THURSDAY, JULY 14, 1887.

ELEMENTARY PRACTICAL PHYSICS.

Lessons in Elementary Practical Physics. By Balfour Stewart, M.A., LL.D., F.R.S., Professor of Physics, Victoria University, the Owens College, Manchester, and W. W. Haldane Gee, B.Sc., Demonstrator and Assistant Lecturer in Physics, the Owens College. Vol. II. Electricity and Magnetism. (London: Macmillan and Co., 1887.)

THE second volume of the now familiar "Stewart and Gee" has at length appeared, and it is satisfactory to find that the hopes and expectations to which a just appreciation of the first has given rise have not been formed in vain, but that the same store of exact information down to the minutest details is to be found in "Electricity and Magnetism" as in "General Physical Processes."

While in this the second volume the authors "have adhered to the plan of subdivision into a series of lessons each descriptive of something to be done by a definite method with definite apparatus," they have treated the subject, to a certain extent, twice over –in the first three chapters generally, with simple and easily extemporized apparatus, and in the remaining chapters as exactly as possible, with all that care and attention to the details of standard patterns of instruments which are essential to the claim, in the title, of "practical." Thus in the second chapter instructions are given for measuring M and H by the method of Gauss without any bought apparatus, while in the sixth chapter is to be found a most complete description of the Kew unifilar magnetometer with figures of the instrument in its two positions and of its parts. There is here a fully worked example, from which a student who has not the advantage of using such an instrument may get an idea of the accuracy obtainable, and from which he may realize the relative importance of the numerous corrections which are applied. To facilitate the calculation of these corrections tables are supplied which will be of value to those using the magnetometer.

Though all will agree that a little practical introduction to the subject generally is of advantage to the student, and that therefore these three introductory chapters serve a really useful purpose, many will question the wisdom of devoting space in an essentially practical book to an explanation of such terms as electromotive force, conductivity, resistance, or of the theory of the battery or the meaning of Ohm's law. These are text-book matters for which a student does not depend on a practical book, nor is he expected to do so. The ten pages devoted to these points are in fact ten pages wasted.

The fourth chapter deals with the measurement of resistance. As this extends over 108 pages, and is divided into sixteen "lessons," it is clear that this very important branch of the subject receives its fair share of attention. The measurement of the resistance of every kind of material, from thick copper bars to insulators, is fully set forth. It is in this chapter that an explanation is given of the method of putting up a reflecting galvanometer and its several adjustments. The directions for fixing the instrument in the most perfect way are excellent. Not a word is said, however, to show that for many purposes such a galvanometer set up in any azimuth and almost anyhow is not less serviceable than when arranged as described. No trouble should be spared, and none is spared by the authors, in showing how to do anything which shall improve the accuracy of work done; but in some cases a mass of elaborate adjustment serves no purpose whatever, and then it should be pointed out that, though useful for this or that purpose, such adjustment may be dispensed with.

In the chapter on the tangent galvanometer the construction of standard and ordinary instruments is of course explained, and the method of using them. Their application to the determination of electro-chemical equivalents and of Joule's equivalent is given here. In the account of the method of finding the quantity of heat developed there is, apparently, a slight oversight. The authors speak of the mean deflection during the time the experiment lasts. If the current is practically constant, the mean deflection may be taken without appreciable error; but if it varies, then the square root of the mean square truly represents the heating effect of the current. It is true that it should be the aim of the experimenter to avoid such variations; but if for some reason they should occur, the student should be told how to make the best of his experiment.

In the sixth chapter, already referred to in part, we find a most admirable description of the methods of determining the magnetic elements. This chapter leaves nothing to be desired.

The chapter on electro-magnetic induction contains an account of a great many experiments on induction of magnetism by currents, of currents by currents, and of currents by magnets; but, as in the third chapter, space is devoted to matters which might with advantage be left to the ordinary text-books. For instance, there is no necessity to prove the expressions for the ballistic galvanometer, or to explain the theory of damping and logarithmic decrement. The determinations of the coefficients of self and mutual induction form the subject of one lesson only. This part may now with advantage be greatly extended, since, lately, Prof. Foster has brought the subject before the Physical Society, and many others have followed suit.

In the last two chapters the condenser and electrometer are treated.

A good deal of useful matter is to be found in some of the appendixes. In the first we find the Wheatstone net and Kirchoff's laws; in the second and third, the theory of the electrical units. The fourth will be found the most valuable, in the laboratory, as there is here much additional information on the comparison of electromotive forces and the construction of standard cells. That on additional practical details is useful as far as it goes.

There is nothing about electro-capillarity, or about instruments depending upon any action of the kind; there is practically nothing about the electro-dynamometer, and there is no index.

Though a few faults have been found, they are mostly unimportant; and it is a matter of opinion whether some, especially the introduction of theoretical explanations into a book intended for use in the laboratory, are faults at all. The book will be found to be of the greatest service in every physical laboratory, and to be a fitting companion to that already so well known. It is to be hoped that the remaining volume, on light, heat, and sound, will soon be ready.

THE ROYAL BOTANIC GARDEN, CALCUTTA.

Annals of the Royal Botanic Garden, Calcutta. Vol. I. The Species of Ficus of the Indo-Malayan and Chinese Countries; Part I. Palæomorphe and Urostigma. By George King, M.B., F.L.S., &c., Superintendent of the Royal Botanic Garden, Calcutta. (London: Reeve and Co., 1887.)

DR. KING deserves well of botanists for his protracted, though evidently profitable, labours on so varied and difficult a genus as *Ficus*. From obvious causes, a large proportion of the large arboreous tropical genera of plants are still very imperfectly known, and, prominent among them, *Ficus;* therefore Dr. King could hardly have extended his researches in a more useful direction. The present publication, which, from its general title, we may assume will not be limited to a monograph of the Asiatic species of *Ficus*, is a tall quarto of sufficient size to illustrate adequately almost all the species of the genus in question. Indeed, this monograph possesses a quite special value, inasmuch as every species is carefully figured in natural size, with enlarged analyses of the floral structure.

Most persons interested in such matters will be familiar with Fritz Müller and Solms Laubach's investigations of the sexual conditions in the flowers of various species of *Ficus*, and the singular phenomena attendant on the fertilization of the ovules. Nevertheless, it may be convenient to give here a brief account of the process.[1] The edible fig, which may be given as an example of the fruit of the genus generally, consists of a thick hollow receptacle, the inner surface of which is thickly studded with flowers; and, in the edible fig, exclusively with female flowers. Male flowers of this species of fig are borne on different plants, called the caprifig; and associated with these male flowers in the same receptacles are numerous female flowers, occupying the greater part of the space. Invariably these female flowers are infested by gall-producing insects, hence they are termed gall-flowers, and very rarely indeed is a single ripe seed found in a receptacle of the caprifig. The insects hatched and nourished in the gall-flowers leave the receptacles of the caprifig at a period when the pollen of the male flowers is being shed, and in making their exit bear some of it with them to the receptacles of the edible fig, which they next visit; but they are unable to deposit their eggs in the perfect females, and only serve to convey pollen to them. On similar mutual adaptations the fertilization of all the species of *Ficus* seems to depend.

In an introduction to the descriptive part of his work, Dr. King details the results of his own examination of several hundred species, extending over some nine years; and he states that Solms-Laubach anticipated him only in his explanation of the true nature of the "gall-flowers," for he had found them in every species of the genus that had come under his notice. He also enters into some further particulars concerning the insects acting in the process of fertilization, though he adds nothing more conclusive. While admitting, and even assuming, that the pollen of the males must be conveyed by the insects developed in the gall-flowers "to the perfect females imprisoned in the neighbouring receptacles," he is still puzzled as to the way in which it is done. We are under the impression that Solms-Laubach indicates, if he does not actually state in so many words, that he had not only frequently seen the winged female insect issuing from the receptacles of the caprifig, but that he had likewise occasionally observed them enter the receptacles of the cultivated fig, which is the female of the same species.

This, the first part of King's monograph, contains descriptions and figures of seventy-six species of *Ficus*, whereof ten belong to his section *Palæomorphe*, and the rest to *Urostigma*, which was originally proposed as an independent genus by Gasparrini, and provisionally retained as such by Miquel. King found five different kinds of flower, variously associated or removed, in the Asiatic species of fig; and upon characters derived from the differentiation and arrangement of the sexual organs he classifies the species in two primary groups and seven sections. The species of the relatively small group *Palæomorphe* are distinguishable from all the others by having spuriously bisexual flowers associated with gall-flowers, while the fertile females occupy separate receptacles. In the definitions of the sections, the pistil in the functionally male flowers is described as rudimentary, though perhaps sterile would be a better term to use, because, as figured, and designated in the explanations of the figures, it is a fully-developed gall-pistil. This condition is regarded as the nearest approach to assumed original complete hermaphroditism.

In all six sections of the larger group the sexes are strictly separated, as to the individual flowers; and in the section *Urostigma*, male, gall, and perfect female flowers are intermingled in the same receptacles. We have overlooked it if there is any explanation of the advantage derivable from the presence of gall-flowers where both sexes are also found in the same receptacle; but it may, perhaps, be found in the fact that the inflorescence is proterogynous or proterandrous, hence insect agency is as necessary as in those species where the sexes are in different receptacles.

In the remaining five sections the male and gall-flowers are invariably borne in one set of receptacles, and the fertile female flowers in another set; and the presence of neuter flowers in the female receptacles characterizes the section *Synœcia*. The neuter flowers contain rudiments of neither sex, which condition King explains by saying the neuter flowers are asexual.

Neuter flowers are wanting in the sections *Sycidium*, *Covellia*, *Eusyce*, and *Neomorphe*; but the arrangement of the flowers is otherwise the same as in *Synœcia*. The two first of these sections have monandrous male flowers, and the two last have diandrous or triandrous male flowers: while the receptacles of the first and third are mostly axillary, those of the second and fourth are usually borne in fascicles on the stem and branches. Thus it will be perceived that the distinctive characters of these four sections are somewhat artificial. However, it is only fair to say that the author himself points out this fact.

[1] Further details will be found in NATURE, vol. xxvii. p. 584.

We have very little to say except in favour of this work, which is certainly one of the most important of recent contributions to systematic botany; but we should have liked to see a closer adherence to established usage in the application of certain botanical terms. To use the terms monœcious and diœcious in relation to the individual receptacles as well as the whole tree is perplexing, and also unnecessary, because suitable terms for expressing these distinctions are current, and even employed by the author himself in some passages. W. B. H.

OUR BOOK SHELF.

Year-book of Pharmacy for 1886. (London: Churchill, 1887.)

General Index to Year-books of Pharmacy, 1864–1885. (London: Churchill, 1886.)

THE "Year-book of Pharmacy" for 1886 contains a larger number than usual of abstracts of papers. Amongst the most interesting of them are perhaps those treating of coca and substances obtained from it. It appears that when the active principle, cocaine, is heated with water it decomposes, losing methyl (CH_3), which is replaced by hydrogen. The product of this decomposition is benzoyl-ecgonine, which can again be converted into cocaine by heating with methyl iodide and methyl alcohol. The replacement of methyl by hydrogen in the conversion of cocaine into benzoyl-ecgonine produces a very marked change in the physiological action of the substances, for while cocaine is distinguished by its extraordinary power of paralyzing the sensory nerves and thus producing anæsthesia of any part to which it is applied, this power is completely absent in benzoyl-ecgonine. Benzoyl-ecgonine, however, has a physiological action very closely allied to that of caffeine—a circumstance which is very interesting in relation to the use of coca and coffee as a beverage.

Another substance used as an intoxicating drink in the South Sea Islands—namely, Kava, obtained from the root of *Piper methysticum*—has been found, like cocaine, to have a powerful local anæsthetic action.

Other abstracts of great interest are those which relate to ptomaines and leucomaines, or alkaloids formed from the decomposition of albuminous matters either outside or inside of the body. These alkaloids are becoming more and more important from the fact that they are now recognized as not only causing poisoning where meat has been taken in a state of putrefactive change, but as causing abnormal symptoms in some diseases. Thus it has been found that in typhoid fever a large quantity of ptomaines occur in tbe fæces, and it is supposed by one writer that the utility of *tisanes* in illness may be due to their aiding the removal of these alkaloids from the body through the kidneys.

By cultivating the comma-bacillus in broth, an alkaloid has been obtained which appears to be identical with that already isolated from the dejecta of cholera patients. In relation to these alkaloids produced in the body, it is very interesting to note that alkaloidal substances may be formed by the action either of ammonia or of compound ammonias on glucose.

A number of new alkaloids have been isolated from plants, and the actions of several of these are described.

The General Index to the "Year-books of Pharmacy" for the Years 1864–1885 inclusive is of great service, saving much time, and enabling one not only to find any paper readily, but to see at a glance what work has been done on a particular subject within the last twenty years.

A B C Five-Figure Logarithms. By C. J. Woodward. (London: Simpkin Marshall and Co., 1887.)

TO those who work in physical and chemical laboratories this little book will be an immense help, for, in the ordinary work of the laboratory, errors of experiment exceed any error of calculation introduced by five-figure logarithms, while the time saved in calculation is very great.

The tables are indexed ledger-fashion, so that the required mantissa may be found in a moment. The differences for the 5th and 6th figures of sequences are found by using side letters denoting the line at the foot of each table in which the required difference is presented. Much greater accuracy is obtained by the last figure of certain mantissæ having dashes above and below to indicate departures from the normal difference. At the end are added a few chemical and physical constants and tables, including some on gas analysis.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

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

Lighthouse Work.

IN the second of the very interesting articles on "Lighthouse Work in the United Kingdom," by Mr. J. Kenward, which have appeared in your pages, some words are used, not intentionally, I believe, but which, by those who are unfamiliar with the subject, might be construed in such a way as to deprive the late Mr. Thomas Stevenson of the credit due to him as the inventor of the dioptric mirror. The following is an extract from Mr. Thomas Stevenson's "Lighthouse Construction and Illumination," published in 1881, which puts the matter on a correct footing:—

"*Mr. J. T. Chance's Improvements of* 1862 *on Stevenson's Dioptric Spherical Mirror.*—Mr. Chance proposed to generate the prisms of the spherical mirror round a vertical instead of a horizontal axis, and also to arrange them in segments. He says (*Min. Inst. Civ. Eng.* vol. xxvi.):—'The plan of generating the zones round the vertical axis was introduced by the author, who adopted it in the first complete catadioptric mirror which was made, and was shown in the Exhibition of 1862 by the Commissioners of Northern Lighthouses, for whom it was constructed, in order to further the realizing of what Mr. Thomas Stevenson had ingeniously suggested about twelve years previously. During the progress of this instrument the idea occurred to the author of separating the zones, and also of dividing them into segments like the ordinary reflecting zones of a dioptric light; by this means it became practicable to increase considerably the radius of the mirror, and thereby to render it applicable to the largest sea light, without overstepping the limits of the angular breadths of the zones, and yet without being compelled to resort to glass of high refractive power.'

"There can be no doubt of the advantage of these improvements, and it is without any intention of derogating from Mr. Chance's merit in the matter that it is added that my first idea was also to generate the prisms round a vertical axis. But the flint glass which was necessary for so small a mirror could not be obtained in large pots, and had to be taken out in very small quantities on the end of a rod and pressed down into the mould. I was therefore obliged to reduce the diameter of the rings as much as possible; and it was thought by those whom I consulted at the time (Mr. John Adie, Mr. Alan Stevenson, and Prof. Swan) that by adopting the horizontal axis the most important and most useful parts of the instrument near the axis would be more easily executed, inasmuch as those prisms were of very much smaller diameter. Mr. Chance not only adopted the better form, but added the important improvement of separating the prisms and arranging them in segments."

Edinburgh, June 28. D. A. STEVENSON.

IN addition to several errors into which Mr. Kenward, in his third article on "Lighthouse Work," has fallen, he seems to have overlooked the experiments made by Messrs. Stevenson, in 1870, on paraffin as an illuminant for lighthouses, and which were fully detailed in the Parliamentary Paper 318, Session 1871. Experiments had been made with some degree of success with burners having one and two wicks, but all attempts to burn paraffin efficiently in the large concentric-wick burners were unsuccessful until Capt. Doty solved the problem. Unaware of what had been done in France, Messrs. Stevenson, early in 1870, had been conducting a train of experiments on paraffin, and had reached important conclusions on the subject, and good flames were got with the single and double Argand lamps, when Capt. Doty submitted his burners to them. The Doty burners were then subjected to crucial tests in Edinburgh, and also to actual trial for a month in a first-order lighthouse. The conclusions Messrs. Stevenson then arrived at and reported to the Scottish Lighthouse Board may be summarized as follows: that paraffin as now manufactured, with a high flashing-point, is safe and suitable as a lighthouse illuminant; the flames of the Doty burners are of great purity and intensity, and easily maintained at the standard height; the lamp-glasses and lamps in use for colza are equally suitable for paraffin; the varying state of the atmosphere does not affect the penetrability of the paraffin light more than the colza light; no structural alterations on the existing apparatus are necessary; the initial power of the lights will be exalted from 10 per cent. in the four-wick burner to fully 100 per cent. in the single-wick burner; and that the use in the Scottish lighthouses of the new illuminant would effect an annual saving of £3478. These conclusions, which subsequent experience has fully borne out, settled the relative merits of paraffin and colza so far as British lighthouses were concerned; and the first four-wick paraffin burner ever permanently installed in a lighthouse was at Pentland Skerries on February 15, 1871, while Argand paraffin burners were in use at Pladda in December 1870, and at the catoptric lights of Great Castle Head in December 1870, and at Flamborough Head in June 1872.

With reference to Ailsa Craig the facts are that in 1878, when Messrs. Stevenson were considering the problem of effectively guarding the Fair Isle by fog-signals, they consulted Prof. Holmes as to the feasibility of working the signals from a central station and sending the compressed air through a long length of piping, and he concurred with them regarding its practicability, and stated that he had worked a signal in Canada at a distance of half a mile. When Ailsa Craig came to be dealt with, the Fair Isle scheme was reverted to, and Mr. Ingrey's firm contracted to carry out the work in accordance with Messrs. Stevenson's specification. The automatic appliances for securing the true periodicity of the siren blasts were designed by Mr. Ingrey.

In giving the history of gas-engines applied as a motive power for actuating fog-signals, a most important advance in lighthouse work, Mr. Kenward does not state that this was done on the Clyde by Messrs. Stevenson in 1875, and that since then they have introduced gas made from mineral oil for driving gas-engines at Langness in 1880, at Ailsa Craig, and at the Clyde.

D. A. STEVENSON.

84 George Street, Edinburgh, July 4.

The Use of Flowers by Birds.

I HAVE just read in NATURE of June 23 (p. 173) Mr. W. White's letter, and should like, with your permission, to add a few words on this subject. A quiet, leafy home has made me well acquainted with the commoner birds, therefore I speak. In the first place, with regard to the non-protective colour of the laburnum blossoms, it must be remembered that the flowers thus used have two other qualities that recommend them to the nest-builders: flexibility and length. Everyone must have noticed how sparrows and other birds steal anything long and limp—pieces of string, &c.—when they are building. Only the other day I caught a sparrow trying hard to untie a piece of thick string with which the branch of a tree had been tied back, and it would have succeeded if I had not gone to the rescue. I have had the ties of budded roses taken away by them also. I have been told by a lady that she once lost a lace handkerchief in a mysterious manner, which was at last discovered—through a telescope—on a high tree, on the nest of a rook or daw. All the flower-sprays mentioned were long and limp. I have seen birds take those of the clematis also.

