THURSDAY, DECEMBER 30, 1886

BABINGTON'S "BIRDS OF SUFFOLK"

Catalogue of the Birds of Suffolk; with an Introduction and Remarks on their Distribution. By Churchill Babington, D.D., &c. Reprinted from the *Proceedings* of the Suffolk Institute of Archæology and Natural History. 8vo, pp. 281. Map and 7 Plates. (London: Van Voorst, 1884-86.)

NUMEROUS as have lately been contributions to local British ornithology, the treatment of the subject is very far from being exhausted, and Dr. Babington's book is extremely welcome as supplying a new catalogue of the birds of a county having so favourable a situation as Suffolk. For though wanting the extended sea-board of one neighbour, Norfolk, which meets the uninterrupted roll of the polar waves, and possessing an almost even coast-line, very unlike the irregular contour of its other neighbour, Essex, Suffolk yet contains the most easterly point of England in Lowestoft Ness, as it is still fondly called, though a "ness" is there as hard to recognise in these days as is the "bay" of its historic Solebay, a few miles further south. Suffolk also is not without its "broads"—at Fritton, Oulton, Benacre, and Easton—insignificant as they may be in comparison with those of the northern half of the ancient East Anglian kingdom. It also shares with Norfolk the great Breydon Water, and with Essex the wide mouth of the Stour, while it has for its own the estuaries of the Blythe, the Alde, the Debden, and the Orwell, by no means despicable, even if they are not equal in size to those of the Colne, the Blackwater, and the Crouch, that drain so much of Essex. Suffolk again has a natural feature, the like of which is not possessed by either of its neighbours:—

"On Orfordness lies many a stone,
But Dungeness has ten for one,"

says the old adage, and it is not until the south-eastern corner of Kent is reached that a similar "beach" is presented, and that one only to be surpassed by the Chesil Bank of Dorset. Highly cultivated, too, as now is almost every acre in Suffolk that will repay cultivation, there are still some wide tracts along its eastern border, and again towards its north-western extremity, which, if indeed they have ever been under the plough, have long since lapsed into an approach to their original condition, and are overgrown with heather and gorse, or form "brecks," kept, by the teeth of countless sheep and rabbits, in the state of the poet's "smooth-shaven green." The western limits of the county not only bound, but slope into, the great Fen district, that spreads for miles and miles in an almost level plain towards the Wash. The chief part of Suffolk has long been inclosed, presenting, in the absence of any but the most inconsiderable elevations, a very uniform appearance; and, were it not for its numerous woods—not many of which are really ancient—and plantations, would afford harbour to few but the commonest of birds. An indefinite district, the soil of which is of the stiffest clay, is colloquially named "High Suffolk"; but where it begins or ends, no one knows; and, for some mysterious reason, nobody will own to living in it. "High Suffolk" always begins in the next parish, or the next parish but one! A great contrast to these heavy lands is presented by the "breck" district already mentioned, where the chalk-formation comes nearly to the surface, and is only overlain by a few inches of the lightest sand—so light, indeed, that some places may be found as bare of vegetation as is a real desert—every particle of fertilising matter having been blown away by the wind after a spell of dry weather; and it will be remembered that in East Anglia the rainfall is less than in any other part of England. This district still retains, in at least one of its birds, in some of its insects, and in a few of its plants, indications of having been once—and that perhaps not so very long ago—a littoral, an arm of the sea having doubtless reached its low hills, and in after times retreating, having left these survivors who still hold their ground. But here we may say that we cannot for a moment subscribe to the opinion to which Dr. Babington gives currency (p. 123), though not saying whether he himself shares it, that the marine connexion was by "a broad estuary running from the South Suffolk coast between Bury St. Edmund's and Stowmarket through Thetford." So far as we are aware, there is no evidence in favour of such a violent supposition, and much against it. On the other hand, a very slight depression of the surface would once more bring the sea from the Wash up to Brandon, if not to Thetford.

We make no attempt to trace the deeper effects of geological formations and changes; but all these superficial characters, here so briefly sketched, combined with the geographical situation of the county, will serve to show why Suffolk should present a field of great interest to the ornithologist; its varied features offering suitable accommodation for many kinds of birds of diverse habits, and its eastward position a sanctuary where the wings of many a weary wanderer from afar may be folded at rest. There is the more need to urge the importance of these favourable circumstances, because they cannot be said to be too prominently laid before his readers by Dr. Babington, who perhaps through modesty, or perhaps through prudence (in which latter case he is certainly to be commended), abstains from setting forth the advantageous conditions of existence that the county of his adoption thus affords, albeit he devotes a few pages (258-268), which might well have been more, to the subject.

In computing the birds of a circumscribed area, it is always a difficult task to decide whether the adventitious strangers whom the accidents of travel may have driven upon its coast should be enumerated among its real inhabitants, for there is really much to be said on both sides of the question. At first sight it seems most absurd that, granting even there is no reasonable probability of its importation, the stray example of an exotic species, whose home may perhaps be in the further wastes of Northern Asia or the wilds of Arctic America, should be enrolled as a "British bird," because it has had the ill-luck to find its way hither and be killed—*secundum usum Anglicanum*—within the confines of the United Kingdom; but almost immemorial practice may be pleaded for this view of the case, and we are not minded to place on record a distinct decision against the claims

of a local faunist on so delicate a question. However, the local faunist should recognise the fact that a long list is not necessarily "a strong list"—to use Dr. Babington's expression—and if space allowed us to go into details we should be inclined to strike off not a few species from his register. It is true that this would not materially alter his position, for a corresponding number would on the same ground have to be struck off the register of other counties. In reality, no one has ever doubted that the Suffolk roll is one of the highest to be found in England. Perhaps it would stand only second to that of Norfolk on the English record, for though both, so far as published lists go, are inferior to that of Yorkshire, we are persuaded that this last has been unduly swollen. We have a strong suspicion that a Kentish list would run any of them very hard; but we here speak without facts, for ornithologists have long been scarce in Kent, and no attempt at a Kentish list has been made for many a year. The comparison instituted by Dr. Babington between the ornithological wealth of Suffolk and certain other counties is in some measure fallacious,—the last list of Sussex birds, for example, dates from 1855 (not 1865 as he inadvertently states), while practically it was compiled in 1849, since which time a good many things have happened. Comparison with inland counties is of course misleading, and probably the well-known published catalogues for Cornwall, Somerset, Northumberland, and Durham, and for the Humber district, are alone those with which catalogues for Suffolk and Norfolk can be rightly compared; while the county last named, from the abundance of ornithological observers it has produced, is manifestly favoured in the race. One other thing may perhaps be mentioned in this connection, and that not so much for Dr. Babington as for authors of future "Avifaunas"; the ornithological richness of a district depends far more on the number of its real inhabitants than on the number of species which have occurred as stray visitors within its limits and only *bonâ fide* travellers. As regards large areas this is a truth so obvious that our remark may seem to be a platitude, but as regards small areas the consideration is too often overlooked.

Among all the English works on local ornithology with which we are acquainted, Dr. Babington's holds a peculiar place. Its contents are distinctly matters of fact, or of what passes for fact; in other words, it is a summary of records. No one would pretend to say that any book of this kind is, or could be, exhaustive; but the author has done his best to make his work so, and the infinite pains he has taken to be precise are present on every page—for every page bristles with references that have obviously cost him immense labour to collect, and his patient industry in culling them deserves the highest praise. On the other hand, this very precision may not unfrequently mislead the unwary. Unless the reader have a competent knowledge, elsewhere obtained, he may be apt to presume that the fact of such or such a species having been recorded as occurring or breeding at such or such a place and at such or such a time is an indication that it has not occurred or bred there at any other time. For the sake of those who are beginners, or ill-instructed in ornithology, and they ought to form a majority of those who use this book, it would have been better had the author uttered a warning against this kind of misconception, which in many cases is certain to follow from this concise method of citing previously recorded observations. Experts, of course, will not be taken in by it, but we think it may deceive others. Experts, however, unless they be accustomed to the way in which local floras are compiled, have some right to complain of the application of botanical methods to a fauna—for it is plain that the "Catalogue of the Birds of Suffolk" is planned on essentially the same principle as would have been a catalogue of the plants of the same county, and not according to any zoological precedent.

A few words are Dr. Babington's due on another matter. To most zoologists his name will be new, and yet he entered the field of biological literature nearly five-and-forty years ago! His ornithological appendix to Potter's "History and Antiquities of Charnwood Forest," published in 1842, was a respectable, not to say ambitious, performance for an undergraduate; and, while showing rudiments of the same scrupulosity as is seen in the present work, is equally removed from loquacity, though containing some information that the British ornithologist would not willingly let die. Both in conception and in execution it naturally has been surpassed by later publications, nor can it be regarded as the original precursor of the numerous local "Avifaunas" of Britain The primacy in this respect[1] belongs, we believe, to. one the author of which has lately died, and to his memory we take this occasion of offering a passing tribute. The "Ornithological Rambles in Sussex," to which was added a catalogue of the birds of that county, appeared in 1849, the work of Mr. Arthur Edward Knox, who died on September 23, 1886, having nearly completed his seventy-eighth year. Mention of this observant naturalist, agreeable author, and accomplished gentleman is all the more needed, since his death obtained scant, if any, notice in the newspapers of the day, though column after column in their broad sheets chronicled the career of a successful horse-jockey who expired not long after. Mr. Knox, it is true, never assumed the character of a man of science any more than that of a man of letters, yet his literary style was of the best, while few professed naturalists more thoroughly practised scientific methods of observation, and none could more fully appreciate scientific worth. His three works—that already named, his "Game-Birds and Wild Fowl," and his "Autumns on the Spey"—all of the kind that is usually called "popular," have some characteristics that at once distinguish them from so many others to which that epithet is commonly applied. They are always accurate, seldom trivial, and never vulgar.

To return, however, to Dr. Babington's little volume. Its value, notwithstanding some shortcomings to which we have referred, is great, and the recorded facts, with which, as already stated, it is crammed, are such as no "British" ornithologist can afford to neglect. As a final mark of attention, let us notice that Dr. Babington's scholarly instinct has inspired him with enough courage to be the first writer who has corrected an unhappy mistake made by Linnæus, and restored (pp. 200-203) the old

[1] Of course there are several other local lists of older date, from that of Markwick downwards, including "The Norfolk and Suffolk Birds" of Sheppard and Whitear; but these were published in journals (mostly in the Linnean *Transactions*), and we are here speaking of separate works the scope of which is ornithology alone.

spelling *Podicipes*, for the ungrammatical, senseless, and misleading *Podiceps*, thereby removing a reproach which every literary man could successfully cast at a zoologist. *Exemplum sequendum!*

INTERMITTENT DOWNWARD FILTRATION

Ten Years' Experience (now Fourteen Years) in Works of Intermittent Downward Filtration. By T. Bailey-Denton. Second Edition. (London: E. and F. N. Spon, 1885.)

