirty-three new members had been elected during the year, and the total number on the roll on April 30 was 477. During the year the Society held eight meetings, at which the following papers were read :—Presidential address, Hail-storms, and is Mars inhabited? by H. C. Russell, F.R.S.—On the importance and nature of the Oceanic languages, by Sidney H. Ray.—On certain geometrical operations, Part I., by G. Fleuri.—A determination of the magnetic elements at the Physical Laboratory, University of Sydney, by C. Coleridge Farr.—Analyses of some of the well, spring, mineral, and artesian waters of New South Wales, and their probable value for irrigation and other purposes, by John C. H. Mingaye.—Ventilation of sewers and drains, by John M. Smail.—Flying-machine work and the ⅛ I.H.P. steam motor weighing 3¾lbs., by Lawrence Hargrave.—The venom of the Australian black snake (*Pseudechis porphyriacus*), by Dr. C. J. Martin and J. McGarvie Smith.—On the effect which settlement in Australia has produced upon indigenous vegetation, by Alex. G. Hamilton (for which essay the Society's bronze medal and prize of £25 were awarded).—Some folk-songs and myths from Samoa, translated by the Rev. G. Pratt, with introductions and notes by Dr. John Fraser.—Preliminary note on limestone occurring near Sydney, by Henry G. Smith.—Observations on shell-heaps and shell-beds, significance and importance of the record they afford, by E. J. Statham.—Notes on the recent cholera epidemic in Germany, by Dr. Schwarzbach.—On native copper iodide (Marshite) and other minerals from Broken Hill, New South Wales, by C. W. Marsh.—On the comet in the constellation Andromeda.—Results of observations of Wolf's Comet (II.), 1891, Swift's Comet (I.), 1892, and Winnecke's Periodical Comet, 1892, at Windsor, New South Wales, by John Tebbutt.—On the languages of Oceania, by Dr. John Fraser.—Notes on some Australian stone weapons, by Prof. Liversidge, F.R.S. The following papers were read before the various sections, viz. :—Medical Section : Recent work on the pathology of cancer, by Dr. G. E. Rennie.—Notes of a case of hydatid of the brain, by Dr. W. Chisholm.—Notes on a case of sarcoma of the testis in a cryptorchid removal, by Dr. Fiaschi. Engineering Section : Description of the engines recently erected at Ryde Pumping Station, with results of the tests applied, by C. W. Darley.—Various systems of tramway traction, by W. F. How.—Recent bridge-building in New Zealand, by A. H. Alabaster.—Notes on the economical use of steam, by T. H. Houghton.—Light railways for New South Wales, by C. O. Burge. Chemical and Geological Section : An account of a visit to New Guinea, together with some notes on the community of life between Australia and New Zealand, by Charles Hedley.—On the occurrence of platinum and associated minerals in the sands of the Richmond river ; also in the lode material of Broken Hill, by J. C. H. Mingaye.—On a remarkable specimen of auriferous quartz containing fossil encrinites.—An account of some intrusive rocks in the neighbourhood of Sydney, by Rev. J. Milne Curran.—On a new mineral containing iodide of copper found at Broken Hill, by W. M. Hamlet.—The Clarke medal for 1893 had been awarded to Prof. Ralph Tate, University, Adelaide. The Council had issued the following list of subjects, with the offer of the Society's bronze medal and a prize of £25 for each of the best researches, if of sufficient merit, to

be sent in not later than May 1, 1894:—On the timbers of New South Wales, with special reference to their fitness for use in construction, manufactures, and other similar purposes.—On the raised sea-beaches and kitchen middens on the coast of New South Wales.—On the aboriginal rock-carvings and paintings in New South Wales. To be sent in not later than May 1, 1895: On the silver ore deposits of New South Wales.—On the physiological action of the poison of any Australian snake, spider, or tick.—On the chemistry of the Australian gums and resins. The chairman read the Presidential address, and the officers and council were elected for the ensuing year, Prof. T. P. Anderson Stuart being President.

PARIS.