But there can be no doubt that birds have a very keen sense of the protectiveness of colour; if you startle a blue tit it will seek a high branch against the sky—blue, and brown, and green; a robin flits away to the brown shadow of a bush; I have even known a young robin, threatened by an elder (they are great disciplinarians), take refuge near a reddish-brown dress.

A thrush is wonderfully clever almost as soon as it is fledged in finding its own tints on some wall or tree-trunk, and making believe to be a piece of it to such an extent that one may approach quite close to it and it will remain absolutely motionless as long as one's eye is upon it; but if the eye is removed, even for a "twinkling," the bird will have hopped down noiselessly behind something before one can look again.

With respect to the yellow flowers, may there not be some quality attached to the colour that birds like, or find profitable? I have watched a thrush during a long hard frost, *devour*—not merely pull to pieces, but eat voraciously—large bunches of yellow crocuses. All the earlier bunches were eaten. When the purple and white came out later it was still faithful to the yellow, and never touched any other; and so eager was it, that when the blossoms were gone it would dig its beak down into the buds and pull out the least bit of yellow that appeared. I watched it from a window close above the bed, and there was no possibility of making any mistake about it. The bird—a very large one—took some again this year, but not many. It could hardly be all for love of colour, though no doubt that is very strong in birds as in children. Birds are very like children.

The sparrows mentioned in my last note made two more trials after I sent it—five in all; and the last time their attempt was nearly composed of white alyssum. After that they gave it up, but I get a severe scolding from them sometimes if I go near the place. They tried to build there last year, and I removed two or three nests, but I allowed a thrush, that had built below and brought forth a brood before I perceived it, to remain. When they left, the sparrows immediately built *on the top* of the forsaken thrush's nest. They seem to have drawn the conclusion—rather hastily, but not irrationally—that *that* was a safe place, and whether or not their thoughts took the shape of words, they chattered over their work immensely. And I do not know where the line can be drawn between words and exclamations (the foundation-stones of language), nor between those and the notes and cries of birds, which are much more numerous and varied and distinctive of purpose than most people imagine, especially those of the robin. The strangely human and canine cries of a party of quarrelling sea-gulls are extremely expressive.

It may be said that there is no progress, no addition to the language of birds; but I am not sure of that. Last winter, a robin, accustomed to be fed at my window on bits of bacon, invented a note by which it called me to feed it. It was quite peculiar—hushed, short, and muttered, as it were. Its object seemed to be to reach my ear and not that of rival birds. It would take a few little bits—very few—when offered, look gratefully in my face, with its head on one side, and away, till it was again hungry; then—*da capo*. The same robin is hopping in and out of the open window continually now, taking what it pleases for itself and young of food set for it.

That birds should be subject, like ourselves, to the tyranny of fashion seems not at all unlikely if one considers the nature of that tyranny. The feeling that seems to oblige people to adopt, notwithstanding their sense of beauty and fitness, fashions that are positively monstrous, must have its roots low down in the scale of Nature. It seems to be composed of a sense of association and a love of the accustomed—both very strong in birds; association, for instance, of wisdom and authority with a wig, of the delightfulness of well-bred women with the extremely undelightful outlines they contrive to give to their figures, &c., &c. The pleasure that the accustomed gives is, I suppose, that of rest. No doubt fashion may reign in the lower regions; may it not control, in a somewhat transient manner, the bee that packs its load from the pollen of a particular flower, of one colour and no other? J. M. H.

Sidmouth, July 3.

Spawn of Sun-fish (?).

DURING a cruise on the west coast of Ireland, from which I have recently returned, I captured a long ribbon of spawn about 40 feet long, 3 feet deep, and a quarter of an inch thick. The ova, about the size of No. 2 shot, were set in a firm gelatinous mass, which floated edgeways in a frilled form. I saw it floating about a foot below the surface, and succeeded in gaffing it and towing it behind the punt by getting some of it fixed over the gunwale. The embryos had developed so as to show eyes when first taken, and in the two days, during which some of it remained alive in a deep can, a further advance took place; but then, owing to the heat of the weather, the ova whitened, its buoyancy was lost, and decomposition set in.

As we saw several specimens of the sun-fish (*Orthagoriscus mola*) in the vicinity, and as the spawn must have belonged to some very large fish, I think it probable that what we found was the spawn of a sun-fish.

I should be glad if any of your readers could throw more light on the subject. W. S. GREEN.

Carrigaline, co. Cork, July 4.

After-Glows.

IN reply to the letter of Mr. L. P. Muirhead in NATURE of June 23 (p. 175), I would ask to be permitted to state that the after-glows are very rich and conspicuous here evening after evening, and occasionally discernible till 10 p.m.

Worcester, July 4, 1887. J. LLOYD BOZWARD.

The Cuckoo in India.

I HAVE been here for just one month, and during that time have constantly heard the cry of the cuckoo. Last Sunday I heard it at Lackwar, fifteen miles from here. This would apparently point to Jerdon's not being correct in saying the cuckoo is rare in India. F. C. CONSTABLE.

Mussoorie, June 15.

Mr. Mutzler, the owner of this hotel—the Charleville—tells me the cuckoo is constantly heard from spring to October.

Luminous Boreal Cloudlets.

IN NATURE, vol. xxxiv. p. 192, attention was invited by the writer to what appeared to him to constitute a special class of self-luminous cloudlets in the northern sky at night, for which, if so recognized, the name "nubeculæ boreales" was suggested.

A careful look-out was kept every night last autumn, winter, and spring for their reappearance here, but to no effect till the night of the 19th inst. Then, and subsequently on the 21st, 24th, and 26th inst., there was an increasing development of the phenomenon in a north polar horizontal arc of 50°, or 25° on each side the true north. At length on the 28th, and last night, the 29th inst., there was a magnificent and marked display.

One of your able correspondents of last year seemed to consider he had already drawn attention to the subject in a previous year in your columns. It appeared, however, he had only remarked upon sunlit clouds, as a phase of the cloud-forms attracting latterly special attention.

It is quite out of the question to attribute the luminosity now referred to in any respect to direct solar illumination at midnight; and fortunately the eminent Astronomer-Royal for Scotland was led to apply the spectroscope, confirming the writer's conjecture as to the sub-auroral and self-luminous character of these cloudlets. His letter of July 31 will be found in NATURE, vol. xxxiv. p. 311.

The recent works of Lemström and Koch, reviewed in NATURE, vol. xxxv. p. 433 *et seq.*, have followed up the subject in noting a sudden and wide-spread development of cirrus clouds and luminous mists in auroræ of Sweden and Labrador.

Dundrum, co. Dublin, June 30. D. J. ROWAN.

The Migrations of Pre-Glacial Man.

WILL Dr. Hicks kindly explain the statement cited in NATURE (vol. xxxvi. p. 185), that the migration of pre-glacial man to this country was "*from* northern and north-western directions."

June 25. GLACIATOR.

On the Pliocene Deposit of Marine Shells near Lattakia, and a Similar Deposit in the Island of Zante.

ON p. 384, vol. xxx. of NATURE, Prof. Hull published an account, furnished him by myself, of the shell deposit in the marl of the Lattakia plain. Since that time I have submitted these specimens to Mr. Etheridge, F.R.S., of the British Museum, who has kindly furnished me with their specific names, *as far as they are determinable.* The subjoined list fixes the geological date or succession of the deposit, which belongs to, or is of the same age or period as, the Pliocene or Crag deposits of Essex, Norfolk, and Suffolk. The fossils from the raised beaches may be of post-Pliocene.

MOLLUSCA.

Class I.—*GASTEROPODA.*

Order I.—PROSOBRANCHIATA.

Sec. A.—**Siphonostomata.**

1. Fam. STROMBIDÆ.

1. *Strombus*, sp.
2. ,, ,,

2. Fam. MURICIDÆ.

3. *Murex branderis*, Brocc.
4. ,, *erinaceus*, Linn.
5. ,, *conglobatus*, Micht.
6. *Fusus rostratus*, Defr.
7. ,, *corneus*, Sow. = *F. gracilis.*
8. ,, sp.
9. *Ranella marginata*, Sow. or Brocc.

3. Fam. BUCCINIDÆ.

10. *Buccinium flexuosum*, Brocc.
11. *Cassis crumona*, Lam.
12. *Cassidaria echinata.*
13. *Columbella nassoides.*
14. *Nassa clathrata*, Defr.
15. ,, *megastoma*, Brocc.
16. *Terebra imbricaria.*
17. ,, near *T. plicaria.*
18. ,, sp.

4. Fam. CONIDÆ.

19. *Conus Noë*, Brocc.
20. ,, *deperditus*, Brig.
21. ,, sp.
22. *Pleurostoma monile*, Brocc.
23. ,, *cataphractra*, Brocc.
24. ,, *turricola*, Brocc.

5. Fam. VOLUTIDÆ.

25. *Mitra scrobiculata*, Defr. (Brocc).
26. ,, sp.
27. ,, sp.

Sec. B.—**Holostomata.**

6. Fam. CERITHIIDÆ.

28. *Aporrhais* (*Chenopus*) *pespelecani*, L.
29. *Cerithium vulgatum*, Brug.

7. Fam. NATICIDÆ.

30. *Natica*, sp.

8. Fam. LITTORMIDÆ.

31. *Phorus agglutinans*, Lam.

9. Fam. TURBINIDÆ.

32. *Turbo rugosus*, Lam.
33. ,, sp.
34. *Trochus patulus*, Brocc.

Class II.—*CONCHIFERA*, Lam.

Sec. A.—**Asiphonida.**

10. Fam. OSTREIDÆ.

35. *Ostrea*, sp.
36. *Spondylus crassicostata.*

11. Fam. PECTENIDÆ.

37. *Pecten*, sp. near *P. altoplicatus.*
38. ,, *jacobæus.*
39. ,, *opercularis*, L.
40. ,, *dubius*, Brocc.
41. ,, *janira*, near *quinquecostatus.*

12. Fam. ARCIDÆ.

42. *Arca polii.*
43. *Pectunculus*, sp.

Sec. B.—**Siphonida, Integro-pallialia.**

13. Fam. CHAMIDÆ.

44. *Chama squamosa*, Brand.

14. Fam. CARDIIDÆ.

45. *Cardium rusticum*, L.
46. ,, *echinatum*, L.
47. ,, *edule*, L.

15. Fam. LUCINIDÆ.

48. *Lucina borealis*, L.

Sec. C.—**Sinu-pallialia.**

16. Fam. VENORIDÆ.

49. *Venus fasciata*, Da Costa.
50. ,, (*Cytheræa*) *casina*, L.

Class III.-*BRACHIOPODA*, Cuv.

51. *Waldheimia complanata.*

It will be seen by this list that three classes, seventeen families, twenty-nine genera, and fifty-one species are represented.

Beside the above marine species, which are found more or less embedded in the soil, as well as on its surface, *Helix pomatia* is found in great profusion all over the surface.

Another species of *Helix*, closely allied to *H. lapicida*, and a species of *Clausilia*. No other terrestrial shells were collected in this region.

In addition to the above Mollusca I found a species of *Toxas-*

ter, species of *Dentalium Noë*, and specimens of *Serpula*, also a large shark's tooth belonging to the genus *Carcharodon*.

During the autumn of 1885 I visited Zante in the Austrian Lloyd's steamer from Trieste to Athens. As the steamer only anchored for a few hours, I had time only for a walk to the top of the hill overlooking the town. A chain of hills trending nearly north and south forms the backbone of the Island of Zante. At the latitude of the town of Zante this chain is broken by a strip of alluvial plain about 2 miles wide, stretching from the eastern to the western coast of the island. The Castle hill is a mass of Pliocene marl, rising about 300 feet above this plain at its eastern edge. The steep side of the hill is channeled with innumerable ravines and gullies, and of the same colour as the Pliocene beds of Lattakia. In coming down the hill, I observed in one locality, within a radius of 30 feet, the following species:—

Cerithium vulgatum, Brug.
Murex conglobatus.
Cardium edule, L.
Venus (*Cytheræa*) *casina*, L.
Ostrea, sp.

All of these were more or less embedded, or had been worked out by the rain, and lay at the bottom or sides of the gullies.

London, June 23. GEORGE E. POST.

The Perception of Colour.

I HAVE not yet heard it stated that our perception of colour is slower for the blue and violet rays than for the green, yellow, and red ones; and as I think that this subject has interest for many of your readers, they will perhaps carry out the following simple experiments on themselves and their friends.

A luminous object, such as a distant gas-lamp, an electric light, or the moon, is looked at through a direct-vision prism after it has been removed out of its case. The spectrum is of course a bad one, but brilliant. Now, if the prism is rolled backwards and forwards between the fingers, so that the spectrum oscillates through a small angle, it appears to bend like a riding-whip which is being flicked from side to side. The blue and violet parts of the spectrum always lag behind. In fact, as far as I could see, the spectrum, instead of being straight, seemed to be gently curved, but very sharply bent between the indigo and the violet part, which would show that the more refractive rays are seen by us very much later (even proportionately) than the others.

As everybody is not able to detect this bending of the spectrum, the following experiment should also be carried out. Instead of rolling the prism, it is passed between the eye and the object as quickly as possible, so that the spectrum is only seen for an instant; and it will be distinctly noticed that it seems to flash from the red end towards the violet—a sure sign that the red is seen first and the violet last. C. E. STROMEYER.

Strawberry Hill, July 5.

Breeding for Intelligence in Animals.

SEEING the results that have been attained by breeding for special qualities in dogs, why should not systematic efforts be made to breed for general intelligence? The correspondents who have from time to time furnished you with illustrations of canine sagacity must be sufficiently numerous to form an Association to promote the interbreeding of intelligent dogs, and the distribution of their offspring to those who would foster and cultivate their intellect. H. RAYNER.

June 27.

The Nephridia of *Lanice conchilega*.

SINCE my paper on the nephridia of *Lanice conchilega*, Malmgren, appeared in NATURE (June 16, p. 162), I have learned that the chief peculiarity to which I called attention in my description of the nephridial system had been observed and mentioned before. In the monograph on the Polycladen by Dr. Arnold Lang, published in 1884, and forming one of the series "Fauna und Flora des Golfes von Neapel," p. 677, occurs the sentence: "Bei *Lanice conchilega*, Pallas, hat neuerdings Ed. Meyer bei erwachsenen Thieren jederseits einen Längscanal aufgefunden, welcher alle Segmentalorgane mit einander verbindet, und nur an einer Stelle durch ein Dissepiment unterbrochen ist." Dr. Ed. Meyer has called my attention to this passage, and informed me that Dr. Lang received permission from him to make use of this and other observations which he (Dr. Meyer) had made in the course of his studies on Chætopoda. The sentence quoted has been also cited by Dr. R. S. Bergh in an article on "Die Excretionsorgane der Würmer," in *Kosmos*, 1885, Bd. ii. p. 115. That sentence is the only account yet published concerning Dr. Meyer's observations on the nephridia of the species in question. When my paper was printed I was unaware of the existence of the sentence in Dr. Lang's monograph, or of the reference to it made by Dr. Bergh. Unfortunately I had not had time to read the monograph through, and had not suspected that there was in it a mention of a novel fact concerning the anatomy of Chætopoda. My examination of *Lanice conchilega* was made in entire ignorance that Dr. Meyer had already investigated its anatomy; otherwise I should of course have mentioned his name in the summary I gave of previous work on the subject. J. T. CUNNINGHAM.

Edinburgh, June 30.

THE PARIETAL EYE IN FISHES.

THE discovery of the parietal eye in lizards by de Graaf and Spencer is so recent that it is hardly necessary to preface an account of the structure of that organ in another group with the history of their researches.

Its high development in some lizards, and, so far as we know, its rudimentary nature in all other existing groups of vertebrates, including fishes and Amphibia, and lastly its entire absence in Amphioxus, are, for those who see in the latter the "Urvater" of the Chordata, points which made it difficult to form any satisfactory morphological conception of its origin.

True, something that admitted of comparison with it could be found in larval Ascidians; and Spencer, at the end of his able paper, endeavoured to trace its "rise and fall" from its supposed homologue, the larval Tunicate eye.

With Wiedersheim and Carrière, I consider that Spencer has placed the eye of the larval Tunicate at the wrong end of the series—if it should come in at all; for, as experience has abundantly shown, it is very easy to compare organs of the higher vertebrates with what are supposed to be homologous organs in Amphioxus and the Tunicata, and at the same time to be entirely in error. I need hardly refer the reader to the instances in which such comparisons have been shown by Dohrn in his famous "Studien" to have been entirely wrong; and holding with him that Amphioxus and the Tunicata are very degenerate vertebrates, and that from them but little can be got for the elucidation of the problems of vertebrate morphology, I felt the necessity of looking elsewhere for the solution of that of the parietal eye in its relations to the paired eyes.

With these problems in view I began to study the development of the pineal eye, and also its structure in such fishes as might be expected to retain it in a more developed condition than most of those we know.

At Prof. Wiedersheim's suggestion I examined the structure of the "pineal gland" in Ammocœtes of *Petromyzon planeri*, in the hope that something more might come out beyond that which the able work of Ahlborn has already made known to us. The result was, in a sense, disappointing, but not unexpected, for, remembering Dohrn's researches, and bearing in mind that the paired eyes of Petromyzon are rudimentary in Ammocœtes, first becoming capable of vision in the adult, I had firm hope of good results from the examination of sexually mature animals.

In the adult the discoveries made exceeded my expectations; and after examining this animal I proceeded to make sections through the brain of Myxine. Here, again, the finds were important, and the research was extended to specimens of *Bdellostoma* and *Petromyzon marinus*, which I owe to the generosity of my former teacher, Prof. Howes.

Before giving the detailed account of my investigations, I may say that neither the anatomical nor developmental studies so far made, give any direct clue to the origin of the organ.

That which seems to me the most likely hypothesis I shall give at the end of this paper, and in its favour I can at least say that it is a morphological explanation of the evolution of the parietal eye, which, so far as I know, is not inconsistent with any known facts.

The epiphysis in Ammocœtes has been described by Ahlborn (*Zeitsch. f. wiss. Zool.*, Bd. xxxix.). His description is mainly correct, and but little can be added to it. The epiphysis itself is divided into a dorsal and a ventral vesicle, and as we are not concerned here with the ventral one, I shall ignore its existence.

In large Ammocœtes the dorsal vesicle lies deep under the skin, and far removed from the light; its position being marked externally by a clear white spot just behind the opening of the nose.

It is a simple closed sac, and retains its attachment to the brain. The dorsal wall is thinner than the ventral, and is made up of a layer of flattened cells, which are not modified to form a lens.

The ventral wall is a much more complicated structure. Towards the inside of the vesicle it presents a layer of rod-like cells, which are more like the rods of a retina than like anything else. Externally (with regard to the vesicle) to this layer are two or three irregular rows of nuclei. There is no lens and no pigment, except a few very minute dots.

In this stage the retina of the parietal eye of Ammocœtes somewhat resembles that of *Cyclodus*, figured by Spencer, but is somewhat better developed, and tends towards the condition found in *Varanus giganteus*.

Except in the presence of the minute dots of pigment, and in the fact that the dorsal wall of the vesicle is not connected by fine strands with the ventral wall, as Ahlborn supposed, there is nothing new in this description, and even now we cannot say that the parietal eye of fully-grown Ammocœtes is very highly developed.