THE treatment of sewage by intermittent downward filtration on specially prepared areas of land is now generally recognised as the most efficient method for the purification of the sewage of towns. Mr. Bailey-Denton is one of the ablest exponents of this system, and one who has had large experience in its practical application. He is also well known as being the joint author, with Col. Jones, of a well-devised scheme for treating the sewage of the metropolis on Canvey Island at the mouth of the Thames—a scheme, however, which has not been received with any sort of approval by the Metropolitan Board of Works. The Royal Commission on Metropolitan Sewage Discharge considered very fully the merits and demerits of the system, and expressed their opinion—"(1) That the process has great scientific merit, and offers valuable practical advantages for the disposal of sewage in situations where broad irrigation is impracticable, and where land suitable for filtration can be obtained. (2) That, however, it appears desirable, when the area of land is considerably reduced, that the sewage should be previously treated by some efficient process for removing the sludge. (3) That an arrangement of this kind would be applicable to the metropolis. . . ." Broad irrigation was defined by the Royal Commission to mean "the distribution of sewage over a *large* surface of ordinary agricultural ground, having in view a maximum growth of vegetation (consistently with due purification) for the amount of sewage supplied," whereas filtration means "the concentration of sewage, at short intervals, on an area of specially chosen porous ground, as *small* as will absorb and cleanse it; not excluding vegetation, but making the produce of secondary importance." On a suitable soil—a sandy loam with a small proportion of gritty gravel to quicken percolation is the best—specially prepared by surface levelling and deep under-drainage, one acre is capable of effectually purifying the sewage—without any preliminary treatment—of 1000 people, provided that the sewage is free from any large proportion of trade or manufacturing refuse, and that storm and surface waters are kept out of the sewers. The obligation to treat storm waters, which come down in the sewers in times of heavy rain, is one of the greatest obstacles in the path of any system of sewage purification, and will continue to be until all towns are supplied with a dual system of drains and sewers. One inch of rain, thrown off 100 acres, equals 2,262,200 gallons; "and if," says Mr. Bailey-Denton, "one-tenth of this quantity suddenly reaches the outfall—say, in half an hour—no mode of treatment yet devised can deal with such a quantity without injury or defect." As a rule, at the present time, despite prospective penalties for river pollution, the mixed sewage and storm water is allowed to pass into the rivers without any sort of treatment. Mr. Bailey-Denton recommends that the storm overflow be connected with osier beds. "The beds are formed in horizontal areas which serve to *check* the rapidity of flow of suddenly discharged rainfall. This check causes the deposit of the floating solid matters in the furrows, while the flood-water rises and overflows the ridges and the osiers growing on them. These beds are not under-drained in any way; their simple purpose being to clarify those excess-waters which, without the check afforded by them, would be impetuously discharged, together with everything floating in them, into the natural streams of the watershed." Mr. Bailey-Denton does not think it necessary or even desirable, in most cases, to precipitate the sludge—the minute suspended particles, organic and inorganic, of sewage—by chemical processes or depositing tanks, before the sewage is applied to the filtration beds. He does not believe that the sludge, unless mixed with solid trade refuse, under proper treatment is capable of clogging the pores of the land or of injuring vegetation. He recommends the filtration beds to be laid out in ridges and furrows—the sewage only flowing into the latter, and not being allowed to flood the ridges on which plants and vegetables are growing. The plants cannot then be injured by the deposit of the solid ingredients of the sewage on their stalks and leaves. "As soon as the deposit of sludge on the sides of the furrows is sufficient to prevent infiltration in any great degree, the sewage is withheld from the areas so affected. The sludge is then allowed to dry (partially) in the furrows, and when in a fit condition it is lifted and dug into the ridges,—as can be seen practised at Gennevilliers (Paris). The slimy matter which had appeared so considerable, and which puddled the bottom of the furrows, when in a wet state, shrinks to a skin of very insignificant thickness when dry, and is readily broken up and mixed with the soil." Still Mr. Bailey-Denton admits that the extraction of the sludge has one great advantage, viz. that "the same land will filter double the quantity of clarified sewage liquid that it would cleanse sewage of which the finer particles have not been removed;" a very important point to towns where the area of land at disposal for sewage purposes is strictly limited.

The intermittency of the application of the sewage to the filter beds is a *sine quâ non*. Each bed should have 18 hours' rest out of the 24, to allow air to follow the sewage as it percolates through the pores of the land, thereby renewing the oxidising properties of the soil—properties largely dependent, no doubt, on the life and growth of certain Bacterial organisms resident in the superficial layers of the soil, which have been shown by Warington and other observers to be the principal agents in the nitrification and purification of the nitrogenous organic matters of sewage. The assimilative power of growing plants is doubtless also a great aid in the purification of sewage, and the plan of ridges and furrows adopted by Mr. Bailey-Denton, in enabling him to raise large crops on filtration areas, has taken away from the system the reproach that it was utterly unremunerative. There can, however, be no doubt that it is in combination with surface or broad irrigation that intermittent filtration is likely to have its most useful application. In a valuable chapter on sewage farming, Mr. Bailey-Denton points

out that whatever the estimated value of sewage may be —8*s.* 4*d.* per annum per head of the inhabitants of water-closet towns, or 1⅗*d.* per ton with a dilution of 61 tons—it is actually reduced to the sewage farmer by attendant drawbacks to the present mode of application to much less than ¼*d.* per ton. The sewage must be applied to the land whether it is wanted or not, and may, under such circumstances, be the cause of mischief to crops rather than of benefit. It has been assumed that by surface irrigation one acre is capable of purifying the sewage of 100 persons; but what farmer, Mr. Bailey-Denton very pertinently remarks, would give even a farthing per ton for the obligation to apply in a year 6100 tons of liquid to an acre—equivalent to a superincumbent depth of 5 feet, or 2½ times the average rainfall—though he would gladly give a larger price per ton if he could have what he wanted, just at such times as he wanted it? "All experiences tend to prove that the obligation to 'get rid' of a large quantity of sewage under all circumstances and conditions, at night as well as day, on Sundays as well as week-days, on cropped lands as well as fallows, and at all stages of growth, from seed-time to harvest, puts it beyond the reach of man to gain any real profit from it." Many of the ordinary farm crops, as cereals, pulses, potatoes, and turnips, are injured by the application of sewage. Rye-grass, cabbages, mangolds, carrots, parsnips, and perhaps onions, are the plants that thrive best under sewage (it is said to be impossible to overdose rye-grass with sewage); but these are crops that may very readily be produced in larger quantities than there are markets for.

The great drawback, alluded to above, can be overcome by every sewage farm having specially prepared filtration areas, capable of purifying the whole sewage, when not wanted on the general surface of the farm, and leaving it within the power of the occupier to draw such quantities, at such times as he requires them, as dressings for his crops. Under such arrangements sewage farming may be expected—as it has been found by Mr. Bailey-Denton at Malvern and elsewhere—to be remunerative to the farmer and satisfactory to the town authorities. The cost of laying out the land for intermittent filtration is high—from 30*l.* to 150*l.* per acre in difficult cases, according to Mr. Bailey-Denton's estimate—but not sufficiently high in any way to counteract the immense advantages which the possession of such filtration areas confers.

A MEDICAL INDEX-CATALOGUE

Index-Catalogue of the Library of the Surgeon-General's Office, U.S. Army. Vol. VII. Insignarès-Leghorn, pp. [100] and 959. (Washington: Government Printing Offices, 1886.)

THE masterly way in which Mr. J. S. Billings is conducting this Index-Catalogue, and publishing punctually year by year these large volumes of about a thousand closely-packed pages, is a matter worth the attention not only of all interested in medicine and surgery, but also of all interested in modern libraries and modern journalistic literature. For the Library of the Office of General Robert Murray, Surgeon-General of the U.S. Army, though only founded in 1830, is now one of the largest collections of medical literature in the world, larger possibly than that of the British Museum, of the Bibliothèque Nationale of Paris, or the collections of Berlin or Vienna, and it contains some manuscripts, notably a letter of Edward Jenner's, which the English librarians would be glad to have. Its catalogue is certainly much more complete, as far as it has been published, in spite of the method of execution having been much more difficult. For these seven volumes that have been hitherto published contain more than 254,000 references to articles or essays in journals and periodicals of all kinds and in all languages, arranged under the subjects to which they refer. The French and German pleasure in framing appended bibliographies on the subjects of some monographs which they publish has never given them courage enough to face such a Herculean task. The number of periodicals which either have been or are being taken in by the Library has risen since last year, when vol. vi. was published, from 3005 to 3270, and extends through a wide geographical range, from the *Norsk Magazin* of Christiania, to the *Klin-le I-letzu* (the *Modern Medical News*) of Yedo; and in wide range of interest from the *Revue des deux Mondes*, to the *Dental Luminary* of Macon, Ga., U.S. The learned compilers of the Index-Catalogue are good enough always to translate the Japanese titles when they print them in English letters; indeed they sometimes go further, and, avoiding the difficulty of even transliterating them, give us merely the title in English, with a warning note that the original title is Japanese. Magyar is also as a rule, though not by any means always, translated; Polish sometimes, Russian only occasionally. The whole method of the book is so perfectly orderly and symmetrical, that it makes us wonder whether this want of rule in translation is one of the trifling points in which the individualism of Mr. Billings' assistants has crept in; for we cannot see that the translated titles are in any way more difficult than the untranslated.

Under the subject-headings come the great masses of quotation of the titles of articles in periodical literature which make the Catalogue so unique. If we turn to the name of an author who writes both books and papers in journals, &c., we shall not find entered under it anything but his separately published works; though, probably, all of those down to his smallest reprint from some Society's *Transactions*, and with these, in smaller type, a reference to other books to which he has contributed or which he has translated; and, if he is dead, a reference, probably, to some biography of him, and some portrait; but, beyond this, none of his contributions to journals or *Transactions*. Nevertheless, under the subject-title of any such contribution, whether it be Jaundice, Jealousy, or Jequirity, will be found a reference to his article if it was signed, and his name, in bold type, clearly standing out among the mass of contributors to that branch of knowledge. It would have been possible, of course, to print such references twice over—once under the heading of the author, and again under the subject-title; but we can hardly wonder that that has not been done, as it would have added some five or six thousand pages to a series of volumes already in danger of being overweighted, and, also, it would have supplied information which is of more importance to the biographer than to medical science.

Of the subject-titles in this volume, the largest is Labor, under which, in 150 pages, a very complete library is catalogued of some 1500 books and 10,000 articles, well arranged under many headings. Under Kidney, the student will probably be content to find references to about 400 books and 2500 articles.

It is easy to show the vast extent of the work attempted and executed; that there are absolutely no inaccuracies in the result is hardly possible, difficult as it may be to find them. The references in this volume certainly stand many tests, and most of those who have made frequent use of the previous six volumes in practical work have acquired a confidence in their accuracy which is very rare in dealing with such an immense mass of varied languages and types and abbreviations so thickly interspersed with figures.

Both the Library and the Index-Catalogue are brought fully up to date. The volume is presented to the Surgeon-General of the U.S. Army in a letter of preface dated June 1, 1886, and it contains the books and periodical references practically complete up to the end of 1885. If any comparatively modern subject is examined, *e.g.* kairine, we find nothing said or known of it before 1882, and yet 120 references, taking us over all the published literature of the subject, down to the end of 1885.

This seventh volume includes the entries from Insignarès to Leghorn. It is likely to be the middle volume of this encyclopædic work; and certainly if Mr. Billings is able to publish his last and concluding volume in 1892 no one who has any interest in the progress of knowledge will hesitate to congratulate him and his colleagues even more heartily, if it be possible, than at present.

A. T. MYERS

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.*]

Sounding a Crater, Fusion-Points, Pyrometers, and Seismometers

THE account given by Prof. John Milne of his ascents and attempts at sounding the crater of Asama Yama is exceedingly interesting, and I can thoroughly sympathise with him in the difficulties he encountered, having been exposed to them on many occasions, and not always coming off so victoriously. He and Mr. Dun, however, have been forestalled by the late Robert Mallet. When I came to Naples some eight years since, I found in one of the store-rooms of the geological department of the Naples University a quantity of apparatus which I soon made out the use of.

It appears that Mallet had this apparatus made especially for the purpose of measuring the temperature and studying the gases and the lava itself within the mouth of the volcano Vesuvius. On his arrival in Naples the state of the mountain did not permit of the experiments being carried on, and the whole of the materials were left in charge of Prof. Guiscardi, who could give no other information than the above. By carefully studying the apparatus I was soon able to understand Mallet's intentions and the mechanism he intended to employ. There are two drums of small wire cable—one for traversing the crater to hold a pulley over the "*bocca*," and the other for letting down the weight and crucible. The crucible is of cast iron with a bayonet-jointed cover, and is, no doubt, intended to contain substances of different fusibilities. The apparatus is, however, an improvement on that used in Japan, in that the sounding-rope is insulated and there is an electrical bell and battery so arranged that when the crucible enters the lava it makes an earth-contact and rings the bell. There are other pieces of apparatus that I could not get at, but I think they are intended for chemical researches.

From these facts it will be seen that Prof. J. Milne has been forestalled as far as the method is concerned, but no experiments were ever carried out, either by Mallet on account of failing health, or by those in whose hands the apparatus fell. I made application to be allowed to use the apparatus, but for various reasons was unable to.

Before leaving this subject, may I appeal to your readers for a list of substances the fusion-point of which is known, and all of which would be above a dull red heat? I should like to have as complete a series as possible, so as to obtain results confined within narrow limits. Also any suggestions as to the best form of pyrometer that might be forced into and held in a stream of flowing lava, and that would not be injured by the breaking off of the rocky crust on its removal.