Academy of Sciences, July 24.—M. de Lacaze-Duthiers in the chair.—Diverse considerations on the theory of luminous waves, by M. J. Boussinesq.—Researches on samarium, by M. Lecoq de Boisbandran.—On the alleged fossil ferns of the coarse Parisian limestone, by M. Ed. Bureau.—On the distribution of the intensity of gravitation on the surface of the globe, by M. Defforges. This memoir has been submitted to the judgment of the Academy by the Minister of War. It contains a summary of the observations of the value of g at thirty-five stations, twenty-six determinations having been made with the "reversible invertible" pendulum invented by Commander Defforges, which eliminates the error due to the sliding of the knife edges. In this pendulum a displacement of the centre of gravity takes the place of the interchange of knife-edges, and the influence of curvature and of any dissymmetry in the action of the air is avoided. In the list of values enumerated, extending from Spitzbergen to Scotland, England, France, Corsica, and Algiers, there are certain anomalies which cannot be explained by supposed inaccuracies of observation and reduction. Clairaut's law, true in general, is almost everywhere masked by these anomalies. On the littorals of the various seas, gravitation presents slight anomalies, which are constant on the same coast, and characteristic of it. The islands show a considerable excess of gravitational force. On the continents the reverse obtains, and the defect appears to grow with the altitude and the distance from the sea. As the real surface of the ellipsoid, according to Clarke, does not depart from the theoretical surface by more than 18·4 feet from the Shetlands to the Mediterranean, the discrepancies cannot be attributed to irregularities in the figure of the earth, but must probably be accounted for on geological grounds.—Observations of Rordame's comet, made with the *equatorial coudé* (0.32m.) of the Algiers observatory, by M. Rambaud.—On the equations of the second degree whose general integral is uniform, by M. Paul Painlevé.—On certain systems of ordinary differential equations, by M. A. Guldberg.—On a nomographic method applicable to equations which may contain up to ten variables, by M. Maurice d'Ocagne.—Density of sulphurous anhydride, its compressibility and expansion in the proximity of normal conditions, by M. A. Leduc. The density of sulphurous acid under normal conditions was found to lie between 2·2638 and 2·2641. The coefficient of expansion between 0° and 20° was, at normal pressure, 0·003963, and at a pressure of 334mm., 0·003787.—On residues of polarisation, by M. E. Bouty. For defining capacities of polarisation it is implicitly admitted that, at least to a first approximation, the whole quantity of electricity which traverses the voltameter circuit during charge is employed in establishing polarisation, and will be recovered during discharge; also that to a given polarisation there corresponds a single and unique value of recoverable charge. M. Bouty shows that the effective capacities of discharge increase in proportion as the polarisation of the voltameter decreases. Even the initial capacities of polarisation cannot be relied upon to give rigidly constant values.—On some new interference fringes which are strictly achromatic, by M. Georges Meslin.—On the oxidation of sulphide of nickel, by M. Ph. de Clermont.—On crystallised cuprous phosphide, by M. A. Granger.—On bismuth subgallate (dermatol), by M. H. Causse.—On the condensation of the alcohols of the fatty series with the aromatic carburets, by MM. A. Brochet and P. le Boulenger.—On the effects of the slow destruction of the pancreas, by M. E. Hédon.—On the interference of excitations in the nerve, by M. N. Wedensky.—Comparison between the anterior and posterior members of some Urodelæ, by M. A. Perrin.—A parasitic entomophagus of the European silk-worm, by M. E. L. Bouvier and G. Delacroix.—Further researches on coccidia, by M. P. Thélohan.—On certain facts which permit a comparison between the central nervous systems of the Lamellibranchiata and the Gasteropoda, by M. A. d'Hardiviller.—On the Rhizoctone of Lucerne, by M. A. Prunet.—On the glacial origin of the breccia of the coal-bearing basins of Central France, by M. A. Julien.—On two Turkish meteorites recently added to the Natural History Museum, by M. Stanislas Meunier.—Desert sands of Lower Egypt, by M. A. Andouard. An analysis of the sands between the Ismailia canal and the Menzaleh Lake showed them to consist of 96·5 per cent. silica, 0·384 water, 0.507 organic matter, and small quantities of other substances such as carbonic acid, alumina, lime, and ferrous oxide. These deserts are gradually being reclaimed by irrigation and by the use of the "black earth" gathered among the ruins of ancient habitations.

GÖTTINGEN.

Royal Society of Sciences, February 22.—H. Weber: Researches in the theory of numbers in the domain of elliptic functions, II. A. Hurwitz: Proof of the transcendency of the number e. H. Burkhardt: On vector-functions which are themselves vectors, an application of invariantal methods to a question of mathematical physics. W. Holtz: On the immediate perception of magnitude in its relation to distance and contrast. W. Ramsay: The isomorphic stratification and the intensity of double refraction in epidote.

March 22.—W. Voigt: Determination of the constants of thermal dilatation and pressure for certain quasi-isotropic metals.

April 12.—O. Wallach: New observations on compounds of the camphor series. W. Voigt: The specific heats c_p and c_v of certain quasi-isotropic metals; determination of the elastic constants of chloride of sodium; remarks on the problem of the transverse vibrations of rectangular plates.

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