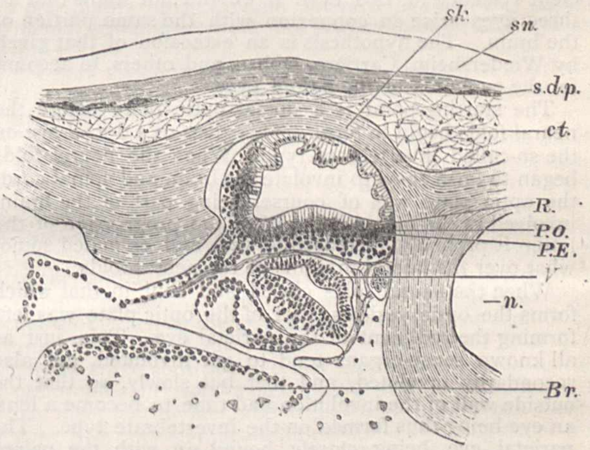
In the adult Petromyzon, just as the paired eyes are highly developed so also do we meet with an increased development of the parietal eye. As is well known since Wiedersheim's researches, the brain of the adult is much compressed in an antero-posterior direction. The dorsal vesicle of the pineal gland lies much further forwards, and more dorsally than in the larva, so that it comes to be nearer the external surface of the body, while it lies buried in the roof of the skull. Its posterior wall is densely pigmented, so much so that it is impossible by ordinary means to make anything out of the structure of the cells composing it. These points can be seen very plainly in longitudinal vertical sections through the brain and skull (see figure).

I ought to mention that the clear white patch of skin lying above the organ is much larger and more marked than in the Ammocœtes. It is, however, difficult to suppose that the white patch is here of much physiological importance, and it can only be referred back to a time when the eye in Petromyzon was of more use than at present. The anterior wall is composed of cells which are thrown into folds (possibly in part due to contraction) projecting into the cavity of the vesicle.

I mentioned above that in the full-grown Ammocœtes there are only a few minute dots of pigment present. So few and so small are these, that unless specially sought for they would be overlooked, as indeed they have been by previous observers. The state of things is much different in the young Ammocœtes of about 2 inches in length. There, as in the adult, the retina of the parietal eye contains a large deposit of pigment. This was first shown me by Dr. Schwarz (a pupil of Prof. Weismann's), who has made, for the study of the paired eyes, some very fine sections of very young Ammocœtes, at stages which I had failed to obtain. I shall figure these sections in the complete account I have in preparation. In the young Ammocœtes the parietal eye is large, and exceeds in size either of the paired eyes. Its posterior wall is really a well-developed retina, with long rod-like elements embedded in pigment, and a series of outer layers of spherical nucleated bodies. Its anterior wall consists of several layers of rounded cells, but it does not form a lens.

In the specimen of *Petromyzon marinus* mentioned before, owing to the soft state of the brain I could only make out a very deep fossa in the skull in the position in which the "eye" is situated in *P. planeri*. The white patch of skin is here very large indeed, and on the whole I am inclined to think that the parietal eye in *Petromyzon marinus* would well repay further investigation.

In Myxine the state of things is even more surprising. Here the parietal eye is a large flattened vesicle lying on the brain and connected with it by a very short solid stalk. There is externally no white patch of skin, but lying in the skin above the vesicle there is a flattened body, which, in structure and position, more nearly



Longitudinal vertical (sagittal) section through the parietal eye of an adult *Petromyzon planeri* [Zeiss C. oc. 2 cam.]. *br*, brain; *c.t.*, connective tissue; *n*, position of nose; P.E., pigment of the retina; P.O., parietal eye, i.e. dorsal vesicle of the epiphysis; R, retina; *s.d.p.*, subdermal pigment; *sk*, skull; *sn*, skin; V.V., ventral vesicle of pineal gland.

resembles the "Stirn-drüse" of Amphibians than anything else. This "Stirn-drüse," as is well known, is a rudimentary portion of the epiphysis, and hence of the parietal eye.

There is no lens and no pigment in Myxine. The anterior wall of the vesicle consists of a single layer of somewhat flattened cells.

The retina has essentially the structure of that of the parietal eye of Varanus, but it lacks the pigment which is there present (*vide* Spencer, "Pineal Eye in Lacertilia," *Q.J.M.S.*, vol. xxvii. Part 2, Plate XIV. Figs. 1 and 6).

Bdellostoma seems, in this, and, as was first shown by Johannes Müller, in other points in the structure of its brain, to resemble Myxine. Without discussing the matter at length, I may say that in the parietal eyes of Petromyzon and Myxine we have to deal with structures which are still well developed, and which were probably once much more developed than now. In this connexion the history of the changes in Ammocœtes is very interesting, and all the more so as confirming and extending Dohrn's opinion that the Cyclostomata have degenerated from highly developed fishes. The parietal eye in Ammocœtes, like many other of its organs, makes a good start, and only degenerates as the Ammocœte degenerates. When the Petromyzon state is reverted to, the parietal eye, like the animal in which it occurs, reverts towards an ancestral condition, and its doing so is an additional point in favour of Dohrn's opinion that the change to the adult Petromyzon is a sort of atavism.

Myxine, though in other respects more degenerate than the adult Petromyzon, retains the structure of the retina in a somewhat more specialized condition, one which most nearly recalls the highest parietal eye presented to us by the Lacertilia.

With regard to the development of the eye in lizards, the only point I will now mention is one which was to be expected to hold, viz. that the lens develops as a thickening of the anterior wall of the vesicle. I may add, however, that it shows signs of a tendency to involution.

And now, without discussing Spencer's speculations, I will briefly state my idea of the manner in which the parietal eye was evolved in connexion with the paired eyes.

From the start of my investigations I was fully convinced that the evolution of all three eyes must be viewed from one common starting-point. The fact that, as Wiedersheim states, even in man nerve-fibres have been traced from the optic thalami to the pineal gland, is sufficient evidence for this, even if we did not know that all three eyes arise in connexion with the same portion of the brain. The hypothesis is an extension of that given by Wiedersheim, Carrière, Dohrn, and others, to account for the evolution of the paired eyes.

The starting-point is a dorsal optic plate before the neural folds begin to form. This gives us a dorsal eye on the so-called invertebrate type. When the neural folds began to form so as to involute the brain and spinal cord, the optic plate was of course, being part of the brain, involved in the involution. With the progression of the latter it probably increased in size, and extended somewhat over the lateral margins of the neural folds.

When the neural folds closed and shut in that which forms the optic vesicles, part of the optic plate was left, forming the rudiment of the parietal eye. This, just as all known sense-organs tend to get involuted, got also secondarily involuted, and that but slowly, so that the outside wall of the involution had time to become a lens, an eye being thus formed on the invertebrate type. The parietal eye, being closely bound up with the paired eyes, got secondarily involuted with them; and, losing its primary mode of origin by delay in its development, it now appears as a secondary outgrowth of the brain, in which the lens is still formed from the outer wall. The lens, moreover, possibly retains traces of an involution.

Spencer has not attempted to grapple with the difficulty involved in the fact that the rods of the retina of the paired eyes are turned from the source of light, while in the parietal eye they are turned towards it.

The explanation given above is not in contradiction with this state of things; it, in fact, receives support from it.

In the complete paper I shall discuss the matter at length, and give ample illustrative figures.

J. BEARD.

Anatomisches Institut, Freiburg i/Br., June 21.

THE JUBILEE ANTICYCLONE.

"QUEEN'S WEATHER" has long been a familiar expression descriptive of the most desired weather for all open-air celebrations and enjoyments; and perhaps no June of the last fifty years has presented us with so many days of such choice weather as the June of 1887. In the language of modern meteorology this is due to the fact that the prevailing type of weather has been anticyclonic. From the middle of June to the beginning of July, thus including the time of Her Majesty's Jubilee, a very pronounced and remarkable anticyclone overspread the British Islands, with its usual attendants of bright weather, strong sunshine and heat during the day, clear and cool nights, and capriciously-distributed rainfall.

Taking June as a whole, temperature was most in excess of the average in the west and north-west of Ireland and over Central Scotland from Inverness to the Solway; the excess at Glencarron, in Ross-shire, being 5°·0, at Laing and Braemar 4°·5, and in many places in Scotland and the west of Ireland about 4°·0. The exceptional character of these temperatures will appear from the fact that during the present century they have only been exceeded in the north-east of Scotland in the Junes of 1818, 1826, and 1846. On the other hand, over England, to the east of a line drawn from Berwick to the Isle of Wight, and to the north of a line from Stornoway to Wick, temperature does not appear to have exceeded the mean of June more than a degree: whilst at Somerleyton in Suffolk, and North Unst in Shetland, the temperature fell fully a degree below the average. These differences were due to the general position of the centre of the anticyclone being well to westward of the British Islands, so that the northern islands and the south-east of England were within the eastern margin of the anticyclone, and hence exposed to the northerly winds and lower temperatures peculiar to that section of an anticyclone, as was pointed out in NATURE ten years ago in reviewing the American Weather Maps. During this anticyclonic weather there were two distinct sources of high temperature, viz. that due to the strong sunshine which found its most decided expression in the high temperatures of Central Scotland; and that due to the warm descending air-currents of the anticyclone, which being most marked at great heights was most strongly expressed at the Ben Nevis Observatory. At this Observatory the means, for the ten days ended June 26, of the daily maxima were 61°·8, and of the minima 50°·3, thus giving a mean temperature of 56°·0, and 11°·5 for the daily range. Quite different was the temperature during these ten days at low levels inland. At Pinmore, for example, in the deep valley of the Stinchar, Ayrshire, the mean temperature was 63°·4, and the daily range 33°·3, or three times greater than on the top of Ben Nevis. On June 21 the contrast was very striking, the minimum on Ben Nevis being 43°·0, whereas at Pinmore it fell to 34°·3, on which morning, as reported by Mr. Donald, the observer, it was freezing at the river side. During the night the high temperature was kept up on Ben Nevis by the descending air-currents of the anticyclone, but the cold currents generated by the night radiation concentrated on and filled the steep narrow valley of the Stinchar.

The frequent occurrence of 40°·0 and upwards between the daily maximum and minimum, so frequently observed over the country, was primarily dependent on the clear dry atmosphere and the strong solar and terrestrial radiation consequent thereon. These great and sudden changes of temperature were on occasions largely increased by the shiftings of the position of the anticyclone, by which a particular locality was at one time on its west side, and therefore in enjoyment of the high temperature peculiar to that position, but a few hours thereafter was within its eastern side and its low temperature.

So far as records have reached us, the rainfall was nowhere above its average, being, however, at or close to the average at Glenquoich and Glencarron, where it was respectively 5·53 and 4·19 inches. On Ben Nevis 7·51 inches fell, being only 0·66 inch less than the average. At Oxford, the deficiency from the monthly mean was only 15 per cent., and at Somerleyton 23 per cent. Generally, however, the deficiency was exceptionally great and widespread, being in nearly all parts of the British Islands from 50 to 95 per cent. less than the June average of the stations. Another feature of the weather was the sudden changes which occurred in the humidity of the air, which were perhaps most striking on June 18, on which day at many places a higher temperature was observed than has been noted for many years. On that day thunderstorms occurred over the greater part of the eastern districts of Scotland, accompanied with dense clouds and a close atmosphere. At a very large number of places not a drop of rain fell. At a few places a heavy, short-continued shower fell, but the air cleared and dried so suddenly that in three minutes all effects of the rain were gone; and everything looked as parched and dried up as before the rain. On the morning of this day the isobars for 9 a.m. revealed the existence of a local shallow depression extending from Ochtertyre, north-eastwards towards Aberdeen, where atmospheric pressure was lower than on either side of it. Here the thunderstorm was severest, and rain fell most generally. At Lednathie, Forfarshire, the storm and rainfall were all but unprecedented. The rain commenced at 12.50 p.m., and ceased at 1.30 p.m., and during these forty minutes there fell 2·24 inches. Mr. Morison, the observer, remarks that "the appearance of the rain while falling was like bright small streams falling straight down"—a description which will recall to some of our readers what they have often noticed during the torrential downpours of the tropics.

The state of many of our rivers attests only too strongly to the persistence and severity of the drought. On Sunday last the level of the Tay was fully half an inch beneath the deep cut made in the red sandstone rock at Perth on June 30, 1826, to mark the unprecedented lowness of the river at that time. The Thames in its upper reaches is covered with high grown rushes and great floating masses of weeds, and nearer London it is reported to be lower than it has been in the memory of the oldest boatman.

NO LANGUAGE WITHOUT REASON—NO REASON WITHOUT LANGUAGE.

As I found that you had already admitted no less than thirteen letters on my recent work "The Science of Thought," I hesitated for some time whether I ought to ask you to admit another communication on a subject which can be of interest to a very limited number of the readers of NATURE only. I have, indeed, from the very beginning of my philological labours, claimed for the science of language a place among the physical sciences, and, in one sense, I do the same for the science of thought. Nature that does not include human nature in all its various manifestations would seem to me like St. Peter's without its cupola. But this plea of mine has not as yet been generally admitted. The visible material frame of man, his sense-organs and their functions, his nerves and his brain, all this has been recognized as the rightful domain of physical science. But beyond this physical science was not to go. There was the old line of separation, a line drawn by mediæval students between man, on one side, and his works, on the other; between the sense-organs and their perceptions; between the brain and its outcome, or, as it has sometimes been called, its secretion—namely, thought. To attempt to obliterate that line between physical science, on one side, and moral science, as it used to be called, on the other, was represented as mere confusion of thought. Still, here as elsewhere, a perception of higher unity does not necessarily imply an ignoring of useful distinctions. To me it has always seemed that man's nature can never be fully understood except as one and indivisible. His highest and most abstract thoughts appear to me inseparable from the lowest material impacts made upon his bodily frame. And "if nothing was ever in the intellect except what was first in the senses," barring, of course, the intellect itself, it follows that we shall never understand the working of the intellect, unless we first try to understand the senses, their organs, their functions, and, in the end, their products. For practical purposes, no doubt, we may, nay we ought, to separate the two. Thus, in my own special subject, it is well to separate the treatment of phonetics and acoustics from higher linguistic researches. We may call phonetics and acoustics the ground floor, linguistics the first story. But as every building is one—the ground floor purposeless without the first story, the first story a mere castle in the air without the ground floor—the science of man also is one, and would, according to my opinion, be imperfect unless it included psychology, in the widest meaning of that term, as well as physiology; unless it claimed the science of language and of thought, no less than the science of the voice, the ear, the nerves, and the brain, as its obedient vassals. It was, therefore, a real satisfaction to me that it should have been NATURE where the questions raised in my "Science of Thought" excited the first interest, provoking strong opposition, and eliciting distinct approval, and I venture to crave your permission, on that ground, if on no other, for replying once more to the various arguments which some of your most eminent contributors have brought forward against the fundamental tenet of my work, the inseparableness of language and reason.

I may divide the letters published hitherto in NATURE into three classes, unanswerable, answered, and to be answered.

I class as unanswerable such letters as that of the Duke of Argyll. His Grace simply expresses his opinion, without assigning any reasons. I do not deny that to myself personally, and to many of your readers, it is of great importance to know what position a man of the Duke's wide experience and independence of thought takes with regard to the fundamental principle of all philosophy, the identity of language and thought, or even on a merely subsidiary question, such as the geneaological descent of man from any known or unknown kind of animal. But I must wait till the Duke controverts either the linguistic facts, or the philosophical lessons which I have read in them, before I can meet fact by fact, and argument by argument. I only note, as a very significant admission, one sentence of his letter, in which the Duke says: "Language seems to me to be necessary to *the progress of thought*, but not at all necessary to the mere act of thinking." This sentence may possibly concede all that I have been contending for, as we shall see by and by.

I class as letters that have been answered the very instructive communications from Mr. F. Galton, to which I replied in NATURE of June 2 (p. 101), as well as several notes contributed by correspondents who evidently had read my book either very rapidly, or not at all.

Thus, Mr. Hyde Clarke tells us that the mutes at Constantinople, and the deaf-mutes in general, communicate by signs, and not by words—the very fact on which I had laid great stress in several parts of my book. In the sign-language of the American Indians, in the hieroglyphic inscriptions of Egypt, and in Chinese and other languages which were originally written ideographically, we have irrefragable evidence that other signs, besides vocal signs or vocables, can be used for embodying thought. This, as I tried to show, confirms, and does not invalidate, my theory that we cannot think without words, if only it is remembered that words are the most usual and the most perfect, but by no means the only possible signs.

Another correspondent, "S. T. M. Q.", asks how I account for the early processes of thought in a deaf-mute. If he had looked at p. 63 of my book he would have found my answer. Following Prof. Huxley, I hold that deaf-mutes would be capable of few higher intellectual manifestations than an orang or chimpanzee, if they were confined to the society of dumb associates.

But, though holding this opinion, I do not venture to say that deaf-mutes, if left to themselves, may not act rationally, as little as I should take upon myself to assert that animals may not act rationally. I prefer indeed, as I have often said, to remain a perfect agnostic with regard to the inner life of animals, and, for that, of deaf-mutes also. But I should not contradict anybody who imagines that he has discovered traces of the highest intellectual and moral activity in deaf-mutes or animals. I read with the deepest interest the letter which Mr. Arthur Nicols addressed to you. I accept all he says about the sagacity of animals, and if I differ from him at all, I do so because I have even greater faith in animals than he has. I do not think, for instance, that animals, as he says, are much longer in arriving at a conclusion than we are. Their conclusions, so far as I have been able to watch them, seem to me far more rapid than our own, and almost instantaneous. Nor should I quarrel with Mr. Nicols if he likes to call the vocal expressions of pain, pleasure, anger, or warning, uttered by animals, language. It is a perfectly legitimate metaphor to call every kind of communication language. We may speak of the language of the eyes, and even of the eloquence of silence. But Mr. Nicols would probably be equally ready to admit that there is a difference between shouting "Oh!" and saying "I am surprised." An animal may say "Oh!" but it cannot say "I am surprised;" and it seems to me necessary, for the purpose of accurate reasoning, to be able to distinguish in our terminology between these two kinds of communication. On this point, too, I have so fully dwelt in my book that I ought not to encumber your pages by mere extracts.

I now come to the letters of Mr. Ebbels and Mr. Mellard Reade. They both seem to imagine that, because I deny the possibility of conceptual thought without language, I deny the possibility of every kind of thought without words. This objection, too, they will find so fully answered in my book, that I need not add anything here. I warned my readers again and again against the promiscuous use of the word "thought." I pointed out (p. 29) how, according to Descartes, any kind of inward activity, whether sensation, pain, pleasure, dreaming, or willing, may be called thought; but I stated on the very first page that, like Hobbes, I use thinking in the restricted sense of adding and subtracting. We do many things, perhaps our best things, without addition or subtraction. We have, as I pointed out on p. 20, sensations and percepts, as well as concepts and names. For ordinary purposes we should be perfectly correct in saying that we can "think in pictures." This, however, is more accurately called imagination, because we are then dealing with images, presentations (*Vorstellungen*), or, as I prefer to call them, percepts, and not yet with concepts and names. Whether in man, and particularly in the present stage of his intellectual life, imagination is possible without a slight admixture of conceptual thought and language, is a moot point; that it is possible in animals, more particularly in Sally, the black chimpanzee at the Zoological Gardens, I should be reluctant either to deny or to affirm. All I stand up for is that, if we use such words as thought, we ought to define them. Definition is the only panacea for all our philosophical misery, and I am utterly unable to enter into Mr. Ebbels's state of mind when he says: "This is a mere question of definition, not of actual fact."