May I be permitted to make a few observations on the question lately raised about the authorship of certain seismographs? Not long since I described in your pages certain instruments that I considered as likely to be useful in such violent earthquakes as shake Ischia from time to time. With the exception of two, no claim was made to originality of principle, and yet I received through your pages a severe scolding from Prof. Ewing. Now if we really go into the literature of the subject we shall find the horizontal pendulum is not the invention of Prof. Ewing, but his present form of seismograph is one of the best applications of such a contrivance for measuring the horizontal component of an earth-wave, and I think he is justified in calling it *his seismograph* in so far as the present model goes. If we did not allow so much, no man using a vertical pendulum, however well contrived and modified, could call such *his*. At any rate I shall leave Prof. Milne, Prof. Ewing, and Mr. Gray to fight their own battle, but Prof. Ewing has fallen into the very same error of which he not long since accused me.

Naples, December 20 H. J. JOHNSTON-LAVIS

The Recent Earthquakes

MAY I ask to be allowed to call attention to some points in relation to the two earthquakes mentioned in your issues of December 9, p. 127 ("Volcanic Eruption in Niua-Fu, Friendly Islands"), and December 16, p. 157 ("Earthquake at Sea"). As regards the first, it is stated that "The whole island has been in a disturbed state for some three months and a half, the dates of the principal disturbances coinciding remarkably with those which are going on in other parts of the world—earthquakes on June 8 and 11, which, I think, are the dates of the first New Zealand outbreaks. . . . This is, of course, not wonderful; but the final catastrophe here took place on August 31, which, we understand, was the exact date of the recent American earthquake. It was preceded for twenty-four hours by earthquakes, and went on for ten days."

Assuming the synchronism of the Tonga eruption and earthquakes with those of the North Island of New Zealand, there is this very interesting relation between the two localities, that they both lie very near to a great circle which I may designate as the "West Coast of Africa Great Circle." This passes through, or near, the following points:—

Cape of Good Hope to St. Helena Bay; mouth of River Orange; Walfish Bay; Cape Martha; Cape Lopez Gonzalez; Bonny River; Algerian coast, near Nemours; south-east coast of Spain, near Almanzora; north coast of Spain (3° 25′ W. long.); west coast of Ireland (Loop Head); southern point of Iceland (near Westmanna Island); north-west point of Iceland; Greenland, Cape York; Melville Island (south coast and point of); Bering Island; Cape Dalhousie and coast-line of Liverpool Bay; Alaska, Montagu Island; Tonga Island (half a degree to west of Tonga Tabu); New Zealand, north-east point of North Island; passes between Adelie Land and South Victoria Land; Enderby's Land. It may be remarked that several of these localities are noted for disturbances both volcanic and seismic.

As regards the "earthquake at sea" mentioned in your number of the 16th inst., the position where it was felt is given as N. lat. 19° 21′, and W. long. 64° 22′; this gives a point about 93 miles north-east of Porto Rico. The interest in this

case lies in the fact that the antipodal point corresponding, being S. lat. 19° 21′ and E. long. 115° 38′, lies about 100 miles north by east of Barrow Island, off the west coast of Australia. It is further interesting to note that the line which joins this point with the southern point of Barrow Island fairly represents the direction of the coast-line at this point, and leads to the presumption of the existence of main lines of faulting there having that direction. To this relation of antipodean points in connection with earthquakes I have already had occasion to call attention.

J. P. O'REILLY

Royal College of Science, Dublin, December 22

Barnard's Comet

THIS comet has been observed here with the 7½-inch refractor, with power 50, than which no higher power could be used with advantage.

On December 19, at 18h., it appeared as bright as a 2nd magnitude star similarly situated; the nebulous head was about 10′ in diameter, with central condensation of perhaps half a minute. The "position" of the principal tail was estimated to be 0°: it remains of a parallel breadth throughout, and does not increase in breadth as it recedes from the head of the comet; this constant breadth is equal to the diameter of the nebulous head, that is to say, 10′. By sweeping, this tail may be traced to a distance of some 10° from the head.

The secondary tail is inclined at an angle of between 30° and 40° to the principal one, and fades away rapidly at a distance of perhaps 1° from the head; it is well defined on the preceding side, but on the following side it melts away into a nebulous mass connecting it with the principal tail for some distance from the head.

On the 27th, at 19h., the comet was decidedly less bright than on the 19th, but the same general description applies.

The "positions" of the two tails were measured, and were: the principal tail, 15°·5; the secondary, 338°; the included angle, 37°·5 ± 0°·5. The secondary tail did not appear as well defined, on the following side, as on the 19th.

Finlay's comet presents no visible feature of interest.

WENTWORTH ERCK

Shankill, co. Dublin, December 28

Electricity and Clocks

IN the absence of any details, apparently Mr. Wilson's simplest plan would be to insulate the hammer and bell of his "small striking clock," and arrange that a galvanic current should pass through both, when they come in contact by the act of striking: this current of course to be directed to a large electro-magnet, to raise the hammer for striking on his bigger bell. Should the striking of Mr. Wilson's smaller clock be on a gong with a leather-beaked hammer, a separate attachment must be made for contact.

HENRY DENT GARDNER

Lee, S.E., December 26

P.S.—If a longer contact be desired, the hammer whilst at rest should repose upon a weak spring, and be kept away from a banking; when the hammer rises, contact will ensue between the spring and banking, and last until the hammer falls again.—H. D. G.

Seismometry

THERE are one or two points in Prof. Ewing's letter on the above subject in the last number of NATURE which seem to call for a few words of reply.

(1) As to the alleged inconsistency between what I wrote in 1881 and what I wrote in my last letter. The remark quoted referred to a light pivoted frame carrying at its centre of percussion, relatively to the axis through its pivot, a pivoted mass. There was no "if need be" about this mass: it was an essential part of the system. I believe the remark I then made was perfectly correct and in no way inconsistent with my remarks in 1886.

(2) As to the vertical-motion instrument, the lever with spring joint used at Comrie in 1842 does not at all resemble the rigid lever working on knife edges and supported by springs as introduced by me and used by Prof. Ewing. On the question of compensating the lever by the addition of negative stability, I have nothing to add to what I stated in my last letter.

(3) As to the publication referred to by Prof. Ewing, the memoir printed by the Tokio University is probably, from the circumstances of its publication, hardly known to anybody. The "Encyclopædia Britannica" article is not, in my opinion, a fair account of what has been done in seismometry.

THOMAS GRAY

7, Broomhill Avenue, Partick, December 27

The Recent Weather

AT Cardross, half-way between Dumbarton and Helensburgh on the Clyde, at about 25 feet above sea-level, in an outer lobby with a temperature of say 45° to 50° F. at 9 a.m. on Wednesday, the 8th inst., the mercurial barometer stood at 27·51 inches, which, with reduction of say 0·02 added for elevation, and say 0·03 subtracted for temperature, would make it 27·50 inches. On January 26, 1884, it stood at 27·39 inches, which with like reductions would give 27·38 inches. These are nearly as low as those you refer to in your number for last week.

Cardross, Dumbarton, December 23 R. B. W.

OBSERVATIONS OF NEBULÆ AT ARCETRI[1]

M. TEMPEL observes under difficulties. The Arcetri Observatory possesses, it is true, two fine refractors by Amici, one of 11, the other of 9⅛ inches aperture; but neither is, properly speaking, available for astronomical use. The smaller is rudely set up on an open and uneven terrace, exposed to every gust of wind, and, at the most, serves to display the wonders of the heavens to curious visitors. Amici I. is duly ensconced in a revolving dome, but clockwork motion is wanting; the circles, both of declination and right ascension, are (strange as it may seem) *undivided;* and when the necessarily somewhat unwieldy instrument is, with infinite pains and without so much as the aid of a handle, pointed towards the object sought, there is actually no means of clamping it in the position so laboriously arrived at! That M. Tempel, under circumstances so discouraging to him and disgraceful to the responsible authorities, should have executed a number of valuable drawings of nebulæ, should have re-observed many such objects neglected, or even believed to have disappeared, since the elder Herschel's time, besides discovering a good proportion of new ones, gives astonishing proof of his keenness, zeal, and accuracy. All the more, nevertheless, there is reason to regret that qualities so rare should be employed at such cruel disadvantage for want of the judicious expenditure of a couple of thousand francs.

The paper before us is accompanied by reproductions of two admirable drawings by the author, one of the Orion, the other of the "Crab" nebula (Messier I.). The latter is of especial interest, as disclosing a feature unnoticed by any previous observer. This is a dark cleft right through the central condensation, dividing it along the major axis into two spindle-shaped nebulæ. Incipient fission would seem to be indicated. On the same plate with his own, M. Tempel has engraved five earlier drawings of the object, by J. Herschel, D'Arrest, Lassell, Secchi, and Lord Rosse. The comparison is instructive, if somewhat disheartening; for, assuredly, no two of the six confronted delineations could be supposed, on an unprejudiced inspection, to have been inspired by one original. Yet the nature of that original sufficiently explains the discrepancies. The apparent form of nebulæ depends upon almost evanescent gradations of diffused faint light, and differs, for each individual eye, with its sensitiveness to them. And since personal equation, as regards such gradations, is shown by many proofs to be enormously large, a vast amount of detailed variation in the representation of the objects exhibiting them becomes intelligible. It is, then, a circumstance of pecu-

[1] "Ueber Nebelflecken. Nach Beobachtungen angestellt in den Jahren 1876-79 auf der Königl. Sternwarte zu Arcetri bei Florenz." Von Wilhelm Tempel. Abhandlungen der Königl. Böhm. Gesellschaft der Wissenschaften. VII. Folge, 1 Band. (Prag, 1885.)

liarly good omen for progress in the study of nebulæ that a mode of record at once so fluctuating and so laborious as that of hand-drawing should be replaced (as it will no doubt soon wholly be) by automatic impressions which, with some points of inferiority, at least leave no room for "individualism."

M. Tempel's description of the Merope nebula (discovered by himself in 1859), and his remarks on the great elliptical mass in the girdle of Andromeda, derive particular interest from recent events. His observational faculty, and the high quality of his telescope, are illustrated in the disclosure to him, by Amici I., of nearly 900 stars in the Pleiades, all of them comprised within the field of view of a 4-inch Steinheil bearing a magnifying-power of 24. With the former instrument he detected independently on September 30, 1875, a few days before reading Bond's description of them, the strange obscure channels in the Andromeda nebula; and has since with some difficulty made out similar markings in some small nebulæ of the same class. They would accordingly appear to be a more or less characteristic feature of "oval" nebulæ, and might perhaps be assimilated to the symptoms of partial duplication in Messier I.

In respect to the nature of nebulæ, our author's experience leads him decidedly to adopt the view of their close connection with stars. He shows, indeed, for spectroscopic evidence a disregard that is neither philosophic nor just; yet his contention that *purely gaseous* nebulæ do not exist, is probably well founded. No aggregation of celestial mist, at any rate, has ever been observed by him in which his 11-inch failed to reveal the pricking light of minute stars, marking some knot or nucleus, and thereby evincing structural relations of a most intimate kind.

THE MATHEMATICAL TRIPOS[1]

III.

WHEN the interval between the earlier portion of the examination and Part III. had been extended to a year, it became evident that some substantial relief must be afforded to the examiners. By the existing regulations a person who accepted the office of Moderator would have to take part in the examination in three consecutive years, and in his second year of office he would have to examine the candidates of one year in Part III. simultaneously with those of the year below in Parts I. and II. This led to the consideration of the whole question of the appointment of examiners. The two Moderators in each year are nominated by two colleges, according to a prescribed cycle of fifty years. This nomination by colleges, though theoretically not very defensible, had worked very fairly so long as the examination only included subjects with which any high wrangler might be expected to be acquainted; but it was clearly unsuitable for Part III. In any case the nomination of the four examiners by four independent bodies might easily bring about the result that among the various subjects included there would be some which had not been made the object of special study by any of the examiners: indeed there was nothing to prevent the four examiners being all pure mathematicians or all physicists. Accordingly, with a unanimity almost unique in matters relating to the Tripos, the Board recommended in a Report dated June 15, 1885, that the examiners for Part III. should be quite distinct from those for Parts I. and II., and that all four should be nominated by the Board. It was also proposed that they should hold office for only one year. This Report was sanctioned by the Senate on October 29, 1886. In future, therefore, the Moderators will not take part in the highest portion of the examination. The appointment of Moderators dates from 1680. Previously the Proctors had themselves presided in the schools, but in that year the duty of conducting the disputations was transferred to the Moderators, who were specially appointed to perform this office. The Moderators have always been, and still remain, high University officers, ranking next to the Proctors.[1] Not only were they the earliest examiners in the University, but it is to them that we owe the origin of the examination system. Their severance from a portion—and that the highest portion—of the examination is therefore a notable event in the history of the Tripos. Neither the Board nor the University would have agreed lightly to such a break in the traditions of the Senate House examination, had it been possible to retain the Moderators as examiners for the final part without altering the system of nomination by colleges. The complete separation of Part III. from the earlier parts of the examination was, however, inevitable. Many members of the University who would discharge most admirably the duty of examining for Parts I. and II. would shrink from Part III.; and the professors and specialists who were best fitted to examine in Part III. would generally be reluctant to undertake the heavy burden of examining all the candidates for Parts I. and II., especially in two consecutive years.

Thus, by the irresistible pressure of events, it has come to pass, in the last few years, that not only the titles of wranglers, senior optimes, and junior optimes have lost their old significance and refer only to the earlier examination, but that even the more ancient title and office of Moderator has undergone a similar restriction. The final part of the examination has indeed made rapid progress: within three years of its first coming into existence it has emancipated itself from union with the earlier parts, and become an independent examination.

Besides these important innovations, the Senate sanctioned at the same time a slight change in the nomenclature of the Tripos, the earlier portion of the examination, previously called Parts I. and II., upon which the list in order of merit depended, being designated Part I., and Part III. being henceforth designated Part II. This change was made in order to bring the nomenclature of the Mathematical Tripos into harmony with that of the Classical and other divided Triposes.

As soon as Part II., to adopt its new name, became an independent examination, the Board directed its attention to the schedule of subjects relating to it. The existing schedule contained only those subjects which had been included in the schedule which came into operation in 1873, when the results of the whole examination were still expressed by one final list, arranged in order of merit. Now that Part II. was a separate examination, and that there was no order of merit, the reasons for the limitation of the subjects had been entirely removed. Although the theory of elliptic functions, which dates only from the publication of Jacobi's "Fundamenta Nova" in 1829, was included, the theory of numbers, which had its origin in Gauss's "Disquisitiones Arithmeticæ" of 1801, was still excluded. Abelian functions, the theory of functions of a complex variable, projective geometry, and quaternions were not formally included by name, and questions on these subjects could only be set, if at all, by straining the meaning of the title of some other subject. Besides the total exclusion of certain branches of pure mathematics, a further reason for revising the existing schedule was afforded by the fact that the four groups A, B, C, D were very unequal both in magnitude and popularity among the students. According to the existing regulations the four groups had to be equally represented by questions,

[1] Address delivered before the London Mathematical Society by the President, Mr. J. W. L. Glaisher, M.A., F.R.S., on vacating the chair, November 11, 1886. Continued from p. 157.

[1] It is still the custom for the list of wranglers, senior optimes, and junior optimes to be shown to the senior Proctor on the evening of the day before it is read in the Senate House. This is doubtless a relic of the fact that the Moderators were originally the substitutes of the Proctors. It has been already mentioned that the Proctors, as well as the Vice-Chancellor, used to have the right to insert a certain number of names where they pleased in the Tripos list.

and this led to a great waste of examining power, many questions having to be constructed each year upon subjects which none of the candidates had studied. The Board accordingly formed a schedule in which all the subjects of pure and applied mathematics were included —none being intentionally omitted. These were divided into eight divisions, the first four relating to pure mathematics, and the last four to applied mathematics. To avoid the waste of questions that would ensue from the examiners having to represent all the subjects in the papers in each year, they proposed that before the first day of December preceding the examination the names of the candidates and of the divisions and subjects in which they desired to be examined should be forwarded to the Registrary of the University. The examiners would thus be made acquainted with the subjects which the candidates had studied, and would be able to frame their questions accordingly. Changes were also proposed with respect to the candidates who were admissible, and to the form of the final list. By the existing regulations only wranglers were allowed to present themselves for examination in Part II., and the list was arranged in three divisions; there was no separation into *classes*, because, as only wranglers were admissible, it was considered that all the candidates were first-class men from the beginning. The new proposals were, that the restriction which admits only wranglers should be removed, and that the candidates should be divided into three classes, each class being subdivided into as many divisions as the examiners in each year thought proper. In previous schemes the endeavour of the Board had been to frame regulations that would tempt the students to specialise their reading. A few years had made so great a difference that, with a view to prevent undue specialisation, the Board now inserted a regulation to the effect that proficiency in subjects taken from more than one of the divisions should be requisite in order that a candidate might be placed in the first class.

The Report containing these proposals was confirmed by the Senate on May 27, and it is noteworthy that both this Report and its predecessor, in which the nomination of examiners was placed in the hands of the Board, were sanctioned without opposition of any kind. The latter of these Reports also made a few minor changes, the most important of which was the omission of the problem paper which had been still retained, from the old five days, in the scheme of 1882.[1] The examination in Part II. had assumed such a character, that the kind of questions to which one would usually apply the name of problems was no longer in keeping with the contents of the other papers.[2]

Under the new scheme, in which all the examiners were to be appointed by the Board with special reference to their collective fitness for conducting the examination in Part II., there was no further need for an Additional Examiner, and this office was, accordingly, discontinued.[3]

Thus has the Mathematical Tripos been divided into two parts; and thus has surely arisen in the University a mathematical examination of a higher type than has been known before, or could have existed under any system in which all the candidates for mathematical honours were required to be examined by the same papers throughout. For those who study mathematics for the sake of exact knowledge or mental discipline, and who propose to go forth into the world to follow professional or other careers, the first part secures all the old stimulus to industry, and gives to those who are successful the same stamp of intellectual distinction as before: such students are released at the end of their third year to enter upon the active duties of their lives, equipped with a sound understanding of the principles of the exact sciences, and with minds well trained to accurate habits in reasoning and in the acquisition of knowledge. To those whose attachment to our science lies deeper, and whose studies have carried them beyond its threshold, the second part, at the end of their fourth year, affords an opportunity of distinction of a higher kind, and one more suited to their tastes: no longer is the wise and thoughtful student hopelessly distanced in the Tripos race by his quick and ready rival.

The wants of the candidate whose mathematical career closes with the last paper in Part I., and of the candidate whose mathematical life only begins from this moment, are equally provided for by the new scheme. The order of merit relates to an examination that can bear it. All the subjects included in Part I. are such as ought to be the common property of every one who has received a sound mathematical education; and by the results of an examination in subjects which all the candidates should have read a list in order of merit can properly be formed. The specialist for the first time is set free to follow his own tastes, and give his whole heart and time to the branches of mathematics by which he is attracted. The University permits him to select any subjects he pleases from the whole range of pure and applied mathematics, and undertakes to examine him in them and award to him the credit he deserves for his attainments. A perfectly free choice is given to him, subject only to the one condition that, in order to qualify himself for admission to the first class, he must not select all his subjects from a single division.[1]

But what to us as mathematicians is more than all, as bearing on the future of our science, is that now for the first time will it be possible in Cambridge for an able and earnest worker and teacher to interest and engage his pupils in his work, and found a school such as we are so familiar with in foreign Universities, where the presence of a great professor has been almost invariably marked by a succession of illustrious pupils—pupils worthy of their master, and worthy to carry on his work. Think of the school of arithmeticians founded by Gauss at Göttingen, and how impossible such a result would have been at Cambridge, dominated as she has been by the competition for places in the Tripos! Great as has been the value to the University of the order of merit—as a stimulus to industry, an encouragement to thoroughness in mathematical study, and a paramount influence in regulating elections to Fellowships at colleges where no independent examination existed—it has yet been in recent years a deadly enemy to the spread of research and the advance of our science. Throughout his whole career the student has had to devote himself unremittingly to the work for his Tripos, taking up a fresh subject each term, and often having to read two in one term. He could never pursue any subject far enough to reach the really interesting portions of it, or obtain complete

[1] Although the Board were unable to make any recommendation upon the subject, I may mention that the principle of prefixing to the final three days a preliminary day, in which the subjects of examination should be those parts of higher pure mathematics which are needed in mathematical physics, found a considerable amount of favour on the Board. The proposal, however, was found to be more difficult in execution than was anticipated (partly on account of the impossibility of forming a perfectly satisfactory schedule of subjects for this day), and was ultimately abandoned by most of its original supporters.

[2] In the first examination in Part III., in 1883, the examiners set, as one of the question papers, a paper of essays; and their example was followed by the examiners in 1884, 1885, and 1886. These essay papers were introduced merely on the authority of the examiners, and not in consequence of any new regulation. Experience seems to show that the essay paper affords very little additional assistance in ascertaining the relative merits of the candidates. The essays were, perhaps, more useful at first, when they were a novelty.

[3] Unless the office should be revived at some future time, there will therefore have been only one Additional Examiner for the final part of the examination, viz. in 1886, the last occasion of the examination taking place in January.

[1] This condition would be complied with by the candidate's showing proficiency in one subject taken from one division and in one other subject taken from one other division. The intention of the Board was to discourage students from specialising too narrowly at too early a period. Some of the divisions (as, for example, the fourth, which contains only projective geometry and analytical geometry of curves and surfaces) are so restricted that it was considered undesirable that students should be allowed to confine themselves entirely to subjects chosen from a single division.

command over its methods: he was always occupied with something new, starting afresh and gaining familiarity with new principles, new processes, new modes of thought. Many of the higher lecturers in the University were necessarily neglected by the students: they could pay but scant attention to any subject which was not adequately represented in the Tripos, and even in the case of the subjects which were so represented they were tempted to pass lightly over those investigations, however important, which from their length and character were unsuitable for reproduction in an examination. Now, however, all this is history. When a good course of lectures upon any high subject is given in the University, those students who have attended the course will send in that subject as one on which they desire to be examined: it will, therefore, be properly represented by questions; and the subject will become one that will be increasingly studied year by year. It will now be possible for any capable mathematician, by means of his lectures, to gather pupils round him who will bring his subject into prominence, and make it one of special study in the University.[1] It has been said that in mathematics we have in England generals without armies: the great men who are independent of circumstances have arisen among us, but where are the rank and file? It is my belief that the great obstacle to the existence of the rank and file has now been removed.

Whatever else it may be, Part II. is at all events a "limiting form." No wider choice of subjects could be given to the candidates; no greater freedom to the examiners. The schedule of subjects includes all mathematics: the examiners may issue any kind of list. By introducing numerous divisions into the classes they may make it approximate as closely as they please to an order of merit; or, on the other hand, they may make it merely a class list. They are empowered to give to their list just such a form as they feel justified in doing by the results of the examination. In the appointment of examiners, also, the limiting form has been reached, all four being nominated by the same University authority, and holding office for one year only.

With respect to Part I., it may be that the ultimate form has not yet been reached. There are some who think that, as in some other Triposes, the students should have the option of becoming candidates at the end of their second year. It would seem, also, that the range of subjects is rather too restricted; and, as may be inferred from what I have said near the beginning of my address, I should myself like to see the elementary portions of elliptic functions included in the schedule of Part I. Still, these are but minor points; and I think that the principle of subjecting all the candidates for mathematical honours to one and the same examination in comparatively elementary subjects, and arranging the list in order of merit, meets with general approval.

A few years ago, when the old Tripos was exerting its stifling influence upon the higher mathematical studies of the Universities, I felt disposed to welcome the abolition of the order of merit as the lesser of two evils; but now that the Tripos is divided, and that the mathematician has his own examination especially framed for him, I should be sorry to see a modified class list substituted for the order of merit in Part I. A severe competition for places has the great advantages of keeping the candidates closely employed, and extracting from them their best work. At present an immense amount of thoroughly good mathematical work is done in the University. We have received from our predecessors a system under which the principles of mathematics are efficiently taught, the powers of the students are exerted to the utmost, and upwards of a hundred persons each year receive a mathematical education which is in some respects unique. These are substantial advantages which should not lightly be jeopardised or exchanged for others that are problematical. Under any other system I think the quantity and the quality of the mathematical work done in the University would suffer. It should be remembered also that there is no subject in which the knowledge of a candidate can be so readily tested by examination as in mathematics, and that in no other subject can the results of an examination be expressed with such certainty and accuracy by an order of merit.