When Mr. Ebbels adds that we cannot conceive the sudden appearance of the faculty of abstraction together with its ready-made signs or words, except by a miracle, he betrays at once that he has not read my last book, the very object of which is to show that we require no miracle at all, but that all which seemed miraculous in language is perfectly natural and intelligible. And if he adds that he has not been able to discover in my earlier works any account of the first beginnings of language, he has evidently overlooked the fact that in my lectures on the science of language I distinctly declined to commit myself to any theory on the origin of language, while the whole of my last book is devoted to the solution of that problem. My solution may be right or wrong, but it certainly does not appeal to any miraculous interference for the explanation of language and thought.

There now remain two letters only that have really to be answered, because they touch on some very important points, points which it is manifest I ought to have placed in a clearer light in my book. One is by Mr. Murphy, the other by Mr. Romanes. Both have evidently read my book, and read it carefully; and if they have not quite clearly seen the drift of my argument, I am afraid the fault is mine, and not theirs. I am quite aware that my "Science of Thought" is not an easy book to read and to understand. I warned my readers in the preface that they must not expect a popular book, nor a work systematically built up and complete in all its parts. My book was written, as I said, for myself and for a few friends, who knew beforehand the points which I wished to establish, and who would not expect me, for the mere sake of completeness, to repeat what was familiar to them, and could easily be found elsewhere. I felt certain that I should be understood by them, if I only indicated what I meant; nor did it ever enter into my mind to attempt to teach them, or to convince them against their will. I wrote as if in harmony with my readers, and moving on with them on a road which we had long recognized as the only safe one, and which I hoped that others also would follow, if they could once be made to see whence it started and whither it tended.

Mr. Murphy is one of those who agree with me that language is necessary to thought, and that, though it may be possible to think without words when the subjects of thought are visible things and their combinations, as in inventing machinery, the intellectual power that invents machinery has been matured by the use of language. Here Mr. Murphy comes very near to the remark made by the Duke of Argyll, that language seems necessary to the *progress of thought*, but not at all necessary to the mere act of thinking, whatever that may mean. But Mr. Murphy, while accepting my two positions—that thought is impossible without words, and that all words were in their origin abstract—blames me for not having explained more fully on what the power of abstraction really depends. So much has lately been written on abstraction, that I did not think it necessary to do more than indicate to which side I inclined. I quoted the opinions of Aristotle, Bacon, Locke, Berkeley, and Mill, and as for myself I stated in one short sentence that I should ascribe the power of abstraction, not so much to an effort of our will, or to our intellectual strength, but rather to our intellectual weakness. In forming abstractions our weakness seems to me our strength. Even in our first sensations it is impossible for for us to take in the whole of every impression, and in our first perceptions we cannot but drop a great deal of what is contained in our sensations. In this sense we learn to abstract, whether we like it or not; and though afterwards abstraction may proceed from an effort of the will, I still hold, as I said on p. 4, that though *attention* can be said to be at the root of all our knowledge, the power of abstraction may in the beginning not be very far removed from the weakness of distraction. If I had wished to write a practical text-book of the science of thought, I ought no doubt to have given more prominence to this view of the origin of abstraction, but as often in my book, so here too, I thought *sapienti sat*.

I now come to Mr. Romanes, to whom I feel truly grateful for the intrepid spirit with which he has waded through my book. One has no right in these days to expect many such readers, but one feels all the more grateful if one does find them. Mr. Romanes was at home in the whole subject, and with him what I endeavoured to prove by linguistic evidence—namely, that concepts are altogether impossible without names—formed part of the very A B C of his psychological creed. He is indeed almost too sanguine when he says that concerning this truth no difference of opinion is likely to arise. The columns of NATURE and the opinions quoted in my book tell a different tale. But for all that, I am as strongly convinced as he can be that no one who has once understood the true nature of words and concepts can possibly hold a different opinion from that which he holds as well as I.

It seems, therefore, all the more strange to me that Mr. Romanes should have suspected me of holding the opinion that we cannot think without pronouncing or silently rehearsing our thought-words. It is difficult to guard against misapprehensions which one can hardly realize. Without appealing, as he does, to sudden aphasia, how could I hold pronunciation necessary for thought when I am perfectly silent while I am writing and while I am reading? How could I believe in the necessity of a silent rehearsing of words when one such word as "therefore" may imply hundreds of words or pages, the rehearsing of which would require hours and days? Surely, as our memory enables us to see without eyes and to hear without ears, the same persistence of force allows us to speak without uttering words. Only, as we cannot remember or imagine without having first seen or heard something to remember, neither can we inwardly speak without having first named something that we can remember. There is an algebra of language far more wonderful than the algebra of mathematics. Mr. Romanes calls that algebra "ideation," a dangerous word, unless we first define its meaning and lay bare its substance. I call the same process addition and subtraction of half-vanished words, or, to use Hegel's terminology, *aufgehobene Worte*; and I still hold, as I said in my book, that it would be difficult to invent a better expression for thinking than that of the lowest barbarians, "speaking in the stomach." Thinking is nothing but speaking *minus* words. We do not begin with thinking or *ideation*, and then proceed to speaking, but we begin with naming, and then by a constant process of addition and subtraction, of widening and abbreviating, we arrive at what I call thought. Everybody admits that we cannot count—that is to say, add and subtract—unless we have first framed our numerals. Why should people hesitate to admit that we cannot possibly think, unless we have first framed our words? Did the Duke of Argyll mean this when he said that language seemed to him necessary for *the progress of thought*, but not at all for the mere act of thinking? How words are framed, the science of language has taught us; how they are reduced to mere shadows, to signs of signs, apparently to mere nothings, the science of thought will have to explain far more fully than I have been able to do. Mr. Romanes remarks that it is a pity that I should attempt to defend such a position as that chess cannot be played unless the player "deals all the time with thought-words and word-thoughts." I pity myself indeed that my language should be liable to such misapprehension. I thought that to move a "castle" according to the character and the rules originally assigned to it was to deal with a word-thought or thought-word. What is "castle" in chess, if not a word-thought or thought-word? I did not use the verb "to deal" in the sense of pronouncing, or rehearsing, or defining, but of handling or moving according to understood rules. That this dealing might become a mere habit I pointed out myself, and tried to illustrate by the even more wonderful playing of music. But, however automatic and almost unconscious such habits may become, we have only to make a wrong move with the "castle" and at once our antagonist will appeal to the original meaning of that thought-word, and remind as that we can move it in one direction only, but not in another. In the same manner, when Mr. Romanes takes me to task because I said that "no one truly thinks who does not speak, and that no one truly speaks who does not think," he had only to lay the accent on *truly*, and he would have understood what I meant—namely, that in the true sense of these words, as defined by myself, no one thinks who does not directly or indirectly speak, and that no one can be said to speak who does not at the same time think. We cannot be too charitable in the interpretation of language, and I often feel that I must claim that charity more than most writers in English. Still, I am always glad if such opponents as Mr. Romanes or Mr. F. Galton give me an opportunity of explaining more fully what I mean. We shall thus, I believe, arrive at the conviction that men who honestly care for truth, and for the progress of truth, must in the end arrive at the same conclusions, though they may express them each in his own dialect. That is the true meaning of the old dialectic process, to reason out things by words more and more adequate to their purpose. In that sense it is true also that no truth is entirely new, and that all we can aim at in philosophy is to find new and better expressions for old truths. The poet, as Mr. A. Grenfell has pointed out in his letter to NATURE (June 23, p. 173), often perceives and imagines what others have not yet conceived or named. In that sense I gladly call myself the interpreter of Wordsworth's prophecy, that "the word is not the dress of thought, but its very incarnation."

F. MAX MÜLLER.

The Molt, Salcombe, July 4.

ON THE PRESENCE OF BACTERIA IN THE LYMPH, ETC., OF LIVING FISH AND OTHER VERTEBRATES.[1]

I FIRST noticed bacteria in the blood of a roach (*Leuciscus rutilus*). This roach, for some hours before it was removed from the water, had been occasionally swimming on its side at the surface—an indication that it was in an exhausted condition. Immediately after the fish was killed, a drop of blood was taken from the heart by a sterilized pipette (with all the necessary precautions) and examined. The blood was found to contain a considerable number of slender motionless bacilli, measuring from 0·003-0·008 micromillimetres in length. On an average, four bacilli were visible in the field at a time, with Zeiss's F objective and No. 1 eye-piece. The peritoneal fluid which was next examined contained so many bacilli that it was impossible to count them; the bacilli were usually lying amongst large granular lymph-cells, and they were longer and more slender than those in the blood. Similar bacilli were found in the lymphatics, spleen, liver, and kidney, and they were abundant in the muscles in contact with the peritoneum, while very few were found in the muscles under the skin of the trunk, and still fewer in the muscles near the tail. The intestine was crowded with similar bacilli to those found in the body-cavity, and, in addition, there were a number of large and small bacteria and micrococci. Bacilli also were found in the walls of the intestine and in the bile-duct. Believing that there was some relation between the diminished vitality of the above roach and the numerous bacilli in the tissues, I examined a considerable number of healthy roach in the same way, and also other fresh-water fish, *e.g.* trout (*Salmo levenensis*), perch (*Perca fluviatilis*), carp (*Cyprinus auratus*), and eels (*Anguilla vulgaris*). In all the healthy specimens examined, with the exception of the trout, bacilli were found in the

[1] Abstract of Paper by Prof. J. C. Ewart, read before the Edinburgh Royal Society on June 6.

body-cavity. Bacilli were also present in the blood of the carp, and on one occasion four bacilli were detected in a drop of blood from what appeared to be a healthy roach. In some the peritoneal fluid contained numerous bacilli, while in others only a few were visible; generally there was a relation between the number in the body-cavity and the number in the intestine, and they were most abundant in fish which had lived for some time in aquaria without food; but in trout which had been fasting for at least ten days, no bacilli could be observed in the peritoneal fluid. The carp which had bacilli in their blood had been living for some months in a small glass aquarium.

The difference between the roach first examined and those examined subsequently led me to endeavour to ascertain whether a sudden change of temperature would produce any influence in the number and distribution of the bacilli. As I anticipated, a rapid change from a spring to a summer temperature (from 48° to 65° F.) greatly diminished the vitality of all the fish experimented with, except the carp; and, as the fish became more and more exhausted, the bacilli gradually increased. If the temperature was raised from 48° F. to 65° F. in two hours, the bacilli of the peritoneal fluid not only increased in the roach, perch, carp, and eel, but they made their appearance in considerable numbers in the body-cavity of the trout, and on one occasion a number of small bacilli were found in the blood of a trout. Although the carp seemed to enjoy the rise of temperature, they were not exempt from the increase of the bacteria in the blood as well as in the peritoneal fluid. In some specimens of blood as many as eight short slender bacilli were visible in the field of the microscope at one time, and the peritoneal fluid in some instances swarmed with long and short bacilli, some of which were motile.

The above observations were confirmed by cultivations in gelatine agar-agar, and in infusions of fish-muscles. In healthy active specimens of the roach and perch, cultivations were easily obtained of the peritoneal bacilli, and generally also from the muscular fibres lying near the peritoneum, but in no instance did I succeed in obtaining cultivations when the blood, or the muscles from immediately under the skin, were used for infecting the culture-media.

Of the sea fish examined I have found bacilli—sometimes long and slender, sometimes short and thick—in the peritoneal fluid and blood of the whiting (*Gadus merlangus*), haddock (*Gadus æglefinus*), cod (*Gadus morrhua*), herring (*Clupea harengus*); and in the peritoneal fluid only of the flounder (*Platessa flessus*), plaice (*Platessa vulgaris*), and lumpsucker (*Cyclopterus lumpus*). I have not hitherto succeeded in demonstrating the existence of bacteria in either the peritoneal fluid or blood of the skate (*Raia batis*), dogfish (*Acanthias vulgaris*), or fishing frog (*Lophius piscatorius*).

There can be no doubt that the bacteria enter the body-cavity by penetrating the walls of the intestine; neither can there be any doubt that, having once established themselves in the peritoneal fluid, they do their utmost to find their way into the blood and tissues. Notwithstanding the presence of active bacteria in the intestinal canal, and the bile and pancreatic ducts, I have failed to discover either bacilli or micrococci in the body-cavity of either amphibia, reptiles, birds, or mammals, when in a healthy condition. Hence it may be taken for granted that, in the higher vertebrates, under ordinary circumstances, either (1) the walls of the intestine form an effective filter or screen, which prevents the passage of the bacteria into the body-cavity; or (2) that the living cells of the mucous and other layers so act on the bacteria that they are destroyed before they reach the body-cavity; or (3) that the cells of the peritoneal fluid effectively sterilize the bacteria which succeed in entering; or (4) that the bacteria are destroyed as they pass along the lymphatics towards the general circulation. Most fish seem capable of tolerating the presence of one or more kinds of bacteria in the peritoneal fluid, whilst others can even tolerate considerable numbers in their blood. It seems, however, that there is a limit to this toleration; for when the equilibrium is disturbed, when by a change of the surroundings the vitality of the tissues is diminished, the bacteria rapidly increase, and unless the tissues as rapidly recover, the bacteria may directly or indirectly cause death.

From the observations made, it appears that bacteria travel most easily along the lymphatic canals and spaces, the lymph-cells being apparently less able to arrest their progress than the blood-corpuscles.

As to the nature of the bacilli found in fish nothing has hitherto been determined. Olivier and Richet seem to think they are neither specific nor putrefactive. At first I thought they were putrefactive, but not specific. Having made some further experiments, I am now inclined to consider them specific and not putrefactive. It has been asserted by previous writers that bacteria are always present in the living tissues of fish, but this conclusion should be accepted with some reserve. For example, trout, roach, and eels, which were gutted immediately after death, and introduced for a short time into a 5 per cent. solution of phenol, and then transferred into sterilized water, remained unchanged for weeks. When examined, dead bacteria were found on the surface of the skin and in the peritoneal lining of the body-cavity, but no living bacteria could be detected in the muscles, nor did they appear in cultivations into which fragments of muscle had been introduced. As was anticipated, when the fish were placed in ordinary water, putrefaction at once set in. Hence, in the meantime, it may be taken for granted that while bacteria exist in the tissues of some fish even at comparatively low temperatures, they are not always, if ever, present in the tissues of others.

THE PROGRESS OF SCOTCH UNIVERSITIES.

THE following three diagrams are meant to convey an idea of the progress of the Scotch Universities—Edinburgh, Glasgow, Aberdeen, and St. Andrews—in recent

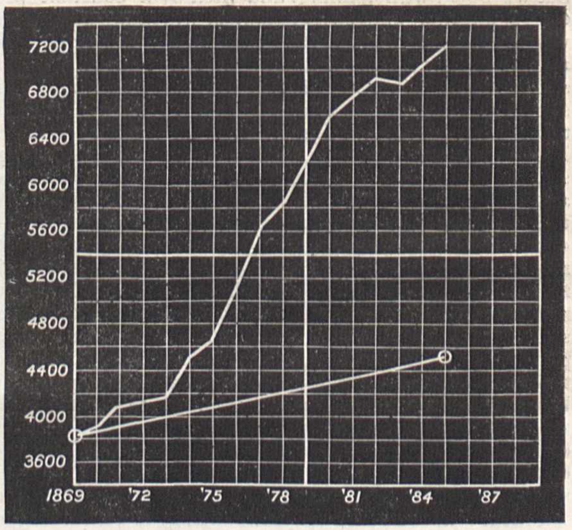


Fig. 1.—Total number of students at the four Scotch Universities (with line of population).

years. The first shows the total number of students each year from 1869 to 1885, and it appears that, with an increase of population of about 18 per cent. in that period, the total attendance has grown over 90 per cent. (The straight line indicates what the growth would have been at the population-rate.) The growth in Edinburgh is greatest, and the other Universities follow in the above order. Nos. 2 and 3 indicate how the students have been distributed among the different Faculties. The preponderance of arts students in Glasgow, and of medical in Edinburgh, will be noted.[1] As regards theology,

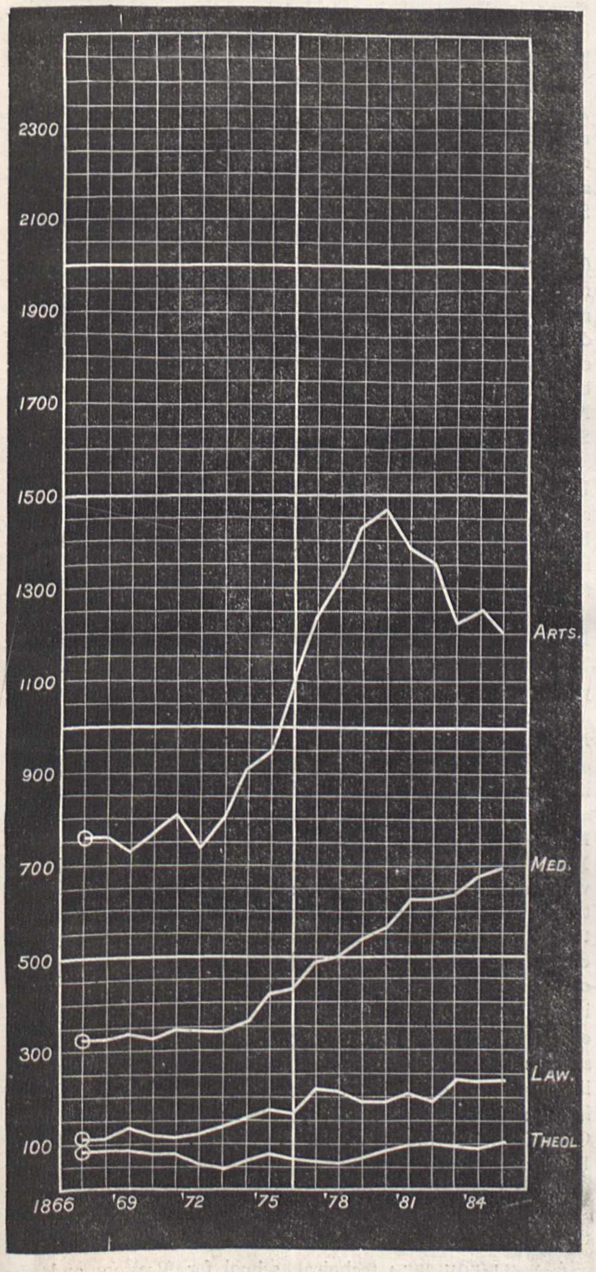


Fig. 2.—Glasgow University. Students in different Faculties (19 years).

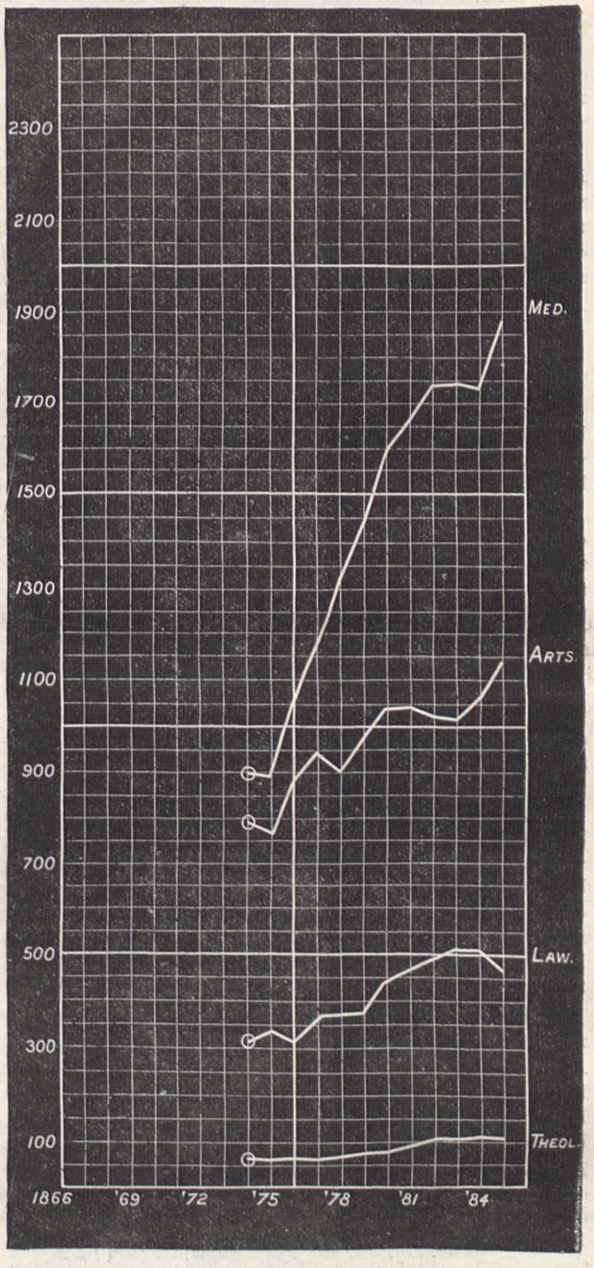


Fig. 3.—Edinburgh University. Students in different Faculties (12 years).

it is to be remembered that the students are only those of the Established Church; the two other large Presbyterian bodies having their own theological schools. (The statistics are taken from Oliver and Boyd's "New Edinburgh Almanac," and the numbers of students at each University include those of the summer as well as the winter session.)

A. B. M.

[1] It is right to state that in the recent classification of Glasgow students a small proportion are given as "Arts and Medicine," "Arts and Law," &c. These we have included as "Arts" students only.

NOTES.

THE Admiralty has, we believe, specially set apart the *Triton* for the use of the scientific branch of the Navy and of men of science at the approaching naval review. It was obviously right that this arrangement should be made, and the Admiralty is to be congratulated on having declined to follow the bad example set by the Lord Chamberlain in connexion with the ceremony in Westminster Abbey.

M. PASTEUR having consented to become a candidate for the office of Perpetual Secretary of the Paris Academy of Sciences, the other candidates have withdrawn their applications, and he will of course be elected unanimously.

THE Committee for the erection of a statue to François Arago, in Paris, on the Place St. Jacques, near the Observatory, held a meeting the other day at the Observatory, Admiral Mouchez in the chair. It was decided that the subscription should be closed on December 31 next. Although the majority of the lists have not yet been returned, it is already known that not less than £700 has been collected. An appeal will be addressed by M. Mouchez to admirers of the celebrated astronomer.

THE Congress of the International Astronomical Society will be held at Kiel from August 29 to September 1.

AT the half-yearly general meeting of the Scottish Meteorological Society, held on Monday, it was intimated that the subscriptions obtained for the Ben Nevis Observatory since the beginning of January last now amount to £1115.

MR. H. H. JOHNSTON, H.B.M. Consul for the Cameroons district of West Africa, has sent home to this country, through the Foreign Office, the collections of natural history objects made during his recent excursion into the Rio del Rey district, a swampy region lying near the base of the Cameroons Mountains, in which it was at one time reported that Mr. Johnston had been taken prisoner and held in captivity by the natives. The collections have been placed by Mr. Sclater in the hands of various specialists to be reported upon. They are not very numerous, and will not probably contain many novelties, as much of the surrounding district has been well explored. But Capt. Shelley has already discovered amongst the birds two examples of a fine new species of plover, which will be described in the next number of the *Ibis* as *Sarciophorus seebohmi*. This plover is remarkable for its rufous forehead, black crown, and chocolate-coloured crop, which render it easily distinguishable from its congeners. There is likewise among the mammals an example of a small shrew new to science, which Mr. Dobson will describe at the next meeting of the Zoological Society, and dedicate to its discoverer.

AN important botanical periodical is about to be issued by the Delegates of the Clarendon Press. It will be entitled *Annals of Botany*, and will be edited by Prof. Bayley Balfour, of the University of Oxford; by Dr. Vines, Reader in Botany in the University of Cambridge; and by Prof. W. G. Farlow, of Harvard University, Massachusetts, U.S.A. The papers, adequately illustrated, will be on subjects pertaining to all branches of botanical science, including morphology, histology, physiology, palæobotany, pathology, geographical distribution, economic botany, and systematic botany and classification. There will also be articles on the history of botany, reviews and criticisms of botanical works, reports of progress in the different departments of the science, short notes, and letters. A record of botanical works in the English language will be a special feature. With regard to the last point, the editors direct attention to the fact that many important contributions to botanical science are not at present brought before the botanical world with that promptitude which their merit deserves, and many are frequently entirely overlooked, owing to the fact that the periodical in which they appear is not readily accessible to botanists generally. An attempt will be made in the *Annals of Botany* to remedy this state of affairs; and it is hoped that it may be possible to make the record fairly complete, embracing works published not only in Great Britain and Ireland, but also in India and the colonies, and in America. To enable them to carry out this intention, the editors appeal to the Secretaries of local Scientific Institutions, Societies, and Clubs, in all parts of the world, to send them early information of the publication of papers relating to botany in any of its branches.

DURING the months of March, April, and May, Prof. Paul Ascherson, of the Berlin University, carried on botanical researches on the coast of Egypt. He has found a surprising number of plants that were formerly unknown. Special interest attaches to the results obtained by him on the coast between the Suez Canal and the Syrian frontier.

THE Berlin Academy of Sciences has granted 900 marks (£45) to Dr. Ravitz (Naples) for the continuation of his researches on the central nervous system of Acephala; 3000 marks (£150) to Prof. Nussbaum (Bonn) for a zoological expedition to San Francisco and investigations on the division of organisms; 600 marks (£30) to Dr. Otto Zacharias (Hirschberg) for the continuation of his studies on the fauna of the North German lakes; and 1200 marks (£60) to Dr. Karl Schmidt for a geological expedition to the Pyrenees.

WE are glad to notice that the Council of the Recreative Evening Schools' Association, through one of their Committees, are organizing a system of elementary instruction in many branches of natural science, to come into operation next season in the London Board schools. These evening classes are held from September or October until April or May, and last winter the Association carried on its operations in eighty of the London Board schools, and hopes to do so in at least 100 next winter. The classes are intended for the continuation of the training of young people between the ages of fourteen and eighteen, who have left the day Board schools. About 80,000 such leave the London schools alone every year, and hitherto not 5 per cent. of them have continued their education. The science teaching is intended to be carried out mainly by lantern demonstrations, and the Committee (among whom we observe the names of Prof. Jeffrey Bell, Mr. F. W. Rudler, Mr. W. Lant Carpenter, Mr. J. Harris Teall, and others) are anxious to obtain the voluntary services of young scientific men, who may be willing to help so good a cause by undertaking to give courses of ten or twelve very elementary lectures, of a thoroughly popular but educational kind, on various scientific subjects. The expenses of lantern, slides, &c., will be borne by the Association. It is intended that the lectures shall be once a week, and shall not exceed forty-five minutes in length. Circulars have been freely sent to the various centres of scientific teaching in London inviting the co-operation of students and others, and further information can be obtained from any member of the "Science Committee" of the Association, or from its Secretary, Mr. J. E. Flower, 37 Norfolk Street, Strand. We are also informed that the Gilchrist Trustees have generously expressed their intention of spending £100 on lanterns and slides for the use of the Association.

A WELL-EQUIPPED technical school for Preston and the neighbourhood is about to be erected and endowed. A grant of £30,000 has been made for the purpose to the Council of the Harris Institute, Preston, by the trustees under the will of the late Mr. E. R. Harris, who left nearly half a million sterling for philanthropic objects in Preston. The site for the school has been given by the Preston Corporation. In the prospectus just issued by the Council of the Institute it is estimated that the cost of the building, furniture, and fittings will not be less than £17,000, of which they are allowed to provide £10,000 out of the grant, the remaining £20,000 being held as an endowment fund. The Council intend that instruction shall be given in all the branches of cotton-spinning, weaving, and designing, mechanical engineering, and the building-trades in general, both in day and night classes. The school will be called the Victoria Jubilee Technical School.

THE Chair of Civil Engineering in the University of Dublin has been filled by the appointment of Prof. Thomas Alexander, who recently returned from Japan after having held the Professorship of Civil Engineering in the Imperial College of Engineering, Tokio, for seven years. Mr. Alexander is the author of several valuable papers on engineering subjects, and has given some new theorems in graphic statics which have been adopted both in English and Continental works on that subject. He is also, jointly with Mr. Arthur W. Thomson, author of a work on elementary applied mechanics.

IN the latest number of the *Zeitschrift für physikalische Chemie* will be found complete details of the classical work of Drs. Krüss and Nilson, briefly announced three weeks ago in the *Berichte*, upon the vapour-density of thorium chloride, which finally sets at rest the controversy as to the valency and position in the natural system of thorium. From a consideration of the physical constants, and the fact that the oxide is isomorphous with the oxides of titanium, zirconium, and tin, thorium was generally supposed to be tetravalent, forming an oxide, ThO_2, and a chloride, $ThCl_4$; moreover, an element of atomic weight 232, having these properties and belonging to the tetravalent series, was required from theoretical considerations based on the assumption of the truth of the periodic law. But, unfortunately, confusion was introduced into all this harmony by the matter-of-fact announcement by no less an authority than Troost that the vapour-density of the chloride had been determined by him to correspond to the formula $ThCl_2$. This, however, meant a divalent thorium of atomic weight 116, for which no place exists in the periodic table. Krüss and Nilson, in their endeavours to get at the truth of this matter, have utilized a quantity of pure thorium, which they had prepared for atomic-weight determinations, by converting it into the chloride, pure colourless prisms of which were eventually obtained by resublimation in a platinum tube. The determination of its vapour-density was then carried out in a platinum vessel and in an atmosphere of carbon dioxide, with the satisfactory result that at temperatures varying from 1102° to 1140°, just above the point of volatilization, the vapour-density corresponds to a formula of $ThCl_4$, while above this temperature the chloride dissociates into free chlorine and a lower chloride. This proves decisively that thorium is tetravalent, and demonstrates the accuracy of results deduced from physical constants. To complete this splendid work, which bears great similarity to the famous work of Nilson and Pettersson on beryllium, the Swedish chemists have redetermined the atomic weight of thorium, which, in the light of their vapour-density determinations, they find to be 231·87.

THE Annual Report of the Chief Signal Officer of the United States Army for the year 1885 has now reached this country. It consists of two volumes: the first contains the usual meteorological results and notices of the works in progress; the second part, a volume of 440 pages (Washington, 1886), is a treatise by Dr. W. Ferrel on the recent advances in meteorology. As might be expected from Dr. Ferrel's works on the "Mechanics and General Motions of the Atmosphere," the subject is not treated in a very elementary manner. In fact, it is stated in the preface that the object has been to select from the material on hand some of the more important principles, methods, and results arrived at, mostly during the last quarter of a century, and to present them in the form of a text-book of the higher meteorology. No descriptions of meteorological instruments are given, as the Report states that this subject will be treated of in a separate work, by Prof. Cleveland Abbe. We refrain from making any comments here on Dr. Ferrel's treatise, further than that it supplies a want that has been much felt by students who have mastered the usual elementary text-books.

VOLUMES 28–30 of the miscellaneous collections published by the Smithsonian Institution (Washington, 1887) contain much valuable matter which should be widely known, viz.:—(1) A fourth edition of Dr. Guyot's meteorological and physical tables, the third edition of which was published more than a quarter of a century ago. Many useful tables have been added, mostly geographical and miscellaneous, but the meteorological tables have generally been reprinted unchanged, and are much behind the present requirements of the science. (2) A catalogue of the principal independent scientific and technical periodicals published in all countries from the earliest times to the close of the year 1882, giving full titles, sequence of series, and other bibliographical details. (3) The scientific writings of the late Joseph Henry, formerly Secretary of the Smithsonian Institution, including his contributions to various Societies and some previously unpublished papers, embracing a period of fifty-five years. This work is divided into two parts, the first containing miscellaneous, and the second meteorological papers.

PROF. SHALER'S article on tornadoes and cyclones in *Scribner's Magazine* for August will contain reproductions of two instantaneous photographs of a tornado which passed over Jamestown, Dakota, on June 6, 1887. The publishers had made a special search for negatives of storms, and given notice of it to many Western photographers. This fortunate opportunity occurred after the article was already in type.

THE "Admiralty Manual of Scientific Inquiry" is such a well-known book, that we need only state the names of the eminent men who have brought the fifth edition, which we have just received, up to date. Astronomy by Sir G. B. Airy, K.C.B., ex-Astronomer-Royal; Hydrography by Capt. W. J. L. Wharton, R.N., Hydrographer of the Admiralty; Tides by Prof. George H. Darwin; Terrestrial Magnetism by Prof. George F. Fitzgerald, assisted by Staff-Commander Creak, R.N., and Mr. G. M. Whipple, Superintendent of the Observatory; Meteorology by Mr. Robert H. Scott, Secretary of the Meteorological Council; Geography by General Sir Henry Lefroy, R.A.; Anthropology by Mr. E. B. Tylor; Statistics by Prof. C. F. Bastable; Medical Statistics by Mr. William Aitken; Geology by Prof. Arch. Geikie; Mineralogy by Prof. W. J. Sollas; Seismology by Mr. Thomas Gray; Zoology by Prof. H. N. Moseley; Botany by Sir J. D. Hooker. About half of the book has been entirely re-written; the arrangement of the present edition being substantially the same as that of former ones. No doubt our men-of-war will by-and-by be used very much more as floating laboratories and observatories than they are at present. When this is done both science and the naval service will be great gainers, and we know of no better means towards such an end than the efficient use of this magnificent compendium published in accordance with the laws of the Admiralty.

"PIONEERING in New Guinea," by the Rev. James Chalmers, contains some very valuable sketches of travels and labours in New Guinea during the years 1878–86. Mr. Chalmers explains that "his hand takes more readily to the tiller than to the pen." Hence he has made no effort to "work up" the contents of his journals into "a finished book," but has been content for the most part to present them exactly as they were written. The book is all the more likely to be appreciated on that account, for it has a freshness and vividness which it could scarcely have possessed if it had sprung less directly from the author's experience. Mr. Chalmers points out that succeeding missionaries and observers can never see the people of New Guinea in the stage of savagery in which he found them when he first went to the island. This gives, of course, a peculiar interest to the record of his impressions. The work contains a map and illustrations, and is published by the Religious Tract Society.

We have received the first eight numbers of "British Dogs" by H. Dalziel (Upcott Gill). The book will supply admirers of the dog with a trustworthy guide, and it provides in an accessible form much information that will be of service to professionals, as well as to amateurs. The descriptions and plates, with slight exceptions, are very good.

Prof. Ayrton's "Practical Electricity" is being translated into the German and Spanish languages.

The tenth volume, lately published, of the series entitled "Monographs of the United States Geological Survey," contains a full account, by Prof. O. C. Marsh, of the Dinocerata, an extinct order of gigantic mammals discovered in the Eocene deposits of Wyoming Territory. The work is admirably illustrated.

The New York Industrial Education Association will begin in the autumn the publication of a series of educational monographs under the editorship of the President of the Association, Dr. Butler. According to *Science*, the papers will treat of various educational topics, historically and critically; and some of the most influential educators, both in America and in Europe, have promised contributions. It is expected that the first monograph will be from the pen of President Gilman, of the Johns Hopkins University. The arguments in favour of industrial education and statements as to its proper organization and development will occupy a prominent place in the series, but not at all to the exclusion of other topics.

On Friday, the 15th inst., a students' *conversazione* will be held at the Technical College, Finsbury. There will be a concert and exhibition, and lectures on "Church Bells" and "Spectrum Analysis" will be delivered, the former by Prof. Ayrton, F.R.S., the latter by Prof. Meldola, F.R.S. A demonstration on "The Use of the Secohmmeter" will be given by Mr. W. E. Sumpner.

In 1880 the Midland Union of Natural History and other Scientific Societies founded the Darwin Medal for the purpose of encouraging original research by members of the Societies forming the Union. The medal is a handsome one, the dies for which were engraved by Mr. Joseph Moore, of Birmingham. On the obverse is the bust of Darwin, and on the reverse a branch of coral, commemorative of one of the most famous of his researches. The subjects for which the medal is awarded are geology, zoology, botany, and archæology. This year it was set apart for archæology, and at the annual meeting of the Midland Union of Natural History Societies, held last week at Malvern, it was awarded to Mr. Edward W. Badger, of King Edward's High School, Birmingham, for a paper on "The Monumental Brasses of Warwickshire."

The second German Fishery Meeting will be held at Freiburg in Baden on July 29 and 30. An excursion to the Imperial Piscicultural Establishment at Hüningen (Alsace) will be made. All inquiries are to be directed to the German Fishery Society, Leipzigerplatz 9, Berlin.

The Deutsche Seewarte has issued a second edition of its ice chart (see Nature, vol. xxxvi. p. 41) compiled from the semi-weekly Atlantic Ice Report, by F. Wyneken, of New York, and from its own observations. The chart shows that the state of the drift ice in April and May was nearly the same as in February and March. Between 48° and 51° W., and north of 42° N., icebergs were frequently met with, but there were very few to the south of this. It is not supposed that the ice will disappear during July, so that vessels cannot yet safely take a more northerly route.

Towards the end of June very remarkable weather prevailed in certain parts of Scandinavia. At Röros, in Central Norway, for instance, it snowed so heavily that sledges might easily have been used. Just before, the weather had been very warm for a long while. In Sweden, on the other hand, several provinces were visited by terrific cyclones, which tore up hundreds of trees by the roots, and unroofed many houses.

At the annual meeting of the Victoria Institute, to be held at the Society of Arts House on Tuesday, July 19, at 8 o'clock, an address will be delivered by the President of the Royal Society.

The total value of the fish landed on the coasts of Scotland during the six months ended June 1887 was £556,058, being a decrease under the corresponding period of last year of £38,332, a decrease under the corresponding month of last year of £34,219, and an increase over last month of £9043.