I believe there are indeed but very few who have graduated in the Tripos who would set a slight value upon the advantage which their mathematical training has been to them throughout life; and on the other hand I think that it has been an indirect benefit to our science that among those who have won distinction in public and professional life there have always been some—and those not the least influential or eminent—who have passed through an extensive and thorough course of mathematical study, and to whom our world of symbols is no *terra incognita*. The fact that our results, unlike the conquests of astronomy and other branches of applied mathematics, can only be expressed by means of a language of their own, requiring years of study, imposes of necessity such narrow limitations upon the numbers of our audience that we cannot be insensible to the advantages of any system by which the power of understanding and appreciating the beauties of our science is extended to others external to our own ranks. Under the new scheme these advantages are still retained; and, difficult as is the problem of combining a mathematical course for the many with the technical requirements of the few, I believe that a satisfactory solution has rewarded the efforts of the last twenty years. I believe that the University of Cambridge will become a great centre of mathematical research and a home of the exact sciences, and that it will be found that these objects have been attained without any sacrifice of the general efficiency of the training received by the bulk of the candidates for mathematical honours.

On taking a survey of the history of the Tripos during the last half century, perhaps the feature that stands out most strongly is the part played by the subjects of electricity and magnetism—their half-recognised existence before 1848, their exclusion until 1873, and the effects which followed their restoration in that year. It was the extension of the dominion of mathematics over these great and growing branches of physical science that broke down the old system. Electricity and magnetism became too important to be excluded; but when included the examination in its old form was too heavily weighted to exist.

The year 1877-78, in which the syndicate of 1877 was endeavouring to frame a scheme that should relieve the strain of the excessive competition without sacrificing the order of merit, was perhaps the most eventful period in the whole history of the examination: it then became evident that it was impossible to retain the existing system even in a modified form, and that a complete reorganisation of some kind was inevitable. Although the frequent changes in the last few years have been productive of some inconvenience, I think it is fortunate that the syndicate was so reluctant to propose any sweeping changes, and that the present scheme has come into existence as it has done—not as the work of any influential legislator, but as the form which the examination has of itself assumed under the pressure of the actual forces at work in the University. The order of merit for the whole examination was not given up till it was clearly shown that its retention was an impossibility; and, on the other hand, Part II. has grown up by a process of regular development, and been moulded into

[1] In the schedule for Part II. no subjects are ignored or favoured less than others, so that by the new scheme provision is made for the growth of any subject which may happen to take root.

its present form by those most interested in promoting the higher mathematical studies of the University.

Special reference also should be made to the "three days." It will be remembered that this preliminary portion of the examination was the principal feature of the scheme which came into operation in 1848. Both the subjects and the methods of solution that may be employed are defined by a schedule, and only those who satisfy the examiners by their performances in these three days are admitted to the subsequent parts of the examination. It is very singular that an arrangement devised so long ago should not only still continue in force, but even be regarded by some as the most thoroughly satisfactory portion of the whole system. The framers of this scheme and schedule might well have been proud of the lasting character of their work if they could have known that it would outlive two sets of University statutes, and, amidst changes on every side, remain unchanged for forty years.

The early history of the Tripos and its gradual development into an examination by written answers, and finally by printed papers also, are especially interesting in these days, when the merits of the examination system are so highly appreciated, and its adoption is so universal. The Senate House at Cambridge is the cradle of the modern form of examination in England.

In connection with the Tripos there is one matter of so much importance that I cannot pass over it entirely without mention. I mean the influence of the system of private tuition. I believe that while there is an order of merit it will always be a great assistance to the majority of the candidates to read with a private tutor. Mathematics is a difficult science; and when a considerable range of subjects has to be traversed in a comparatively short time, and the knowledge of the candidate has to be finally tested by an examination such as Part I. of the Tripos, it cannot fail to be a great advantage to him to have his difficulties explained, his path smoothed, and his skill in working out problems developed, by an experienced private tutor specially interested in his individual welfare. The system of private tuition has been objected to from two points of view: (1) because it is unsatisfactory that the instruction which is valued most highly by the student should be received from his private tutor instead of from college lecturers or University professors; and (2) because the student who has followed implicitly, during his whole undergraduate career, the minute directions of one man with regard to his reading, is placed after his degree, when he is deprived of his guide, in a very unfavourable position for pursuing further his mathematical studies. The first objection does not concern us here: my own feeling is, as I have just said, that, whenever an order of merit exists and the competition for places is keen, the services of private tutors will necessarily be called into requisition. The second objection is one which is of far more importance to our science. There can be no question that, brilliant and eminent as have been the greatest of the private tutors at Cambridge, one result of the system has been that many of the ablest students have been left after graduation not only without any knowledge of the way to follow up the study of the subjects of which they had learned the elements, but even without any taste or inclination to do so. The private tutor's manuscript and verbal instruction had superseded all need of referring to the original memoirs, and the nascent wrangler knew nothing of the great world of mathematical literature or of the modes of reaching it. On the other hand, it is only fair to say that the amount of mathematical knowledge acquired by the best pupils from their private tutors in the course of their undergraduate career was really wonderful; and that till quite recently neither the University nor the colleges offered any inducement to the mathematical student to continue his reading after the Tripos. The fact that the student's horizon should have been bounded by the Tripos, and that his training should have been directed with the view to giving him skill in working out questions rather than to developing his taste for the science he was studying, was principally the fault of the system as a whole; but it was certainly intensified by the complete subjection of the pupil to the course of reading placed before him by the private tutor. A student whose interests and aspirations had been at least held in check, and perhaps entirely stifled, throughout his whole undergraduate career, was generally too subdued or helpless to be able to make use of his freedom when the examination was over.

Under the new scheme the private tutor still occupies in the main his old position with respect to Part I., although, of course, the higher places in this examination have much less significance than before. With respect to Part II. it is quite different. No attempt is made by private tutors to teach these higher subjects, which, both from their character and extent, are clearly unsuited for private tuition; and the students are compelled to rely upon the lectures delivered in the colleges and University in their preparation for this final examination. Thus, in their fourth year they are brought into contact with the leading mathematicians in Cambridge; and when the examination sets them free to pursue their own studies or researches, they start on their new career fresh from the best teaching which the University affords.

Although the subject of my address is the Mathematical Tripos, it may be regarded as still falling within my province to refer to other changes that have taken place in the University for the purpose of encouraging original mathematical work. Fourteen years ago Trinity College invited mathematical candidates for Fellowships to send in, before the examination, dissertations upon any subjects of their own selection. It was announced that these dissertations, if possessed of decided merit, would be taken into account in the Fellowship election, together with the results of the Fellowship examination. Not only have these dissertations been of the greatest value in guiding the choice of the electors, but many of them have been important contributions to mathematical literature.[1] The example of Trinity College has been recently followed by St. John's College and King's College. The Smith's Prizes, which for a great number of years had been awarded by a special examination, are now awarded annually for mathematical dissertations, the candidates being free to select their own subjects. This new scheme passed the Senate on October 25, 1883, and the first award of the prizes under it was made in 1885. Powerful inducements are, therefore, now held out by the University and some of the colleges for the best students to devote themselves to original work. The importance to our science of these direct incentives to research cannot be overestimated. They come into operation as soon as the stimulus of the examination is removed, and, instead of resting upon their laurels, the ablest mathematicians of the year are induced to concentrate their powers upon a single subject, just at the time when they are undaunted by any amount of hard work, when their stock of general mathematical knowledge is freshly acquired, and when their minds are flexible, vigorous, and free from care. It is indeed strange to look back upon the changes of the last few years, and to contrast the encouragement now

[1] Among the Trinity dissertations which have subsequently been printed, I may mention the late Mr. R. C. Rowe's "Memoir on Abel's Theorem" (*Phil. Trans.*, 1881), Mr. Forsyth's "Memoir on the Theta Functions" (*Phil. Trans.*, 1882), Mr. Homersham Cox's "Application of Quaternions and Grassmann's Ausdehnungslehre to different kinds of Uniform Space" (*Camb. Trans.*, 1882), Mr. Gallop's "Distribution of Electricity on the Circular Disc and Spherical Bowl" (*Quart. Math. Journ.*, 1886), and Mr. R. Lachlan's "Systems of Circles and Spheres" (*Phil. Trans.*, 1886).

given to mathematical research with the indifference, or even worse, of twenty years ago.[1]

I cannot close my address without saying a few words upon our Society. We were founded in 1865, and so to-day we attain our majority. I think we can safely say that we have steadily and uniformly kept to our single purpose of promoting the advance of mathematics. We have published seventeen volumes of *Proceedings*, and every paper we have printed has been subjected to a rigorous examination by two referees. We already have a history to look back upon: familiar presences among us—De Morgan, Clerk Maxwell, Clifford, Henry J. S. Smith, Spottiswoode—have passed away; and for most of us this very room is full of associations with those whom we shall see no more. I should like before concluding to formally express our gratitude to our two Secretaries, Mr. Morgan Jenkins and Mr. Robert Tucker, who have served us so faithfully almost from our foundation, and to whom the successful development of our Society has been largely due. I will not utter any aspirations with regard to our future: we shall never be a great Society in numbers, but we can continue to do what we have done, and to spare no effort to encourage the advance of mathematical science.

THE INTERNATIONAL COMMITTEE OF WEIGHTS AND MEASURES

THE results of the scientific investigations made under the directions of the Comité International des Poids et Mesures at their Bureau at Sèvres during the past year are stated in vol. v. of their "Travaux et Mémoires," recently published (Gauthier-Villars, Paris, 1886) under the authority of the Director of the Bureau. This volume contains the following papers:—"Note sur l'étallonage des sous-divisions d'une règle, sur l'étude des erreurs progressives d'une vis micrométrique, et sur le calibrage des thermomètres," by Dr. O. J. Broch; "Études thermométriques," by M. Ch. Ed. Guillaume; "Études sur la balance," by Dr. M. Thiesen; "Sur quelques analyses chimiques faites pour le Bureau International," by M. Tornöe. The two latter memoirs, however, are published under the responsibility of their authors.

In the method of calculating the errors of the subdivisions of a standard measure of length, or of calibrating a thermometer, Dr. Broch has followed the celebrated astronomer P. A. Hansen; but he has endeavoured to render Hansen's method more simple; and he has abbreviated it and reduced the number of observations, without increasing the probable error of the results obtained. Convenient tables of equations are given for the more ready application of Hansen's formula, and also examples of an abbreviated method for calculating the several lengths of the decimetres, centimetres, and millimetres on a subdivided standard metre.

The second part of this Note deals with the progressive errors of the micrometer-screw. As each interval to be measured on a linear standard is contained within two lines, we have to pass by successive turns of the micrometer-screw from one line to the other. Each line in turn is bisected by means of cross or of parallel webs; and not only do the personal errors of bisection have, of course, to be allowed for, but even small errors in the micrometer-screw itself have to be corrected. Examples of such corrections are given in this note. In considering the progressive errors of micrometer-screws, we are not sure that Dr. Broch has sufficiently, however, investigated the variation in the amounts of such errors owing to the wear of the screw.

In the third part of the note is given an explanation of an abbreviated method of calibrating graduated glass tubes or thermometer-stems, and of applying corrections to the calibrated lines. The method of interpolation by differences is also discussed and simplified.

Dr. Guillaume, in his "Études thermométriques," continues the thermometric work which was begun by Dr. Benoit, and by Pernet at this Bureau. It is required of all standard thermometers verified at the Bureau, that they should carry the fundamental points 0° and 100° C.; that they should have a total length of as much as 70 centimetres, the diameter of the stem varying from 3·5 to 5·5 millimetres; and that each division should be nearly 5 millimetres in length. The testing of the thermometers includes the three distinct operations:—

(1) Division and calibration.

(2) Determination of the coefficient of pressure (when the thermometer is placed alternately in a vertical and in a horizontal position).

(3) Determination of the fundamental points and of the mean value of each degree.

It is with these operations, as well as with the actual verification of certain standard thermometers at the Bureau since the year 1883, that Dr. Guillaume now deals. The paper is an interesting one, and all the observations are printed in the fullest detail. Particularly in that part of this paper which discusses the variations in the readings of thermometers by time and circumstance, there is much to be learnt.

Of late, attention has been given, especially in Germany, to the kind of glass best adapted for thermometers, the zero-points of thermometers made of some kinds of glass, being found less likely to alter by age like ordinary thermometers. A careful analysis made by M. Tornöe of the glass used for the bulbs of two of Tonnelot's thermometers used at the Bureau, gave the following results:—

	Hard glass	Plate glass
Silica	71·52	60·68
Sulphuric acid	0·72	0·37
Chlorine	traces	—
Peroxide of iron	0·22	—
Lime	14·55	5·44
Soda	10·81	10·50
Potash	0·37	6·55
Magnesia	traces	traces
Protoxide of manganese	traces	—
Oxide of lead	—	15·12
Alumina	—	—
Alumina, with traces of iron and manganese	—	0·87

The analyses of the stems of the thermometers showed somewhat different results.

The memoir by Dr. Thiesen, "Études sur la balance," continues the excellent work on the construction and use of the balance which was originally begun at the Bureau by M. Marek. In the "Théorie générale de l'équilibre statique de la balance," and in the "Calcul de l'équilibre de la balance," Dr. Thiesen has discussed the conditions which affect the equilibrity of a balance, and also has investigated the effects of outside influences during weighings, as those arising from currents of air and from changes in the condition of the air; and from electrical disturbances, magnetic and radiometric. A good balance may be relied on to 0·001 mgr. in the comparison of two standard kilogramme weights, but outside influences increase the probable error to ± 0·004 mgr.

The labours of the Bureau have been particularly devoted to the perfecting of existing methods, and they have resulted in the attainment of far higher accuracy in weighing and measuring than was thought to be possible, or necessary, even ten years ago. We trust that the labours of the Comité may soon be crowned by the completion of the international metric standards of length and weight, for which all their present investigations are preparatory.

[1] Under the old system, the Cambridge graduate who devoted himself to mathematical research possessed one advantage over his Continental colleagues in the wider range of his general mathematical knowledge. Although Part I. is considerably more restricted than the Tripos of 1848-72, this advantage is still retained to a substantial extent.

NOTES

MR. C. L. GRIESBACH, lately geologist to the Afghan Boundary Commission, and deputy superintendent of the Geological Survey of India, has been appointed by the Viceroy to officiate as superintendent.

THE annual meeting of the Association for the Improvement of Geometrical Teaching will be held on Friday, January 14, 1887 (11.30 a.m.) at University College, Gower Street. At the afternoon meeting (2 p.m.) the following papers will be read :—"On the Teaching of Modern Geometry," Rev. G. Richardson ; "The Modern Treatment of Maxima and Minima," Rev. J. J. Milne ; and on "Geometry from an Artist's Point of View," G. A. Storey, A.R.A. The meetings are open to all who are interested in the objects of the Association.

OUR readers will be interested to hear that at the meeting of the British Association recently held in Birmingham, a movement was originated in the Committee of Section D (Biology) having for its object an application to Government for a small grant out of the Civil List to Mr. Thomas Bolton of Birmingham, whose important services to science as a naturalist and microscopist have long been well known and appreciated. A memorial setting forth Mr. Bolton's claims was prepared by Mr. W. R. Hughes, late President of the Birmingham Natural History and Microscopical Society, and was signed by Sir J. W. Dawson, the President of the British Association, and by a large number of eminent men of science. It also received the signature of the Mayor of Birmingham. The memorial was recently presented to Lord Salisbury as First Lord of the Treasury, who has recommended that Her Majesty grant Mr. Bolton a Civil List pension of 50*l.* per annum.

THE finest of all Japanese botanical books is the Honzo Dsufu. It is also from a scientific point of view the most valuable, inasmuch as it contains excellent coloured figures of no less than 1500 species of Japanese plants, of many of which there are no other published representations. Franchet and Savatier, in their "Enumeratio plantarum in Japonia sponte nascentium," quote throughout the copy in their possession, which was not, however, quite complete. It is in ninety-six volumes, or rather *livraisons*, and is rare even in Japan. It was prefaced in 1828, but only the first six *livraisons* have ever been printed, and the rest only exists in hand-made copies. It has long been desired to obtain a copy for the library of the Royal Gardens, Kew, and this wish has at length been gratified by the kind liberality of Mr. Tokutaro Ito, grandson of the well-known Japanese botanist, Keisuke Ito. Mr. Ito is now studying botany at the University of Cambridge, and lately communicated a revision of Japanese *Berberidaceæ* to the Linnean Society, of which he has recently been elected a Fellow. The Kew copy of the Honzo Dsufu is probably the finest to be obtained in Japan. It came from the library of Senator Tanaka (himself a distinguished botanist), who, with extraordinary generosity, placed it at the disposal of Mr. Ito for presentation to Kew.

IN the *Annalen* of the Vienna Natural History Museum, Herr von Pelzeln and Dr. von Lorenz have just published the first of a series of articles on the types of birds contained in that Museum. This cannot fail to be of the greatest use to students, who often require to know the present resting-place of typical specimens. Following the Cuvierian arrangement as adapted by Gray in his "Hand-list of Birds," the authors present, as a first instalment, a list of the types of the *Accipitres* and *Tenuirostres*. The chief interest naturally centres round the species procured by Johann Natterer in Brazil, for nothing more wonderful is known in the history of ornithology than the way in which Natterer's collections, made in the early part of the present century, still remain the basis of our knowledge of the ornithology of that country, and, notwithstanding the subsequent efforts of travellers, there are numbers of Brazilian species obtained by Natterer alone, and unrepresented in any Museum except that of Vienna. Curiously enough, too, the Vienna Museum also possesses several of Latham's and Shaw's types, founded on the specimens in the Leverian collection, and purchased in 1806. The value of a type was not understood in England so long ago as 1806, and the specimens were allowed to leave the country, to find a home in Austria. Such would scarcely be permitted now, under the enlightened management of our authorities at the Natural History Museum at South Kensington, who are doubtless mindful of the disgrace attaching to the British Museum in former years, when that institution allowed the whole of the Gould collection of Australian birds, with its 300 types, to go for 1000*l.* to America, where it now lies, scarcely heeded, in the Museum of the Academy of Natural Sciences of Philadelphia. Let us hope that the Gouldian types are better looked after in the Philadelphia Museum than some of the types of Du Chaillu's Gaboon species, which are no longer forthcoming, to the no small embarrassment of ornithological students.

PROF. MENZBIER has recently published, in the *Bulletin* of the Society of Naturalists of Moscow, an account of the birds collected by Mr. Zaroudnoï, a Russian naturalist, who has been exploring the oasis of Akhal-Tekké, the Kara-Kum desert, and the adjacent mountains, in Central Asia. The want of funds appears to have crippled the efforts of the traveller to a great extent, but he managed to procure 184 different species of birds, though his observations were confined to the summer months and early autumn. Mr. Zaroudnoï found several rare species nesting, and besides his own observations there are some interesting scientific notes from Prof. Menzbier's pen. We are informed that the traveller has recently prosecuted a further expedition into Khorasan and Northern Afghanistan, the results of which may be expected to be of considerable importance to zoologists.

THE *Auk*, which is the journal of the American Ornithologists' Union, and answers to our English *Ibis*, has just completed its third volume, under the able editorship of Mr. J. A. Allen, who is the President of the American Ornithologists' Union. The present volume abounds in interesting memoirs, and fully maintains the high standard of the journal. The Union now numbers 46 active members, 112 associate members, 26 foreign members, and 59 corresponding members. The Committees on the Migration and Geographical Distribution of North American Birds and for the Protection of North American Birds have both done excellent service during the past twelvemonth.

MR. G. H. HINSBY, of Hobart Town, has forwarded us a useful list of the birds of Tasmania : 178 species are found in the island, but the author is apparently unaware that several Tasmanian birds to which he gives the same scientific name as the Australian species are considered by recent writers to be peculiar to Tasmania itself.

A RECENT issue of the *Japan Weekly Mail* contains a report of the Japan Educational Society, an association founded to bring together persons interested in education, to assist in its diffusion, and to improve and advance education in the country. Besides general and ordinary meetings in furtherance of the objects of the Society, members are frequently sent to various localities at the request of local educational institutes for the purpose of delivering addresses or lectures. Thirty-three numbers of the memoirs have been published, the total number printed being 100,000. In addition, books under the title "Hints to Educators" were published, and 7000 copies printed. The number of members is 3000, and a prince of the Imperial House is President.

UNDER the title of a "Descriptive List of Native Plants of South Australia recommended for Cultivation," Mr. J. G. Otto Tepper, F.L.S., has reprinted in pamphlet form some notes that apparently appeared periodically in Adelaide. As a reason for publishing the list Mr. Tepper says:—"At the rate South Australia and its sister colonies are progressing in civilisation, the time can easily be foreseen when for long distances from any centre of population not a mark would be discoverable where any one could view the native vegetation in its natural state. Owing to the very local distribution of many Australian herbs, shrubs, and trees, there is even the possibility that they may be entirely extirpated, caused by ruthless and ill-judged clearing, depasturing of domestic animals, choking by introduced weeds, and the diminution of the moisture in the soil by the first two causes. Few attempts are made to cultivate any, so far as we know, though a few (for example *Kennedya monophylla*) have already found their way to the favour of gardeners, who, perhaps, do not even know that these plants are indigenous." The list consists of a number of plants belonging to very different natural orders and of very different characters, such as herbs, trees, shrubs, &c., as may be instanced by species of *Mesembryanthemum*, *Viola*, *Acacia melanoxylon*, &c., &c. To each plant its habit and size are given, a short description of the leaves and flowers, time of flowering, and nature of locality where found. The descriptions, however, are by no means equal in point of detail, some being considerably longer than others. To some of the plants the natural orders are stated, while to others no mention whatever is made. No references are made to the uses of the plants, and no kind of arrangement of genera has been adopted, either scientifically, alphabetically, or in any other way. The list may be of use to those for whom it has been written, but it would have been more valuable if some arrangement had been adopted by which any given plant could have been found without wading through the whole nineteen pages.

MR. STEVENS, the Queensland naturalist whose visit to the Veddas of Ceylon we have already mentioned, addressed a recent meeting of the Asiatic Society of Ceylon on this little-known people. He found the time at his disposal on his first visit too short to investigate satisfactorily the problem of their origin, but he intends going amongst them for another six months on his approaching return from India. He has offered to live with them for a year or two if such a long absence from his other duties can be arranged. He regards the popular notion in Ceylon of the Veddas as a cruel, vindictive, suspicious people as wholly erroneous. He found them truthful, hospitable, and honest, but they exhibit a marked aversion to Singhalese and Tamils. They are very peaceful, and hence a European can travel amongst them in perfect safety and freedom. They have a language of their own which the Singhalese do not understand, and of which he collected a considerable number of words for examination by Oriental scholars. They are expert archers, and can send an arrow completely through a wild animal. Mr. Stevens would prefer to face a rifle in the hands of an experienced person at fifty yards' distance rather than a Vedda armed with his bow. They have no idea of boiling anything; they use the fire-drill, and they appear to have had sufficient knowledge of working in metals to supply themselves with weapons. He questions whether there are 500 Veddas in all Ceylon, so that soon it will be difficult to find a real one. Hence he urges the great importance to science of a thorough study now of their language and habits. Demonology is, he thinks, an incorrect term to apply to their religion; it is, rather, "Kapuism." They do not believe in the existence of any injurious or malevolent spirits. Once a year the whole of a Vedda encampment make a propitiation; it is not worship, but simply a propitiation to the eight or nine gods of their pantheon. They divide themselves into eight clans, which rank in a kind of social gradation, depending, in some instances, apparently on their traditional origin. He obtained skulls of representatives of seven of these clans. Throughout the address, Mr. Stevens constantly insisted on the tentative nature of his investigations so far. His facts, "or, rather, supposed facts," are entirely unverified. They require assortment and further examination, and he urges societies and students in Ceylon to undertake the work. It is greatly to be hoped that Mr. Stevens himself may be able to carry out his project of residing amongst the Veddas for a prolonged period, and studying them from the inside, and, in a certain degree, as one of themselves. One of his facts requires no verification, viz. that he can live and travel amongst them with safety, and that he has the capacity for making friends of them.

M. DE QUATREFAGES, at a recent meeting of the Geographical Society of Paris, advanced the theory with regard to the migration of peoples at a remote period of antiquity, which, at a subsequent meeting, was discussed and approved by M. H. Chevalier. The theory is that these migrations were due essentially to the gradual increase of cold in the northern regions, which forced the inhabitants to wander to the south in search of a more temperate climate. M. Chevalier quoted certain passages from the Zend Avesta, which, he argued, corroborated this theory.

A PROSPECTUS has been issued by the Council of the "Lochbuie Marine Institute" on the Isle of Mull, recently established under the auspices of the National Fish Culture Association, setting forth their objects. One of these is to incubate herring-ova to re-stock such locations in Scotland as have been depleted of that fish through the action of fishermen in exhausting the supply under the belief that they were general instead of local. Meteorological and other observations are also to be carried out under the direction of Mr. Anderson Smith.