The additions to the Zoological Society's Gardens during the past week include an Entellus Monkey (*Semnopithecus entellus*, ♀) from India, presented by Capt. W. L. Prentice; a Grey Squirrel (*Sciurus cinereus*) from North America, presented by Mr. Percival Farrer; two Weasels (*Mustela vulgaris* ♂ ♀) from Sussex, presented by Mr. Clement Wykeham Archer; two Blue-headed Pigeons (*Starnœnas cyanocephala*) from Cuba, presented by Mr. John Marshall; two Common Gulls (*Larus canus*) from Scotland, presented by Mr. T. A. Cotton; two Lapwings (*Vanellus vulgaris*) from Essex, presented by Mr. Gervase F. Mathew; an Alligator Terrapin (*Chelydra serpentina*) from North America, presented by Prof. Agassiz; a Speckled Terrapin (*Clemmys guttata*), an American Black Snake (*Coluber constrictor*), from North America, presented by Mr. Samuel Garman; a White-fronted Capuchin (*Cebus albifrons*) from Brazil, a Dingo (*Canis dingo* ♀) from Australia, deposited; two Gluttons (*Gulo luscus*) from Russia, a Redshank (*Totanus calidris*), two Lapwings (*Vanellus vulgaris*) from Suffolk, purchased; a Mandarin Duck (*Æx galericulata*), two Red-crested Pochards (*Fuligula rufina*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

Researches on the Diameter of the Sun.—In continuation of his investigations on the supposed changes in the sun's diameter from year to year (Nature, vol. xxxv. p. 496), Prof. Auwers publishes in the *Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, 1887, No. xxviii., the result of his researches on the yearly inequality of the diameter. The existence of such an inequality has been pointed out by Lindenau in his discussion of Maskelyne's observations; by Cesaris, Carlini, and Rosa in the Milan observations; and by Struve in the Dorpat observations. More recently Rosa has discussed extensive series of Greenwich observations of the sun, and also Madras observations; Newcomb and Holden have discussed Greenwich and Washington observations; and Hilfiker has discussed transits of the sun's diameter obtained at Neuchâtel. To these must now be added Prof. Auwers' careful discussion of the Greenwich transit-circle observations, both of horizontal and vertical diameter, obtained during the years 1851–83 inclusive, as well as of the extensive series of Washington and Oxford observations collected in his former paper, referred to above. These discussions all show the existence of apparent inequalities in the sun's diameter during the year, but do not appear to be at all conclusive as to the reality of such variations in the sun itself. In Prof. Auwers' opinion they are due to the effect of temperature on the instrument, or to the effect of difference in the telescopic image of the sun as observed at opposite seasons of the year. Thus a most remarkable inconsistency appears in the results obtained from the Greenwich observations, both of horizontal and vertical diameter, 1851–83, and from the Neuchâtel observations, of horizontal diameter only, for 1862–83. The following table shows the discordances from the mean for each month of the year for the two series:—

Month.	Greenwich.	Neuchâtel.
	″	″
January	−0·36	+0·66
February	−0·24	+0·54
March	−0·03	+0·24
April	+0·22	−0·51
May	+0·25	−0·54
June	+0·08	−0·34
July	+0·08	−0·33
August	+0·01	−0·54
September	−0·06	−0·19
October	−0·10	+0·38
November	−0·22	+0·23
December	−0·35	+0·41

It appears obvious that these results must be attributed to other causes than physical changes in the sun's diameter.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 *JULY* 17–23.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on July 17

Sun rises, 4h. 4m.; souths, 12h. 5m. 50·5s.; sets, 20h. 7m.; decl. on meridian, 21° 13′ N.: Sidereal Time at Sunset, 15h. 48m.

Moon (New on July 20) rises, 1h. 19m.; souths, 9h. 0m.; sets, 16h. 50m.; decl. on meridian, 17° 15′ N.

Planet.	Rises.	Souths.	Sets.	Decl. on meridian.
	h. m.	h. m.	h. m.	° ′
Mercury	5 59	13 14	20 29	13 45 N.
Venus	8 23	15 6	21 49	7 53 N.
Mars	2 14	10 35	18 56	24 1 N.
Jupiter	12 43	18 0	23 17	9 15 S.
Saturn	4 11	12 12	20 13	21 6 N.

Occultations of Stars by the Moon (visible at Greenwich).

July.	Star.	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image.
			h. m.	h. m.	° °
17	85 Tauri	6	1 5	1 45	30 286
17	Aldebaran	1	3 16	3 33	139 172
18	115 Tauri	6	1 50	2 40	73 237

July.	h.	
19	4	Saturn in conjunction with the Sun.
21	17	Mercury in conjunction with and 3° 40′ south of the Moon.

Variable Stars.

Star.	R.A.	Decl.		
	h. m.	° ′		h. m.
U Cephei	0 52·3	81 16 N.	July 17,	22 32 *m*
			,, 22,	22 11 *m*
R Corvi	12 13·8	18 38 S.	,, 20,	*M*
δ Libræ	14 54·9	8 4 S.	,, 22,	23 16 *m*
U Coronæ	15 13·6	32 4 N.	,, 22,	20 54 *m*
U Ophiuchi	17 10·8	1 20 N.	,, 21,	2 31 *m*
				22 38 *m*
W Sagittarii	17 57·8	29 35 S.	,, 17,	21 0 *m*
			,, 21,	1 0 *M*
U Sagittarii	18 25·2	19 12 S.	,, 22,	1 0 *m*
R Scuti	18 41·5	5 50 S.	,, 23,	*M*
S Sagittæ	19 50·9	16 20 N.	,, 20,	2 0 *m*
			,, 23,	2 0 *M*
S Aquarii	22 51·1	20 57 S.	,, 18,	*M*
S Pegasi	23 14·8	8 18 N.	,, 18,	*M*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
	°	°	
Near ο Cassiopeiæ	11	+48	Very swift. Streaks.
,, 63 Cygni	315	47	Swift. Short.
From Cassiopeia	350	52	Very swift.

GEOGRAPHICAL NOTES.

THE July number of the Proceedings of the Royal Geographical Society contains a detailed report of the paper read by Dr. Junker on his explorations in Central Africa. Mr. Delmar Morgan contributes, from Russian sources, a long account of Russian geographical work in 1886, which contains much that is interesting. One of the most important Expeditions was that under J. V. Ignatieff, to explore the magnificent Khan Tengri group of mountains in the Thian Shan, whose summits soar to a height of 22,000 to 24,000 feet. The botanist of the Expedition, A. N. Krasnof, made some extremely important investigations, with especial reference to the flora of the high snow and ice regions of the Thian Shan, as compared with that of the Polar regions recently worked up by Wittrock. M. Krasnof is of opinion that the valley of the Ili once had an entirely different vegetation to that possessed by it now, and that this early plant-life has completely perished owing to the desiccation of Central Asia and the consequent change in its climate. Formerly, M. Krasnof says, the whole flora of the Ili valley was similar to that still preserved at the foot of the snowy mountains, resembling that of Central Russia. At present all the lower chains are deprived of the moisture they derived from melting ice-fields, and have changed their flora in the most radical way, having now only Central Asian forms. M. Krasnof's general conclusions are that formerly the Thian Shan flora was intermediate between the Altai and the Alpine, and resembled more closely that of the Central and Northern Caucasus. The process of desiccation began in the south, and showed itself by the formation of detritus, retreat of the glaciers, and disappearance of lakes. It caused the formation of loess deposits, sand, and pebble-strewn plains, while it diminished the areas of marshes and black-earth deposits. All plants common to Polar and Alpine regions disappeared from the southern slopes and syrts, while coniferous and deciduous arborescent vegetation also vanished from all waterless slopes. Wherever the snow has ceased to lie, the ancient flora has also perished, only a few species having adapted themselves to a continental climate and assumed an Asiatic character.

THE current number of *Petermann's Mitteilungen* contains several papers of special scientific interest. M. Yokoyama contributes an account of a paper by J. Tanaka, on the vegetation zones of Japan, while Herr Ernst Hartert describes the botanical results of his journey along with Herr Standinger in the Western Soudan. Dr. Supan's paper on the climate of Europe, as regards the duration of a certain mean temperature in different areas, will be found of great value in working out the physical geography of Europe. Dr. Supan's object is to show the length of time (the number of months) a mean temperature—low, temperate, or high—prevails in a European area, and to mark off on maps the areas in which the temperature endures, the number of months being expressed by colours. Many geographical and biological considerations depend on such general facts of climate as Dr. Supan is endeavouring to work out. He divides temperature into three classes: (1) 0° Cent. and under, which he calls the "Frost Period"; (2) 10° to 20° C., the "Warm Period"; (3) 20° C. and over, or the "Hot Period." The duration of these temperatures he has noted at 471 different stations in Europe and the countries round the Mediterranean. The results, which he has represented cartographically by areas of colour, may be briefly summarized thus:—The lines of equal duration of the "Frost Period" run similarly to the winter isothermal lines, changing from a southerly direction in the West of Europe to a south-easterly and then east-south-easterly in the East of Europe. As regards the "Warm Period," it is only on the Atlantic side of Europe that the lines of equal duration run distinctly south-east, elsewhere on the Continent they approximate very nearly to the parallels of latitude; while for the "Hot Period" they show a north-easterly direction. Thus in all three maps the contrast between the oceanic west and the continental east comes out very sharply. A glance at Maps 1 and 2 explains why the Norwegian highland was in the Glacial epoch the birth-place of North European land-ice; the reason is not to be found in the extraordinarily low temperatures, but in the duration of the cold and warm periods. In all districts where a coast range of mountains interposes between the interior and the sea, or where the hills rise abruptly from the sea, the lines of equal duration press closely together, notably in Norway and the Alps. Dr. Supan emphasizes the importance, in considering the climate of Europe of such regions of depression as the valleys of the Rhone and Rhine, the low-lying region of Hungary, and the plain of Poland.

News of the African traveller, Herr Gottlob Ad. Krause, has been received at Berlin through the missionary Steiner from Christiansborg on the Gold Coast. On April 16, Herr Krause arrived at Salaga, north of the Appanti kingdom; proceeding in a northerly direction he succeeded in reaching the vicinity of Timbuctoo. At present, most likely, he has arrived at the Togo coast.

THE PROGRESS OF GEOGRAPHY.

At the anniversary meeting of the Royal Geographical Society, held on May 23, 1887, General R. Strachey, the Vice-President, delivered an address, from which we take the following extracts :—

The attention of geographers during the year, as far as regards Africa, has been chiefly directed to the basin of the Congo, where many explorers, of various nationalities, have been employed in exploring and surveying the numerous streams which combine to make the Congo one of the greatest fluvial systems of the world. Other explorers have been engaged in the same region in examining into its economical and prospective commercial resources, but at present without definite results. An excellent summary of the geographical work done in the Congo region up to the middle of last year was given to the Society in this hall, in June last, by Sir Francis de Winton, who had then recently returned from his two years' administration of the country. The most important of the new explorations he described was that of Lieut. Wissmann and his party, who had embarked on the upper waters of the Kassai River, near the part made known to us by Livingstone and Cameron, and navigated it to its junction with the Congo. Since then Dr. Wolff, one of Wissmann's companions, has explored the Sankuru, a large northern tributary of the Kassai, and found it navigable for a long distance. One result of this latter exploration is to show that another navigable river of the far interior, the Lomami, enters the Sankuru from the north-east, and that it is a distinct river from the Lomami of Cameron, recently ascended by Grenfell, which enters the Congo near Stanley Falls.

The direction which the Kassai takes—in a long curve, from south-east to west-north-west—causes it to be the recipient of nearly all the drainage of the southern half of the Congo basin, and near its junction with the main stream it adds to its volume the waters of another great tributary, the Quango, besides the Mfini from a chain of great lakes further north. The united waters are poured into the Congo through the Kwa, which, according to Mr. Grenfell's measurement, is contracted in its passage through a range of low hills, and at its mouth is only 700 yards wide (a little higher up only 450 yards); the depth of the swiftly flowing stream Mr. Grenfell was unable to ascertain, as no bottom was touched with a line 120 feet long.

The prospective value to the Congo State of the Kassai, with its immense mileage of navigable waters flowing through fertile plains, is acknowledged on all hands. Already stations have been founded on its banks, and Portuguese traders are choosing the newly-discovered river route in preference to their old inland road into the interior from Loanda. It has been during the past few months repeatedly reascended by river steamers, once by Sir Francis de Winton himself.

Equal in importance and extent have been the explorations and surveys along the main river and many of its tributaries carried out by Mr. Grenfell. The chief of these explorations were noticed by the Marquis of Lorne in the Address of last year; and a brief general account of his surveys was given, together with a reduction of his admirable series of river charts, in the October number of our Proceedings. Since then Mr. Grenfell has added to his achievements the ascent of the unknown portion of the Quango between its junction with the Kassai (or Kwa) and the Falls of Kikunji, which latter was the farthest point, coming down river, reached by a former traveller, Von Mechow.

Other considerable additions have been made to our knowledge of the Congo region, by Lieuts. Kund and Tappenbeck, members of a scientific Expedition sent out in 1884 by the German African Association. These two courageous travellers, instead of following the courses of the rivers like others, and gleaning information only of the country and people along the banks, struck across the country, first from Stanley Pool to the south, and thence towards the east, crossing in succession all the southern tributaries, from the Quango inclusive to the Lukenye, beyond the Kassai; a toilsome and dangerous march of about 600 miles. Another member of the same Expedition. Dr. Büttner, made also a land journey, of less extent, but not less interest. Starting from San Salvador, the old capital of the Congo, he travelled eastward and crossed the Quango, reaching the capital of a Negro potentate named Kasongo, whence he struck northward to the main Congo above Stanley Pool. Much valuable information regarding the configuration of the country and the ethnology and products of the interior was obtained on these two journeys. We learn, for example, that the whole western section, to a distance some 400 miles inland, is a hilly country cut up by deep valleys, to which succeeds, further inland, a wide stretch of undulating plains, wooded only along the courses of streams, and that it is only when the eastern side of the Kassai is reached that continuous tropical forest is met with.

North of the Congo the French have been active both in completing the pioneer exploration of their new possessions and in laying down with scientific precision large tracts of country imperfectly known. The most important work of the latter kind is that of Capt. Rouvier, the representative of France on the joint Commission for laying down the boundary between the Congo State and the French possessions. This accomplished surveyor fixed numerous positions by a long series of observations both for longitude and latitude, and his Report, which will be accompanied by an atlas of thirty-eight maps on various scales, will form a solid contribution to our geographical knowledge of the region. An important pioneer exploration, about the same time, was made by M. Jacques de Brazza, brother of the eminent traveller, to the north and east of the French stations on the River Ogowé, undertaken soon after Mr. Grenfell's discovery of the magnitude of the Mobangi, and apparently with the object of ascertaining whether that great river flowed within the French boundary as fixed at the Berlin Conference. After a journey of a month's duration through dense forests, M. de Brazza emerged on an open plain, through which flowed, not the Mobangi, but the Sekoli, an independent tributary of the Congo lying far to the westward. After a fruitless attempt had been made to penetrate beyond this river, his party built canoes and descended the Sekoli to its mouth. It has been recently announced that by arbitration the French boundary has been extended a little farther to the east than fixed by the Berlin Conference, so as to include the right bank of the Mobangi. A complete and very useful *résumé* of all the geographical work accomplished by recent French explorers in the Ogowé-Congo region, by Major de Lannoy de Bissy, was contributed to our Proceedings for December last, illustrated by a map reduced from the French surveys.

Public interest has recently been directed towards the region north of the Congo, and the practicable routes it may offer to the Niam-Niam countries and the Egyptian Soudan, in consequence of the despatch of the Expedition under Mr. Stanley, for the relief and rescue of Emin Bey, which has adopted the Congo route to the Upper Nile in preference to the more direct and shorter route inland from Zanzibar. A paper giving a *résumé* of all published information regarding this region was recently read in this hall by our accomplished young colleague, Mr. J. T. Wills. Since then, you have had before you the greatest of all travellers in this little-known region, Dr. Junker, and heard his own account of his six years' explorations. The wide open plain country lying between the Congo and the Nile, which Dr. Junker described to us, is watered by numerous streams, the chief of which, the Welle-Makua, flows westerly in the direction of the Upper Mobangi, and, judging from Dr. Junker's maps, it is difficult to dispute his conclusion, in which Mr. Wills agrees, that the two rivers are the same. Other geographers believe that the Welle-Makua belongs to the Shari system and flows into Lake Chad. The alternative offers one of those problems in which speculative geographers seem to delight; but in this case it will not be long before a solution is arrived at in the only satisfactory way—namely, by actual exploration. Meantime we learn, by the latest news from the Congo, that Mr. Stanley has chosen to adopt a somewhat more direct route to Emin Pasha than that first proposed—namely, from the Congo near Stanley Falls by land to the shores of the Albert Nyanza.

Two more journeys across the continent have been brought to a successful conclusion during the past year. One by M. Gleerup, a Swedish officer, formerly in the service of the Congo State, who crossed from Stanley Falls to Zanzibar, and the other by the experienced traveller and geologist, Dr. Oscar Lenz, who undertook, in 1885, an expedition for the purpose of reaching Dr. Junker and Emin Pasha *viâ* the Congo. Reaching Stanley Falls in February 1886, Dr. Lenz was unable to obtain men from the Arab traders there to accompany him on the march through the unknown country between that point and the Upper Nile, and proceeded to Ujiji in the hope of meeting with better success there, and advancing northwards along the eastern side of Lake Tanganyika. The disturbed state of the country and the excitement in Uganda made this impossible, and he took the Tanganyika and Nyassa route to the Indian Ocean, emerging at the Portuguese settlement of Quillimane.

Further south, Dr. Hans Schinz, a learned botanist and ethnologist, has been exploring with fruitful results the region between the Kunene and Lake Ngami.

On the eastern side of the continent our Society is especially interested in the expedition of Mr. J. T. Last, who was commissioned by us in the summer of 1885 to proceed to the region between the Rovuma and the Zambesi, and follow up the work of Mr. O'Neill by exploring the Namuli Hills and the Lukugu Valley. We hear by recent telegram of his safe arrival at Zanzibar, and may shortly expect him home to give us in person an account of his journey. The letters which we have received from him from time to time have informed us that he has carried out his programme, though he found the summit of the Namuli Hills inaccessible, and, in addition, traversed the whole region a second time, striking into the interior from Quillimane, and emerging at Ibo on the Mozambique coast.

Count Pfeil, one of the most active of the pioneers in the newly-acquired German Protectorate of Eastern Tropical Africa, published last year an account of his two journeys in Khutu and in the neighbouring region, a country previously known to us only through Thomson's expedition to the Central African Lakes. Some additions to our knowledge of the geography of this part of the African interior have resulted from Count Pfeil's labours, the most interesting of which is the discovery of the main stream of the Ulanga, or upper course of the Rufigi, a river which this explorer claims to be of some importance, and which he navigated in a boat for upwards of 150 miles.

The unsuccessful attempt of the experienced African traveller Dr. Fischer to carry succour to Dr. Junker in 1885–86, a mission with which he was charged by that traveller's family, would have excited great interest in the earlier days—not long past—of Central African travel. The route he took led for several hundred miles through a totally unexplored country, namely, from the Pangani westward across the region which still remains a great blank on our maps to the caravan route between Unyanyembe and Victoria Nyanza. He reached the southern shores of the Victoria in January 1886, but found it impossible to obtain leave to pass through the territory of the fanatical king of Uganda. Turning backward he made a valiant attempt to reach the Upper Nile by the eastern side of the great lake, but his supplies failed him by the time he arrived at Lake Bahringo, and he returned with a sorrowful heart to the coast. He did not long survive the fatigues of this arduous journey, but died soon after his return to Europe, in November last.

In the continent of Asia the most important addition to our accurate geographical knowledge of the interior is no doubt that gained by the joint Russian and British Commission, which has been engaged on the survey of the northern frontier of Afghanistan from the borders of Persia to the Upper Oxus, but pending the diplomatic settlement of disputed points this information has not been made public, though it will doubtless soon become available. A brief note of a portion of this work, describing surveys made by Capts. Maitland and Talbot, between the Hari-rud and Bamian, connecting Herat with the last-named place, and also with points north of the Oxus, and the neighbourhood of Kunduz, has appeared in our Proceedings. The total area surveyed amounts to about 120,000 square miles, mapped on the scale of ¼ inch to the mile, in 60 sheets. These brilliant results are believed to be unique in the annals of surveying. The chief of the British topographical staff, by whom these surveys were undertaken, was Colonel Holditch, to whom one of the Gold Medals has now been awarded, in recognition of the valuable services to geography rendered by him in this and other similar expeditions.

Much valuable geographical work has also been accomplished by Mr. Ney Elias, the Gold Medallist in 1873, who was despatched from Ladakh on a mission to Chinese Turkistan, and diverging westward at Yengi-Hissar, traversed the Pamir Plateau for a distance of 360 miles, to the Khanat of Shignan. The details of this journey have not yet been made known by the Indian authorities, but Sir Henry Rawlinson has communicated to our Proceedings a note in which he points out that his former suggestion that this route, first brought to notice by Major Trotter, was probably that by which caravans of Rome passed from Bactria, and had been used as a military road in comparatively modern times, is confirmed by the additional light now thrown on the subject; and he identifies the lake *Rang-Kul*, visited and described by Mr. Elias, as the famous Dragon Lake of Buddhist cosmogony, and as answering very closely to the description given by the Chinese traveller Hwang-tsang in the seventh century.

Mr. A. D. Carey, a gentleman in the Indian Civil Service, has in a most enterprising manner devoted a period of leave of absence to a very remarkable journey in Eastern Turkistan and Tibet, and has traversed a large part of those central regions which have lately been made known by General Prejevalsky, and of which a brief *résumé* was given in the last Presidential Address. Accompanied by Mr. Dalgleish, an enterprising trader, who had previously visited Eastern Turkistan, he started from Ladakh in the summer of 1885, taking a route which had never before been trodden by a European, from Leh eastward across the high Tibetan plateau, and descending to Kiria by an extremely difficult and rugged defile *viâ* Polu. After a short stay here, he traversed the desert northward, along the course of the Khotan River, and arriving at the Tarim, crossed that river to Shah-yar and Kuchar. At the end of the year he tracked the Tarim to Lake Lob, and proceeded thence in a southward direction to the foot of the great escarpment which in this meridian forms the northern limit of the Tibetan highlands, where he wintered, and made a fresh start across the Altyn Tagh in the spring of 1886. No news having been received of him for many months, his friends had begun to fear for his safety, but all anxiety has been set at rest by recent telegrams from India announcing his safe arrival at Ladakh at the end of the winter. Considering that Mr. Carey travelled without escort and unarmed, and that his journey has been performed on slender means through vast unknown tracts peopled by tribes supposed to be of hostile and fanatical temper, his exploit is one of the most remarkable in the recent annals of adventurous travel.

Northwards of Khatmandu, the capital of Nepal, about 400 miles of entirely new traverse in Nepal and Tibet has been contributed by a native explorer, surnamed M—H., besides a confirmation of the details of a hundred miles of ground previously travelled over. It is regretted that the explorer brought back no determinations of heights, which would have been most interesting, for he crossed the main ridge of the Himalayas by one of the highest passes (the Pangu-la), and approached within 15 miles of Mount Everest. Another native surveyor, R—N., who accompanied Colonel Tanner in his explorations on the Tibetan border in the autumn of 1884, was despatched across Bhutan and the mountains to the east to reach Gyala Sindong, the lowest point yet reached on the Sanpo, and, starting from the left bank of the river, to find his way back to India by *any* practicable route, without recrossing the river. The object was to set at rest the vexed question of the connexion between the Brahmaputra and the Sanpo on the one hand, and the Irawadi on the other. The explorer met with bad luck at the outset, from the fact of there being hostility between Tibet and Bhutan, a state of things which had closed all the passes into Tibet. He therefore had to find his way back to India down the Hachhu and Wongchu Rivers to Baxa, having been detained and kept under surveillance for ten days by the *jongpon* of Chukhajong. His next attempt was made from Dewangiri, whence he proceeded by a pretty direct route to the Monlakachung Pass, and thence to the vicinity of Seh, a very large monastery on the Lhobra River, the position of which had been previously obtained from the north by Lama U—G.'s traverse of 1883. Here, in consequence of the rumours regarding the advance of the Tibet Mission from the south, and of a party of Russians from the north, the officials absolutely stopped his further progress, and kept him in custody for nine days, and then conveyed his party under escort to Seh. From here he escaped with his party by night, and, keeping away from the beaten tracks, found his way to Menchuna (lat. 28° N., long. 92° E.), and thence, *viâ* Tawang, to Odalguri, along the route formerly traversed by Pundit Nain Singh. His work furnishes about 280 miles of new route survey, and throws light on the general geography of Bhutan, besides forming a connexion with the work of Pemberton (1838) from the south, and of the Pundit and the Lama from the north.

Another journey carried out by three English gentlemen through the heart of Manchuria, from south to north from the shores of the Yellow Sea, and from west to east to the Russian settlement of Vladivostock on the Pacific coast, also calls for notice. The party consisted of Mr. H. E. M. James, of the Indian Civil Service; Mr. F. E. Younghusband, of the King's Dragoon Guards; and Mr. H. Fulford, of the Chinese Consular Service. We have received at present brief accounts only of this meritorious achievement; but they are sufficient to show that the travellers made excellent use of their opportunities of gaining accurate information regarding the country, its inhabitants, and products. One of their objects was to ascend the Pei-shan or White Mountain, the highest mountain in the country, which they accomplished, and fixed its altitude by boiling-point and aneroid at 7525 feet, the estimates previously given in books making it 10,000 or 12,000 feet. A very good map of their route was plotted and a copy obligingly communicated to the Society. Mr. James has just arrived in England, and we may hope to have an early opportunity of hearing from his own lips an account of his journey.

The recent addition of Upper Burmah to the territories administered by the Viceroy of India, makes it certain that before long the various questions that have till now puzzled geographers in relation to the course of the rivers that rise in Tibet and flow from that country, will be finally cleared up, and a staff of surveyors under Capt. Hobday is already at work in this country. The sources of the Brahmaputra have already been clearly designated; but doubts still surround the origins of the Irawadi, which actual surveys will, it is to be hoped, before long dispel.

The expectations entertained of the opening up of the still unknown interior of New Guinea, from the southern or British portion of the island, by the expedition of Mr. H. O. Forbes, have, unfortunately, not been fulfilled. Mr. Forbes spent the rainy season in the early part of 1886 in camp, at a short distance inland from Port Moresby, profiting by the enforced inactivity, in cultivating friendly relations with the tribes, learning the languages, and making botanical collections. The remainder of his resources during these months was exhausted, and when at the commencement of the fine season, in April, he made a bold attempt with the great advantage of the companionship of the Rev. J. Chalmers, to reach the summit of the Owen Stanley Range, the term of service of his Amboynese escort had expired, and he could do no more than make a few observations in the rugged country at the foot of the mountains, 75 miles distant from the coast. Since then, he has not been enabled to renew his explorations. We learn, however, that the Government of Victoria has taken the matter in hand, and that a well-equipped Expedition is in preparation for the exploration of the interior, the leadership of which is to be offered to Mr. Chalmers, whose account of his varied explorations along the south-eastern coast-region, given at one of our evening meetings during this session, will be fresh in your memories. The great influence which this experienced missionary pioneer has obtained over the natives, and his knowledge of their habits, inspire us with great hopes in the success of this enterprise, which so much depends on the willingness and fidelity of native followers. Several minor excursions have since been made by various travellers, but very little has been added to our knowledge of the southern portion of the island. Capt. Everill's larger Expedition, fitted out in New South Wales, succeeded in ascending the Fly River and penetrating for some distance up an eastern arm or tributary named the Strickland, which is said to flow in the rear of the range of coast hills, but the map of the parts explored has not yet reached us.

In German New Guinea the discovery of the important river, named after the Empress Augusta, was confirmed by Capt. Dallmann, who in April 1886 ascended it in a small steamer for a distance of 40 miles, and it has since been further navigated by Admiral Von Schleinitz and Dr. Schrader in the steamer *Otilie*, which reached a distance of 224 miles from the mouth, the ship's steam launch ascending 112 miles further, finding still sufficient water, but being obliged to return for want of fuel.

The progress made in the great continent of America, which still offers wide fields for the explorer, and still wider and more productive fields for the physical geographer, remains now to be briefly noticed. As a contribution to physical geography, Mr. John Ball's recently published volume on his voyage round South America and various short journeys inland at various points, merits special mention. It is a model of what serious books of travel that aim at conveying accurate knowledge of the countries visited ought to be.

In Central America, our colleague, Mr. A. P. Maudslay, continues his explorations of the sites and his studies of ruined cities, having returned to Yucatan and Guatemala after reading to us in June last the results of his second and third visits to Central America. His work has great geographical and ethnological as well as antiquarian interest, and his excavations at Copan show that the ruins are those of a city, and not simply of a group of sacred edifices, and that the course of the Copan River has changed somewhat since the remote time at which the massive walls of the buildings had been erected. He believes that he has good ground for concluding that Copan and other cities were abandoned before the Spanish discovery of America in 1492.

Lastly, there remains to notice an admirable labour of exploration in the interior of Brazil by a private scientific Expedition consisting of Dr. Karl von den Steinen, Herr W. von den Steinen, and Dr. Otto Claus. These gentlemen set themselves the task of exploring the course of the Xingu, one of the great southern tributaries of the Amazons. The work was accomplished in 1884, but the first detailed accounts of it were published only in May and June last year. The party proceeded in the first place overland to Cuyaba in the far interior, and, organizing there their caravan, proceeded to the sources of the great river, and descending along the banks of the principal stream, through wild Indian territory, to the point where it becomes navigable, built bark canoes, and paddled down the river a distance of about 1000 miles to its junction with the Amazons. Throughout the journey, in addition to the geographical survey, physical, biological, and anthropological observations were made with the usual thoroughness of German travellers.

It will not be out of place at the present time, when our countrymen are celebrating in all parts of the globe the fiftieth year of the reign of Her Majesty Queen Victoria, to look back on the progress that has been made in geographical knowledge since the commencement of that reign, which dates seven years after the foundation of our Society. The time at my disposal will only admit of an extremely brief review, and I would refer you for more ample details to the valuable memoir drawn up by our esteemed Secretary, Mr. Clements Markham, and published by the Society a few years back, under the title of "Fifty Years' Work of the Royal Geographical Society." A comparison of the maps of fifty years ago with those of the present day shows how great have been the additions made to our knowledge during this period. Foremost, in this respect, must be placed the maps of Africa, the interior of which has been transformed from an almost complete blank, containing little more than hypothetical geographical features derived from the reports of native traders some of which had been handed down to us from the time of Ptolemy, to trustworthy representations, based on precise data, of a vast system of rivers, lakes, and mountains, the existence of which had been wholly unknown to the civilized world. This continent has at length been traversed and retraversed in all directions, and what remains unknown, consists of details needed to fill in well-ascertained large outlines, rather than essential features still to be discovered. Closely following the progress of geographical research, some of the latest fruits of which it has been my agreeable duty to recognize to-day, when presenting one of the Gold Medals of the Society to Mr. Grenfell, the advance of commercial enterprise is already carrying the pioneers of civilization, recruited from all the principal States of Europe, into the heart of what may without exaggeration be called a newly-found quarter of the globe.

The additions to our knowledge of the great insular continent of Australia have been hardly less remarkable; and the difficulties that have been overcome, and the enterprise and endurance displayed in the investigation of its geography, have never been surpassed in the history of the earth's exploration. Here, too, hand in hand with the advance of geographical knowledge, the domain of civilization has been extended, and the Australian colonies have started into existence fully armed as it were from their birth for the battle of national life. Our fellow-subjects in those distant countries have already displayed their complete fitness to undertake the task of further geographical investigation in that quarter, and to them we may now confidently leave it, assuring them of the continued sympathy and interest with which their labours will be regarded by this Society.

During the period to which I am referring, much also has been done to add to our knowledge of the formerly little understood geography of Central Asia. The Russian geographers on the north, and our own surveyors on the south, have now almost entirely cleared away the darkness that shrouded this part of the earth's surface. The limits and the nature of the central plain lying between the mountains of Siberia and of Tibet have been at length satisfactorily ascertained. The long-discussed problem of the true source of the Brahmaputra has been finally solved. The remarkable plateau of Tibet has been crossed in many directions, and important parts of it have been accurately surveyed, so that here also what remains to be done is rather to complete the delineation of details than to enter upon altogether new investigations.

The large geodetic and topographical operations in connexion with the international demarcation of the northern boundary of Afghanistan will supply all that seems still required to complete the maps of Western Asia between the Indus and the Caspian.

Turning to the American continent, we find a measure of progress which, to say the least of it, quite equals that obtained elsewhere. The exploration of the vast tract lying between the valley of the Mississippi and the Pacific has been carried out by the United States Government with a degree of completeness, both in respect to its topographical representation and its physical characteristics, that has probably never been approached elsewhere, and the whole country has thus been thrown open to the enterprise of the energetic citizens of the United States, who have not been slow to possess themselves of its natural wealth.

In British North America, under less favourable conditions for the prosecution of such systematic surveys as those carried out in the territories of the United States, much has still been done, and the recent opening of the railway connecting Columbia on the Pacific with the eastern Canadian States, and the establishment of another through route to Eastern Asia, will doubtless before long lead to the thorough exploration of the countries through which the railway passes.

The Arctic voyages which had been originally commenced with the hope of finding a practically useful north-west passage to Asia, have long ceased to be animated by such an expectation, and their repetition has been undertaken in the cause of geographical exploration alone.

The results of the numerous expeditions undertaken during the last fifty years, combined with those obtained by land journeys directed from British North America, have very completely defined the southern border of the Polar Sea between Behring Strait and Greenland, and have secured the precise delineation of the somewhat complicated system of channels by which the northern border of the American continent is intersected, and of the islands formed by them, along the Arctic circle. In like manner the boundary of this sea has been determined by voyages directed to the north-east along the northern border of Asia.

The highest latitude reached hitherto is rather less than 83½° N. —that is, within 500 miles of the Pole. The further extension of the exploration of the north of Greenland and of Franz-Josef Land may still be possible, and it is by journeys in this direction that any closer approach to the North Pole will probably be most readily attainable.

I should not omit mention of the memorable voyage to the Antarctic Circle under the most experienced of the Arctic naval commanders of his time, the results of which were of the greatest scientific value, though the difficulties arising from climate that stand in the way of a near approach to the South Pole prevented the Expedition reaching a higher latitude than 78° 11′ S.

Lastly, I may notice the remarkable additions that have been made during this epoch to our knowledge of the ocean, its depths, its temperature, the winds and climates that prevail over its various portions, its currents, and the life with which it abounds. Much of the knowledge thus acquired has supplied completely new and wholly unexpected data with which to deal in our endeavours to interpret the earth's history, and to understand the phenomena it presents to us.

It has been in connexion with the extension of geographical discovery, both that to which I have thus more specially referred, and other similar explorations to which specific reference has not been possible, that there has been accumulated a great mass of knowledge which has had a most important place among the causes which justify our assigning to this epoch its conspicuous character of deserving to be recorded in the history of the present times as the age of scientific progress. There is no room to doubt that it was only by aid of the accumulation of a knowledge of numerous forms of life from various countries, developed under different conditions, that the remarkable generalizations of Darwin and Wallace as to the origin and distribution of species became possible ; and that in this sense those great conceptions of the signification of the wonderful variety in the forms of animal and vegetable life, and of the remarkable manner in which they are found associated in various parts of the earth, which it has truly been said are worthy of being classed with the sublime discoveries of Newton, may be regarded as consequences of geographical exploration and discovery. In a somewhat similar manner the progress of geology follows that of geography, and the same may be said of almost all the natural sciences.

In some branches of science the student is able to submit his conclusions to the test of experiment, to vary the conditions of his investigation at his pleasure, and to draw his inferences from the varying results under the changed conditions. In the great laboratory of Nature no such control of conditions is within our power. But by suitable variation of our geographical position, we are able to observe the effects that the physical forces of Nature have produced under varied conditions, and it thus becomes possible to some extent to obtain a substitute for the power of direct experiment.

Properly to estimate the relation between geographical conditions and any observed effect, it is obviously necessary to possess a sound knowledge of the physical forces that may be called into operation in producing that effect, and consequently such a knowledge is of essential importance to every geographer.

I shall not detain you to say anything more on the much-discussed subject of geographical education. I desire to point out, however, that, for such reasons as I have briefly indicated, it is hardly possible to over-estimate the value of exact and scientific geographical research, and that this can only be attained by those who have been properly prepared by previous training. Such a training, it is hoped, may be provided by the instruction which it has been the earnest desire of the Society to see imparted at our chief Universities, and which I trust may not only add to the number of our scientific travellers, but serve generally to throw on many other branches of study that light which an intelligent knowledge of geography alone can supply.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The following is the list of Scholarships, Prizes, Associateships, &c., awarded at the Normal School of Science and Royal School of Mines, South Kensington, for the Session 1886-87 :—

First Year's Scholarships—Samuel B. Asher-Aron, William Tate, James A. Schofield, Savannah J. Speak. Second Year's Scholarships—William Blackmore, Henry Sowerbutts.

Edward Forbes Medal and Prize of Books for Biology—Miss Agnes Calvert. Murchison Medal and Prize of Books for Geology—Thomas H. Holland. Tyndall Prize of Books for Physics, Part I.—James W. Rodger. De la Beche Medal for Mining—John W. Sharwood. Bessemer Medal with Prize of Books from Prof. Roberts-Austen for Metallurgy—John Richards. Hodgkinson Prizes for Chemistry—1st Prize, Books, John T. Hewitt ; 2nd Prize, Book, William E. Hotson. Frank Hatton Prize for Organic Chemistry—John T. Hewitt.

Associateships (Normal School of Science)—Mechanics (1st Class) : Albert Griffiths, Ernest A. Hamilton-Gordon. Physics (1st Class) : Arthur T. Simmons. Chemistry (1st Class) : John H. Powell, John T. Hewitt ; (2nd Class) : William R. Bower, Herbert Anderson, Walter D. Severn, Ernest H. Smith, Frank Belcher. Geology (1st Class) : Walter G. Ridewood, William F. Hume.

Associateships (Royal School of Mines)—Metallurgy (1st Class): John Richards, André P. Griffiths, James A. Gilmour, Arthur E. Cattermole, Andrew McWilliam ; (2nd Class) : Sidney Allingham, Hugh Barbour, Arthur M. M. Cooke, George W. Card. Mining (1st Class): John W. Sharwood, Arthur M. M. Cooke. (2nd Class): Cæsar Bello, John Leechman, Andres Franchy, John H. Grant.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. ix. No. 4 (Baltimore, June 1887).—The number opens with a further instalment of Prof. Sylvester's lectures on the "Theory of Reciprocants" (pp. 297–352), which grow in interest as we approach their close—promised in a subsequent number. Lectures xxv. to xxxii. are reported as before by Mr. Hammond, and are accompanied by the lecturer's notes.—M. Maurice d'Ocagne (pp. 354–80) in a paper "Sur une Classe de Nombres remarquables," discusses properties of the numbers symbolically represented by K_m^p. Form a table of squares, as in the case of Pascal's arithmetical triangle, putting in the top left corner K, and in the vertical and horizontal lines the successive numbers 1, 2, 3 . . . The K-numbers will then be, first row 1, second row, 1 1, third row 1 3 1, fourth row, 1 7 6 1, fifth row, 1 15 25 10 1, and so on; the law of formation being, "Multiply the number of the pth column of the qth row by the number of the column, and add to the result the number in the $p-1$th column of the qth row to get the number in the pth column of the $q+1$th row": thus, in the above, $15 = 2 \cdot 7 + 1$, $25 = 3 \cdot 6 + 7$, $10 = 4 \cdot 1 + 6$. These numbers, like those of Bernoulli and Euler, frequently occur in analysis. Many curious results are obtained. —We next have "Extraits de Deux Lettres addressées à M. Craig par M. Hermite" (pp. 381–88). These notes are upon a definite integral formula of Fourier, upon a formula due to Gauss, and upon a formula first given by Weierstrass (an expression for the sine by a product of prime factors).—The volume closes with a notelet by Prof. Franklin, entitled "Two Proofs of Cauchy's Theorem."