DR. FOREL sends us the following list of recent earthquakes in Switzerland:—December 16, 16h. 0m., at Sarnen (Unterwalden); 22, 0h. 3m., 4h. 20m., and 5h. 30m., at Pontresina (Grisons), all Greenwich time.

WE have referred on several occasions to the extraordinary number of rats which emerge from various parts of the building when the late Exhibitions at South Kensington have closed and the supply of food is cut off. This year their number has been larger than ever, and shortly after the termination of the late Colonial and Indian Exhibition the rats, desperate with hunger, invaded every part. During the summer nothing would induce them to enter traps, whereas now they rush in as fast as they are set, and not until they have devoured the bait do they seem to realise the fact that they are prisoners, when they seek deliverance in their usual wild fashion. During last week their cravings for food culminated in a fierce onslaught upon one another, which was evidenced by the piteous cries of those being devoured. Their method of seizing their victim is to suddenly make a raid upon one weaker or smaller than themselves, and after overpowering it by numbers, they tear it in pieces. At the present time there cannot be found a single young rat in the building. So far this is satisfactory, as the large numbers bred during the summer will thus become exterminated.

AT present the city of Worcester possesses a public free library and natural history museum in one building, and a Government school of art in another. It is proposed to celebrate the Queen's Jubilee by establishing an institution to be called the Victoria Institute in a central position in the city, in which the existing library, museum, and school of art will be placed, and to unite with them in the same building a school of science and an art gallery. The cost is estimated at 18,000*l.*, of which the Corporation have voted 7000*l.*, and the old site and other sources of income will leave only about 5000*l.* to be raised by

public subscription. A considerable portion of this amount has already been raised.

A LATE issue of the Batavia *Dagblad* contains a report of a paper read by Dr. Cornelissen, of the Java Medical Service, before the Society for the Advancement of Medical Science of Java, on his researches in Acheen, in Sumatra, into the causes of the dreaded disease *beri-beri*, known as *kakke* in Japan—a species of elephantiasis. Dr. Cornelissen comes to the unexpected conclusion that it is infectious, and is propagated by bacilli. He accordingly recommends a thorough system of disinfection in hospitals and troop-ships where patients suffering from this malady have been kept. The theory has caused much excitement in Java and the neighbouring regions where the disease prevails, for it has not hitherto been suspected that it was infectious. Dr. Cornelissen's theory, however, does not appear to be generally accepted in Java and the Straits Settlements.

IN the current number (27) of *Excursions et Reconnaissances* of Saigon, M. Aymonier brings to a conclusion his notes on Annam, the particular province dealt with being Khanh-Hoa. The most interesting part of the paper is the sketch of the so-called savages, or Mois, inhabiting the mountains of the province. These papers have now been running through many numbers of the periodical, and are encyclopædic in their nature. M. Aymonier is, beyond question, the greatest living authority on Cochin China generally, and he undertook prolonged journeys into various parts of the country with a view to perfecting his information for this series. His original intention was to explore the whole coast of Annam up to Tonquin, but the rebellion of 1885, which resulted in frightful massacres of missionaries and native Christians, prevented him from carrying out this project. Accordingly in his "Notes" he has been compelled to omit all reference to the ancient kingdom of Ciampa, as well as to a great part of Annam, and to confine himself to the two great southern provinces Binh Thuan and Khanh-Hoa, which stretch from Ciampa on the coast across to Cambodia. Capt. Réveillère, who has already twice navigated the Meikong rapids in a gunboat, describes a voyage on that river in a steam-launch. The Meikong can scarcely be said to be a new river to geography, inasmuch as the greater part of its course was described with great minuteness in the work recounting the details of La Grée and Garnier's expedition from Saigon along the Meikong to the Yangtsze, published ten or twelve years ago. Father Azemar describes the Stiengs, amongst whom he lived between 1861 and 1866, and gives a vocabulary of their language. The Stiengs form one of those wild tribes which inhabit the mountains between Cochin China and Tonquin on the east and Laos and Siam on the west. The writer thinks they have no ethnic affinity with the Mongol family, mainly basing his opinion on differences in language and manners.

PERHAPS the most important point to be noticed about the Perthshire Society of Natural Science, the *Proceedings* of which for the past year we have received, is that the present method of publication has been abandoned. For six years past the *Proceedings* have, for the most part, been reprinted from the reports of the meetings which have appeared in a local newspaper. But the selection and arrangement of matter most suited to a newspaper were not always the best adapted for the *Proceedings* of a scientific Society. The Council have, therefore decided to commence a new series of *Transactions* and *Proceedings*, which will be specially printed for the Society, under the supervision of a publishing Committee. An examination of the *Proceedings* now before us certainly reveals so much activity in many departments of research that the Council appear justified in this resolution. It is especially noticeable that the papers read refer, almost without exception, to local investigation —in our judgment the most valuable and instructive work in which the members of such a Society could systematically engage. Thus, we have some notes on a collection of nests and eggs presented by a local landowner; a thorough description, by several hands, of the natural history of Kinnoull Hill, under the heads of Introductory, Geology, Flowering Plants, Ferns, Mosses and Fungi, Insects, Mollusca, and Vertebrates, and many others of the same kind. Dr. Buchanan White's address this year, as last, urges the improvement of the museum, with a view to securing more space for the exhibition of the collections. He dwells on the value of a properly selected and arranged museum as an educational medium for the members of the Society, and, quoting the words we used last year in regard to this subject, that a local museum, to be of the fullest value, should be made as complete as possible, he explains what degree of completion he expects such a museum to attain.

WE have received the *Proceedings* of the Holmesdale Natural History Club, with its home at Reigate, for 1884 and 1885. The papers are of a very general kind, ranging from the continuity of protoplasm to the wild animals of South Africa, and from mahogany to the Yellowstone National Park. Students will probably turn with most interest to two papers by Mr. W. H. Beeby on recent additions to the flora of Surrey, Mr. Tyndall's meteorological notes for the two years, and Mr. Crosfield's paper on the geographical distribution of wild plants in the British Isles.

THE Town Council of Bombay has unanimously resolved that the municipality must bear its share, with the Government and other public bodies, in the expenses of the establishment of a technical school, and a sum of 5000 rupees was voted for the purpose at a late meeting. The scheme is one drawn up by Dr. Cooke, Principal of the Poona College of Science, and explained by him to the Council. The skilled artisans, he said, turned out by the school would be a benefit to the country and to the municipality alike.

THE additions to the Zoological Society's Gardens during the past week include an Indian Rhinoceros (*Rhinoceros unicornis* ♂) from India, presented by the Maharajah of Cooch Behar; a Tiger (*Felis tigris* ♂) from India, presented by the Zoological Gardens, Calcutta; a Chanting Hawk (*Melierax musicus*) from South Africa, a Red-throated Diver (*Colymbus septentrionalis*), European, presented by Lord Lilford, F.Z.S.; a Short-eared Owl (*Asio brachyotus*), British, presented by the Rev. Hubert D. Astley, F.Z.S.; ten Moorish Geckos (*Tarentola mauritanica*) from the borders of the Mediterranean, presented by Mr. J. C. Warburg; three Zebus (*Bos indicus* ♂ ♂ ♂) from India, a Montagu's Harrier (*Circus cineraceus*), European, deposited.

OUR ASTRONOMICAL COLUMN

THE SPECTROSCOPIC METHOD OF DETERMINING THE DISTANCE OF A DOUBLE STAR.—Mr. A. A. Rambaut, in a paper communicated to the Royal Irish Academy on May 24, discusses at some length the possibility of determining the distance of a double star by measures of the relative velocities of the components in the line of sight by means of the spectroscope. Of course, as soon as Dr. Huggins had demonstrated that it was practicable to measure the rate of approach or recession of a star, it was seen that it would be at least theoretically possible to determine the distance of a star by this method, but Mr. Rambaut does not merely repeat the suggestion, but examines the conditions of the problem that he may ascertain what chance there is of putting it into successful operation. His first step is to find the value of πV for the satellite star of any binary system, π being the parallax in seconds of arc, and V the velocity of motion in the line of sight expressed in miles per second. The resulting formula is—

$$\Pi V = \frac{la^2\sqrt{1-\epsilon^2}\cdot\sin(\phi-\lambda)\sin\gamma}{Pr\sqrt{1-\epsilon^2\cos^2\phi}} = k,$$

where ϕ denotes the angle between the tangent and major axis,
λ denotes the angle between the line of nodes and major axis,
γ denotes the angle between the plane of orbit and tangent plane to sphere,
P denotes period in years,
l denotes mean motion of earth in miles.

This equation therefore gives a relation between Π and V depending only on the period and the angular elements of the orbit, so that if either Π or V can be measured the other may at once be determined. If k be greater than unity, then either V must exceed ten miles per second, or Π one-tenth of a second of arc. If, then, the spectroscope show the lines in the spectra of both stars to be absolutely coincident, it follows that the parallax must exceed 0″·1, and the star will repay investigation. But if a measurable displacement be noticed, V can be determined, and the parallax will follow at once. So that "all double stars for which k is at any time greater than unity may be said to be within measurable distance either by the spectroscopic or the trigonometrical method." If, however, k be less than unity, the star may still chance to be within a measurable distance, for V may be small either from the small linear dimensions of the orbit or the length of the period; but if k be smaller than unity, and V be large, then we shall at once know, "with a certainty which the mere failure to measure its parallax trigonometrically could never reach, that the star is at an inconceivable distance from the solar system." Mr. Rambaut next proceeds to determine k for some 39 stars, the elements of whose orbits he takes for the most part from Houzeau's "Vade Mecum." In the case of five only does it exceed unity, viz., α Centauri 6·023, Sirius 5·400, 70 Ophiuchi 1·270, η Cassiopeiæ 1·247, and γ Coronæ Australis 1·224. Of these the parallax has already been determined for all but the last named. This star, the components of the pair being of nearly equal magnitude, would be well adapted for examination by the spectroscopic method if one of the new giant telescopes were employed, and since $k = 1{\cdot}224$, had it been examined in 1880 either the velocity in the line of sight would have been found to exceed 12 miles per second, or the parallax to exceed 0″·1. Since a star fainter than the fifth and a half magnitude would be beyond the reach of even the most powerful instrument to successfully measure its movement in the line of sight, the field of inquiry is practically confined to α Centauri, and the following three stars for all of which k is fairly large though less than unity: ξ Ursæ Majoris 0·895, γ Virginis 0·624, and ζ Herculis 0·605. The result of Mr. Rambaut's inquiry is therefore to show that but little practical use can be made of the suggested combination of the two methods in the case of double stars.

NAMES OF MINOR PLANETS.—The following minor planets have recently received names:—No. 254, Augusta; No. 255, Oppavia; No. 257, Silesia; No. 260, Huberta; and No. 261, Prymno.

COMET FINLAY (1886 *e*).—Dr. J. Holetschek gives (*Ast. Nach.*, No. 2763) the following elements and ephemeris for this object, which, though now diminishing somewhat in brightness, becoming well placed for observation in northern latitudes:—

T = 1886 November 22·48418.

$\omega = 315\ 21\ 0{\cdot}5$
$\Omega = 52\ 45\ 43{\cdot}2$ } Mean Eq. 1886·0.
$i = 3\ 1\ 9{\cdot}4$

$\log q = 9{\cdot}997122$ $\log a = 0{\cdot}533468$
$\log e = 9{\cdot}850744$ Period = 6·31 years.

Ephemeris for Berlin Midnight

1887	R.A. h. m. s.	Decl. ° ′	log r	log Δ	Brightness
Jan. 0	23 49 17	1 2·3 S.	0·0565	9·9245	2·3
4	0 8 58	1 23·7 N.	0·0670	9·9343	2·1
8	0 28 10	3 45·0	0·0779	9·9461	1·9
12	0 46 52	5 59·9 N.	0·0889	9·9598	1·7

The brightness at the time of discovery is taken as unity.