Rivista Scientifico-Industriale, April 30.—Recent progress in the theory of the microscope, by Dr. Aser Poli. Reference is made more especially to the labours of Abbe, Helmholtz, Crisp, and others, which have been either originally published or reproduced in the Journal of the London Royal Microscopical Society during the last ten years.—On the electric conductivity of gases and vapours, by Prof. Giovanni Luvini. This is a reply to Prof. Edlund, of Stockholm, who has recently urged several arguments against the author's views regarding the non-conductivity of gases and vapours. These arguments are examined in detail, and it is shown generally that, being mainly based on theoretic grounds or gratuitous assertions, they cannot affect the conclusions to which the author has been led by carefully conducted experiments.—Celestine of Montecchio Maggiore, by G. Bettanini. Preparatory to a complete study of this mineral, a brief description is here given of its crystalline forms and general physical properties. Its specific gravity is shown to be 3·965 at a temperature of 14° C.

Bulletin de l'Académie Royale de Belgique, May.—A new reptile discovered in the Aix-la-Chapelle district, by the Abbé G. Smets. Considerable interest attaches to this discovery recently made in a sandpit at Moresnet, a comparison with the Dinosaurians brought to light in the chalk formations of the New World showing that it is a carapaced Hadrosaurian, the first representative of this family yet found in the eastern hemisphere. —On the electrical phenomena of the excitatory process in the heart of the dog, by Léon Fredericq. This elaborate paper is introduced by an historical summary, from the discovery of the negative variation of the heart of the frog by Kölliker and H. Müller down to the recent studies of Sanderson and Page, with an account of the stroboscopic method employed by Martins to demonstrate the simple nature of the electric variation of the heart in the dog and rabbit. This is followed by a full description of the apparatus employed and experiments made by the author, who has investigated the subject by means of an electrometer modelled on that described by Lovén. A detailed account is added of the results of these researches, illustrated by a series of photographic diagrams.—The solar eclipse of October 29, 1886, observed on the Congo, by A. Merlon. These observations were taken with great care in 3° 7′ S. latitude above the Congo-Kassai confluence to the north of Kwamouth. By means of the data obtained and here supplied, the longitude of the point of observation may now be accurately determined. The instruments used were Abbadie's theodolite, Leroy's chronometer, and Fortin's barometer.

Rendiconti del Reale Istituto Lombardo, June.—On the sulphate of copper, as a remedy against the mildew of the grape-vine, by Prof. E. Pollacci. A crucial chemical experiment is described, showing that the sulphate of copper cannot pass from the grape to the wine except in the minutest quantities. Some critical remarks are added on various other remedies recently proposed against diseases of the vine.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 16.—"The Electromotive Properties of the Electrical Organ of *Torpedo marmorata*." By Francis Gotch, B.A., B.Sc. London, M.A. Oxon. Communicated by Prof. Burdon Sanderson, F.R.S.

After an introduction, in which the author sets forth the present state of knowledge with reference to the electromotive properties of the electrical organ of Torpedo, he gives an account of his own experimental investigations in three sections.

The first section relates to the nature of the changes produced in the electrical organ by mechanical injury and by heat, and the relation of these changes to those which manifest themselves under similar conditions in muscle and nerve, a subject which has not hitherto been inquired into.

In the second, the duration and the character of the response of the electrical organ to stimulation of its nerve are investigated for the first time by means of the rheotome and galvanometer.

In the experiments which are recorded in the third section, the author has entered on the examination of the after-effects which are produced in the organ by the passage through it of voltaic or induction currents, a subject which has been recently investigated by Du Bois-Reymond.

The author is led by his experiments to believe that the physiological effects produced in the organ by injury, by the passage of currents, and by the stimulation of the electrical nerve, are, notwithstanding that they differ so widely from each other in distribution, duration, and intensity, all phenomena of excitation.

Physical Society, June 25.—Mr. Shelford Bidwell, F.R.S., Vice-President, in the chair.—The following communications were read:—Note on magnetic resistance, by Prof. W. E. Ayrton, F.R.S. and Prof. J. Perry, F.R.S. In the spring of 1886 the authors made experiments on the magnetic induction through horse-shoe electro-magnets when excited by constant currents. The inductions through different armatures and air spaces were also measured. The results show that for small exciting powers the law of parallel resistances is true for magnetism, taking leakage into account. From experiments made with two electro-magnets, the poles of which were placed at different distances apart, the authors conclude that the magnetic resistance of air is proportional to length, or to length plus a constant. A note on magnetic resistance was read before the Society on March 12, 1887, by the same authors, describing experiments on two iron rings, one whole and the other divided by a radial saw-cut. Since then the experiments have been repeated with great care by Colonel Swinton and Mr. Sörenson, of the Central Institution. The resulting curves agree with those previously obtained. On measuring the air space it was found considerably less than estimated, and the magnetic resistance of air relative to iron (assuming no "surface resistance") comes about 1500. Experiments made with different air spaces together with the above seem to show a considerable "surface resistance." Prof. S. P. Thompson thought dynamo-makers had evidence of such "surface resistance" from the care exercised in avoiding joints in the magnetic circuit wherever possible, and Mr. Bosanquet mentioned some experiments he had recently made on the resistance of joints during the various stages of fitting. The changes of resistance are very large, and he concludes that, however good the fit, it is not possible to reduce the surface resistance to a negligible quantity.—On sounding coils, by Prof. W. Stroud and Mr. J. Wertheimer. The paper describes experiments on coils and helices of wire which emit sounds when variable electric currents are passed through them. The pitch depends on the frequency of the current variations. The authors believe the sounds due to the attractions of adjacent parts of the wire which cause shortenings and lengthenings as the current increases or decreases. To prove this, two identical coils were made, and one of them embedded in plaster of Paris. This gave no sound when the variable current was passed, whilst the other emitted the usual note. It was also found that no sound could be got from a single turn of wire, whilst one and a quarter turns gave an audible sound under the same conditions.—On comparing capacities, by Mr. E. C. Rimington. This is an investigation of the conditions under which the integral current through a galvanometer in a balanced Wheatstone's bridge is zero, when the battery circuit is broken; two adjacent arms, A and D, of the bridge being shunted by condensers of capacities K_1 and K_2. It is shown that $\frac{K_1}{K_2} = \frac{C}{B}$, where C and B are the resistances of the arms opposite to A and D respectively. If A and D be made infinite, the necessity of balancing for steady currents is obviated; but if either of the condensers has an appreciable leakage, corrections are required. The best resistance to give to the galvanometer is shown to be $G = \frac{B(C + D)}{B + C}$, and the conditions under which a telephone may replace the galvanometer are $\frac{K_1}{K_2} = \frac{C}{B}$. The case where all the arms have self-inductions is investigated.—On the effects of change of temperature in twisting or untwisting wires which have suffered permanent torsion, by Mr. Herbert Tomlinson. The author's attention was re-directed to the subject by the note read by Mr. Bosanquet on May 14. Some eight years ago he made experiments on such wires, and upon the effects due to changes produced in the thermal expansibility of the metals, by permanent elongation or compression. Thus if a small square be drawn on the surface of a wire, and the wire subjected to permanent torsion, the square becomes a rhombus, the longer diagonal of which suffers permanent extension, and the shorter diagonal permanent compression. If permanent extension causes an increase in thermal expansibility, and compression a decrease, then a rise of temperature will cause the wire to twist more, and *vice versâ*. With annealed iron wires which have suffered permanent torsion, remarkable effects take place at about a red heat. On heating such a wire, it untwists slightly until a bright red heat is attained, when a sudden twist takes place. On cooling, a sudden untwist occurs at about the same temperature. These effects have been previously observed by Prof. Barrett, who believes them to be connected with the sudden changes in the magnetic properties of iron, and to take place at the same temperature. This latter conclusion was found to be erroneous, for the author exhibited experiments showing that the magnetic change takes place at a temperature decidedly lower than that at which the jerks above referred to, occur.—On permanent magnet ammeters and voltmeters of invariable sensibility, by Prof. W. E. Ayrton, F.R.S., and Prof. J. Perry, F.R.S. The sensibility of ordinary permanent magnet ammeters and voltmeters increases as the strength of the magnet decreases, whereas in those of the Deprety-D'Arsonval type (in which a suspended coil controlled by torsion swings between the poles of a permanent magnet) the reverse effect takes place. By combining the two systems, the authors have devised instruments whose sensibility is unaltered by changes in the strength of the magnet. The torsional control of the D'Arsonval is removed, and a small permanent magnet attached to the swinging coil. As the large permanent magnet changes, the controlling and deflecting forces change in the same proportion, and the deflection for a given current remains unaltered.

Zoological Society, June 23.—Prof. W. H. Flower, F.R.S., President, in the chair.—Mr. Sclater exhibited the skin of a White-nosed Monkey of the genus Cercopithecus, lately living in the Society's Gardens, which appeared to be the *C. ascanias* of Schlegel. It had been obtained by the Rev. W. C. Willoughby from the west shore of Lake Tanganyika, East Africa.—Mr. Sclater also exhibited and made remarks on a specimen of the Pheasant from Northern Afghanistan lately described by him as *Phasianus principalis*.—An extract was read from a letter addressed to the Secretary by Mr. A. H. Everett, of Labuan, reporting the return of Mr. John Whitehead from his expedition to Kina-Balu Mountain, in Northern Borneo, with specimens of some fine new birds, mammals, and other objects of natural history.—Dr. Günther, F.R.S., exhibited and made remarks on a hybrid Pheasant, between a male Golden Pheasant (*Thaumalea picta*) and a female Reeves's Pheasant (*Phasianus reevesi*). Dr. Günther also exhibited a living hybrid Pigeon, produced by a male white Fantail Pigeon and a female Collared Dove (*Turtur risorius*).—Dr. Günther, F.R.S., read a report on the zoological collections made by Capt. Maclear and the other officers of H.M.S. *Flying-Fish* during a short visit to Christmas Island. This island is situated in the middle of the Indian Ocean, south of Java, and had never been before visited by naturalists. The collection, which had been worked out by the staff of the British Museum, consisted of ninety-five specimens, amongst which were examples of two mammals, two birds, two reptiles, two mollusks, two Coleoptera, two Lepidoptera, and a Sponge, new to science.—Mr. F. E. Beddard read a paper on *Myrmecobius fasciatus*, in which he described a remarkable glandular structure stretched across the anterior region of the thorax of this marsupial.—Prof. F. Jeffrey Bell read the sixth of a series of studies on the Holothuridea. The present paper contained descriptions of several new species belonging to the genera *Cucumaria*, *Bohadschia*, and *Holothuria*.—Mr. A. Smith-Woodward read a paper on the fossil teleostean genus *Rhacolepis*. The author gave a detailed description of this Brazilian fossil fish, which had been named and briefly noticed by Agassiz. Three species were defined, and the author showed that the genus had hitherto been erroneously associated with the Percoids and Berycoids. He considered it an Elopine Clupeoid.—A communication was read from Mr. James W. Davis containing a note on a fossil species of *Chlamydoselachus*. The author pointed out that some teeth from the Pliocene of Orciano, Tuscany, figured and described by R. Lawley in 1876, were referable to this newly-discovered genus of Sharks. He named the fossil species *C. lawleyi*.—Mr. Frank E. Beddard read the fourth of a series of notes on the anatomy of Earthworms. The present communication treated of the structure of *Cryptodrilus fletcheri*, a new species from Queensland.—A communication was read from Mr. Roland Trimen, containing observations on *Bipalium kewense*, of which worm he had obtained many specimens from gardens at the Cape.—Dr. Günther gave the description of two new species of fishes from the Mauritius, proposed to be named *Platycephalus subfasciatus* and *Latilus fronticinctus*.—Mr. Sclater read a note on the Wild Goats of the Caucasus, in which he pointed out the distinctions between *Capra caucasica* and *C. pallasi*, which had been until recently confounded together.—Mr. G. Boulenger made remarks on the skull and cervical vertebræ of *Meiolania*, Owen (*Ceratochelys*, Huxley), and expressed the opinion that these remains indicated a Pleurodiran Chelonian of terrestrial and herbivorous habits. The peculiar structure of the tail pointed to a distinct family (*Meiolaniidæ*).—A second paper by Mr. Boulenger contained remarks on a rare American fresh-water Tortoise, *Emys blandingii*, Holbrook, which was shown to be a close ally of *Emys orbicularis* of European fresh waters, but to present distinct differential characters.—Mr. A. Dendy read a paper on the West Indian Sponges of the family Chelininæ, and gave descriptions of some new species.—Mr. H. Seebohm gave the description of a new species of Thrush, from Southern Brazil, proposed to be called *Merula subalaris*.—A communication was read from Mr. R. Bowdler Sharpe, containing the description of a new species of the genus *Calyptomena*, lately discovered by Mr. John Whitehead on the mountain of Kina-Balu, in Borneo, which he proposed to name *C. whiteheadi*.

PARIS.

Academy of Sciences, July 4.—M. Janssen in the chair.—Inauguration of the statue to Nicolas Leblanc, by M. Eug. Peligot. It was stated that this bronze statue, erected to the memory of the illustrious chemist, inventor of artificial soda, was unveiled on June 28 in the court of the Conservatoire des Arts et Métiers.—Note accompanying the presentation of the Report of the English Commission appointed to inquire into M. Pasteur's treatment of rabies, by M. Pasteur. While expressing his great satisfaction at the general tenor and conclusions of this Report, the author referred in feeling terms to the premature death of his distinguished fellow-worker, M. Vulpian, who had not lived to receive this high testimony to the efficacy of the method of cure in which he had taken so much interest.—Note on the first labours of the Observatory of Nice, by M. Faye. After passing in rapid review the services already rendered to science during the construction of the works at this important astronomical station, the author stated that these works are now completed by the erection of the great 0·76 m. telescope, constructed by the brothers Henry, and mounted in Eiffel's wonderful revolving dome, whose diameter exceeds that of the Pantheon at Rome. He added that the International

Geodetic Association has decided to hold the next session of its Permanent Commission in October of this year at the Observatory of Nice.—General method for determining the constant of aberration, by M. Lœwy. In this concluding paper the particular process is described by means of which the research may be made independent of the errors due to the action of the screw in the apparatus already described.—On some double phosphates of thorium and sodium, or of zirconium and sodium, by MM. L. Troost and L. Ouvrard. After examining the action of the metaphosphate, of the pyrophosphate, and orthophosphate of potassa on thorine, zircon, and their salts, the authors here describe the action of the meta-, pyro-, and orthophosphate of soda under analogous conditions. From the study of the double phosphates formed by these bases with soda and phosphoric acid, they are unable to derive any argument in support of the theory that has been advanced on the relation of zircon to thorine in order to justify the formula of a bioxide given to the latter substance. In a future communication the reactions will be described which separate both of these compounds from each other, and bring thorine more into relationship with the protoxides.—Remarks accompanying the presentation of two works on subterranean waters in the present and former geological epochs, by M. Daubrée. In the first of these works, relating to the present epoch, the author describes the manifold action of water in its passage through the rock on the constitution of the terrestrial crust. The underground waters are studied from the several stand-points of their *régime*, their temperature, and their composition. The second work, dealing with past epochs, studies the action of these waters in modifying the original substance of the crust of the earth, and especially in connexion with the distribution of minerals. It is shown generally that the superheated water, whose presence is betrayed by thermal springs and igneous exhalations, slowly and silently brings about great and permanent effects in the interior of the globe, at all times giving rise to mineral deposits of all kinds. By its incessant subterranean circulation, and especially by its chemical work, it accomplishes a sort of vital action, which is perpetuated from age to age.—On an atlas of marine meteorology presented to the Academy by M. Mascart. A limited number of copies of this work have been issued by the Central Meteorological Bureau in connexion with the Exhibition at Havre, and at the expense of a person who desires to remain anonymous. It has been prepared by M. Léon Teisserenc de Bort, and comprises thirty-two charts based on the best published and inedited materials. The first series deals with the mean distribution of pressure, and of the prevailing winds during the different seasons on the surface of the globe. The second is more especially devoted to the study of the Atlantic Ocean, indicating the atmospheric systems, the temperature of the sea, the position of the Arctic and Antarctic floating ice, the line of equal declination, &c. According to the donor's intention the work will be distributed gratuitously to all captains of the mercantile marine who have by their personal observations contributed in any way to the progress of meteorological studies.—Fluorescences of manganese and bismuth (continued), by M. Lecoq de Boisbaudran. In this paper the author deals (1) with two solid solvents, one of which, in the presence of the other, plays the part of a moderately active body, and an active substance fluorescing energetically with one only of these solvents; (2) with two solid solvents, the first of which (α) plays the part of a moderately active body and two active substances fluorescing energetically, one with the two solvents α and β, the other with β alone.—Elements and ephemeris of the planet 267, by M. Charlois. These elements have been calculated by three equatorial observations made at the Observatory of Nice on May 27 and June 9 and 27, 1887. At the instant of opposition on June 5 the planet was of magnitude 13·5.—On the position of the foci in a tangential bundle of plane curves, by M. G. Humbert. From various considerations deduced from Leguerre's theorem, the author arrives at the general proposition that the poles of any three series are the foci of three algebraic curves of the same class, belonging to the same tangential bundle; inversely the real foci at a finite distance from a curve of this bundle constitute a system of poles. —On the synthesis of pilocarpine, by MM. Hardy and Calmels. The synthesis of this substance has been obtained by means of β-pyridino α-lactic acid. It takes place in two phases: (1) transformation of this acid into pilocarpidine; (2) transformation of pilocarpidine into pilocarpine.—On the origin of the striated Bilobites, by M. Ed. Bureau. These tracings, occurring on certain sandstones, are referred to the footprints of some Crustacean of the order of Phyllopods, which cannot at present be more accurately determined.—Observations on the meteor of June 17, 1887, by MM. Waltner and Didier. This meteor, seen at an altitude of about 45° above the horizon near the Mont-Parnasse railway-station at 7.45 p.m., was especially remarkable for its extraordinary brilliancy. It disappeared in about five seconds, without any noise or explosion, before reaching the top of the houses.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Matter and Energy (Kegan Paul).—My Microscope: by a Quekett Club Man (Roper and Drowley).—Exercises in Practical Chemistry, vol. i. 4th edition: Harcourt and Madan (Clarendon Press).—Bibliographie Générale de Astronomie, vol. i.: Houzeau and Lancaster (Hayez, Brussels). Four-Figure Mathematical Tables: J. T. Bottomley (Macmillan).—Handbook of Fern Allies: J. G. Baker (Bell).—Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung, Jahrgang iv., 1885 (Magdeburg).—Actes de la Société Helvétique des Sciences Naturelles; Compte Rendu, 1885-86 (Genève).—Compte Rendu des Travaux de la Société Helvétique des Sciences Naturelles, 1886 (Genève).—Mittheilungen der Naturforschenden Gesellschaft in Bern ans dem Jahr 1886 (Bern).—Foods and Food Adulterations; part 1, Dairy Products (Washington).—Journal of Anatomy and Physiology, July (Williams and Norgate).—Mind, July (Williams and Norgate).—Journal of the Society of Telegraph-Engineers and Electricians, No. 67, vol. xvi. (Spon).—Folk-Lore Journal, vol. v. part 3 (Stock).—Zeitschrift für wissenschaftliche Zoologie, xlv. Band, 3 Heft (Engelmann, Leipzig).—Botanische Jahrbücher für Systematik, Pflanzengeschichte, und Pflanzengeographie, Achter Band, v Heft (Engelmann, Leipzig).—The Indian Forester, April, May, and June 1887 (Roorkee).

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