COMET BARNARD (1886 *f*).—The following ephemeris for Berlin midnight is in continuation of that given in NATURE for December 9 (p. 134):—

1887	R.A. h. m. s.	Decl. ° ′	log r	log Δ	Brightness
Jan. 0	19 32 32	4 5·2 N.	9·8652	0·1478	10·5
5	19 53 52	1 13·5 N.	9·8935	0·1845	7·8
10	20 11 46	1 20·1 S.	9·9243	0·2177	5·8

The brightness at the time of discovery is taken as unity.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 JANUARY 2–8

(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 January 2

Sun rises, 8h. 8m.; souths, 12h. 4m. 14·9s.; sets, 16h. 1m.; decl. on meridian, 22° 55′ S.: Sidereal Time at Sunset, 22h. 49m.

Moon (at First Quarter) rises, 11h. 56m.; souths, 18h. 12m.; sets, oh. 38m.*; decl. on meridian, 2° 25′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	6 41	10 39	14 37	22 38 S.
Venus ...	8 41	12 36	16 31	23 5 S.
Mars ...	9 34	13 52	18 10	19 35 S.
Jupiter ...	2 10	7 16	12 22	11 11 S.
Saturn ...	16 35*	0 40	8 45	21 49 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

Jan.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
4	μ Ceti	4	20 28	21 33	87 348
5	*f* Tauri	4	17 21	18 24	48 293
6	71 Tauri	6	18 50	19 7	359 334
6	θ^1 Tauri	4½	19 47	21 2	68 295
6	θ^2 Tauri	4½	19 54	20 55	47 316
6	B.A.C. 1391 ...	5	21 2	22 19	108 289
6	85 Tauri	6	22 19	near approach	27 —
7	Aldebaran ...	1	0 17	1 15	165 283
7	111 Tauri	5½	19 51	near approach	340 —
7	115 Tauri	6	20 53	22 6	95 261

Jan. h.
2 ... 20 ... Sun at least distance from the Earth.

Saturn, January 2.—Outer major axis of outer ring = 46″·4; outer minor axis of outer ring = 18″·5; southern surface visible.

Variable Stars

Star	R.A. h. m.	Decl. ° ′			h. m.	
U Cephei	0 52·3	81 16 N.	...	Jan.	2, 0 3	*m*
				,,	6, 23 43	*m*
λ Tauri	3 54·4	12 10 N.	...	,,	5, 2 12	*m*
S Cancri	8 37·5	19 26 N.	...	,,	5, 1 40	*m*
U Hydræ	10 32·0	12 48 S.	...	,,	5,	*M*
R Crateris	10 55·0	17 43 S.	...	,,	6,	*m*
S Leonis	11 5·0	6 4 N.	...	,,	6,	*M*
W Virginis	13 20·2	2 48 S.	...	,,	2, 4 0	*M*
δ Libræ	14 54·9	8 4 S.	...	,,	3, 19 41	*m*
				,,	6, 3 33	*m*
U Coronæ	15 13·6	32 4 N.	...	,,	7, 2 14	*m*
U Ophiuchi	17 10·8	1 20 N.	...	,,	4, 4 18	*m*
		and at intervals of			20 8	
W Cygni	21 31·8	44 52 N.	...	Jan.	4,	*M*
δ Cephei	22 25·0	57 50 N.	...	,,	4, 20 0	*M*

M signifies maximum; *m* minimum.

Meteor-Showers

The principal shower of the week is that of the *Quadrantids*, maximum January 2, radiant R.A. 228°, Decl. 53° N. Other showers are as follows:—From the borders of Gemini and Cancer, R.A. 119°, Decl. 16° N.; near θ Ursæ Majoris, R.A. 140°, Decl. 57° N.; near ζ Bootis, R.A. 220°, Decl. 13° N.

NOTES FROM THE OTAGO UNIVERSITY MUSEUM

IX.—*On the Nomenclature of the Brain and its Cavities*

IN working at the brain of the lower Vertebrata, the inconvenience of the received terminology of the cerebral cavities became so manifest, that I adopted the plan[1] of distinguishing each cavity by the simple expedient of placing before the syllable *cœle* (κοῖλος, κοιλία) the prefix used for the corresponding division of the brain in the systematic nomenclature adopted in Quain's "Anatomy." Thus, the entire cavity of the mid-brain of fishes, for which the usual names "aqueduct of Sylvius" or "iter a tertio ad quartum ventriculum" were unsuitable, became the *mesocœle* or cavity of the mesencephalon, the "lateral ventricles," the *prosocœles* or cavities of the prosencephala, and so on. A similar but more thorough-going reform had been previously and independently proposed by Burt Wilder (*Science*, ii., 1881, pp. 122 and 133), and adopted in Wilder and Gage's "Anatomical Technology" (New York, 1882). Prof. Wilder was good enough to write to me on the subject, and, after some correspondence had passed between us, he published an article[2] giving a full account of the nomenclature he proposed to adopt, and stating that certain of his terms (*e.g. neurocœle* for the entire cavity of the cerebro-spinal axis, and *encephalocœle* for the entire system of brain-cavities) had been proposed by me.

The chief features in Wilder's nomenclature are the following :—

(*a*) The adoption of *diencephalon* in preference to the more cumbrous *thalamencephalon* as the systematic name of the 'tween-brain (*Zwischenhirn*). The former term is given as a synonym by Allen Thomson (Quain's "Anatomy," ninth edition, vol. ii. p. 828), and is used by Rolleston in "Forms of Animal Life." In correspondence with this, the third ventricle becomes the *diacœle* (*thalamocœle*, mihi).

(*b*) The adoption of Quain's name of *epencephalon* for the cerebellum (*Hinterhirn*), and of *metencephalon* for the medulla oblongata (*Nachhirn*). Huxley's term, *myelencephalon*, for the latter division, is rendered inconvenient, to say the least, from the fact that it is used by Owen to designate the entire cerebro-spinal axis. The fourth ventricle is called the *metacœle* (*mvelocœle*, mihi), and the cerebellar ventricle the *epicœle* (*metacœle*, mihi).

(*c*) The word prosencephalon is used in the same sense as by Quain, *i.e.* as including the whole of the fore-brain proper (*Vorderhirn*). Both Owen and Huxley, on the other hand, use this term as synonymous with cerebral hemisphere, *i.e.* speak of paired prosencephala. In correspondence with this, the entire cavity of the fore-brain is called the *prosocœle*, and the lateral ventricles themselves *procœles* (*prosocœles*, mihi).

(*d*) The unpaired cerebral rudiment of the embryo is distinguished as the *protocerebrum*.

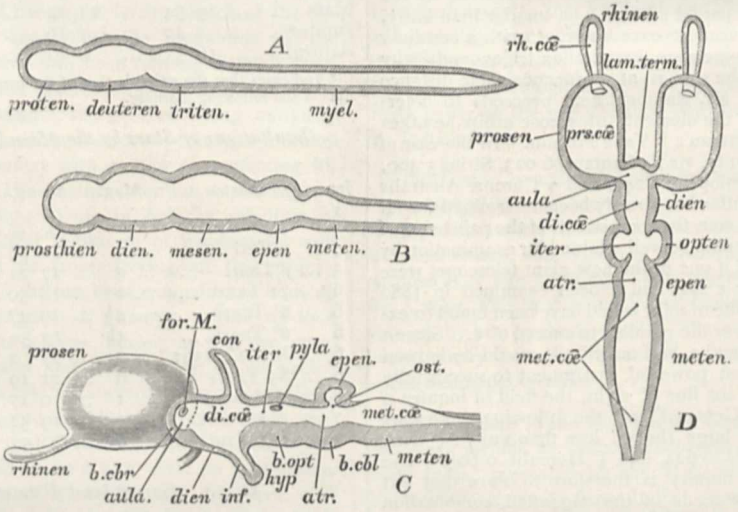

FIG. 1.—Diagrams showing three chief stages in the development of the nervous system. A, the *neuron* is divided into *myelon* and *encephalon*, the latter being again divided into the three primary vesicles, *protencephalon*, *deuterencephalon*, and *tritencephalon*. Similarly, the *neurocœle*, or general cavity of the neuron, is divided into *myelocœle* and *encephalocœle*, and the latter, again, into *proto-*, *deutero-*, and *trito-cœles*. B, the brain now consists of five encephalomeres, the *prosthi-*, *di-*, *mes-*, *ep-*, and *met-encephala*, containing respectively the *prosthio-*, *dia-* *meso-*, *epi-*, and *meta-cœles*. C, D, the brain has assumed its permanent form, and is shown in C in vertical, in D in horizontal section. The prosthiencephalon has sent out paired prosencephala, a small unpaired portion, the *basicerebrum* (*b.cbr*), being left, the latter being bounded in front by the lamina terminalis (*lam.term*). Each prosencephalon has further given rise to a *rhinencephalon*. Similarly, the prosthiocœle now consists of unpaired *aulæ* and of paired *proso* and *rhino-cœles* (*prs.cœ*, *rh.cœ*), the former communicating with the aula by the foramina of Monro, or portæ (*for.M.*). The diacœle is continued above into the conarium (*con*), below into the infundibulum (*inf*) with the hypophysis (*hyp*). The mesencephalon consists of an unpaired ventral *basi-opticus* (*b.opt*), and of paired *optencephala*; its cavity of a median *iter*, and of paired *optocœles*, which communicate with the iter by the *pylæ*. The epencephalon is divided into a dorsal portion, the cerebellum, or epencephalon proper, and a ventral division, the *basi-cerebellum* (*b.cbl*), containing a cavity, the *atrium* (*atr*), which communicates with the epicœle proper, or cavity of the cerebellum, by the *ostium* (*ost*). The metencephalon and metacœle (*met.cœ*) have undergone but little alteration.

(*e*) The unpaired portion of the fore-brain, left by the budding-off of the cerebral hemispheres, is not specially named, but its cavity is termed the *aula*. This is a large and distinct cavity in some sharks (*e.g. Scymnus*, Fig. 2), but in the higher forms becomes the Y-shaped passage between the third and the lateral ventricles. This passage is sometimes spoken of as the "foramen of Monro," but the latter term is more correctly applied to the aperture between each of its anterior limbs and the corresponding lateral ventricle: this aperture Wilder calls the *porta*.

(*f*) The specialised cavities in the optic lobes of Amphibia and Sauropsida are called *optocœles*, the name *iter* (abbreviation of "iter a tertio ad quartum ventriculum") being retained for the unpaired portion of the *mesocœle* or entire cavity of the mid-brain. The iter communicates with each optocœle by a small aperture, the *pyla*. No name is given to the ventral portion of the mesencephalon after formation of the optic lobes, *i.e.* the part usually known by the awkward plural designation *crura cerebri*.

(*g*) The ventral portion of the epencephalon, the fibres of which become the pons Varolii in mammals, is called the *præ-oblongata*, the word *post-oblongata* being used as a synonym for metencephalon or medulla oblongata in the restricted sense.

(*h*) The entire cerebro-spinal axis is called the *neuron*, its cavity the *neurocœle*.

(*i*) The name *encephalocœle* is applied to the entire system of brain-cavities, or to the single cavity of the undivided embryonic encephalon.

(*k*) The name *myelocœle* is applied to the central canal of the myelon. This cavity is also distinguished into a lumbar dilatation, the *rhombocœle* (sinus rhomboidalis) and a contracted portion, the *syringocœle*.

[1] "Notes on the Anatomy and Embryology of *Scymnus lichia*," *Trans. N.Z. Inst.* xv. (1882), p. 222; "A Course of Instruction in Zootomy," London, 1884.

[2] "Encephalic Nomenclature," *New York Medical Journal*, xli. (1885), pp. 325 and 354.

This scheme I propose to modify in certain particulars. For the sake of clearness I give diagrams (Fig. 1) showing three important stages in the development of the brain, as well as drawings of the brain of *Scymnus lichia* (Fig. 2). The latter shows with such diagrammatic clearness the typical structure of the Vertebrate encephalon that I now always use it as a starting-point for the study of that organ in my lectures.

(*a*) I propose to follow Wilder in his use of the words neuron and neurocœle, encephalon and encephalocœle, myelon and myelocœle (Fig. 1, A). The words syringocœle and rhombocœle appear to me unnecessary: I prefer to say that in some Vertebrates (*e.g.* birds) the lumbar region of the myelocœle is dilated into a sinus rhomboidalis.

(*b*) The three primary cerebral vesicles may be called respectively the *protencephalon*, *deuterencephalon*, and *tritencephalon*; their cavities the *protocœle*, *deuterocœle*, and (primary) *tritocœle* (Fig. 1, A).

(*c*) In what may be called the sub-primary stage of segmentation, the anterior, or first, and the posterior, or third, cerebral vesicles have each divided into two parts, the brain thus consisting of

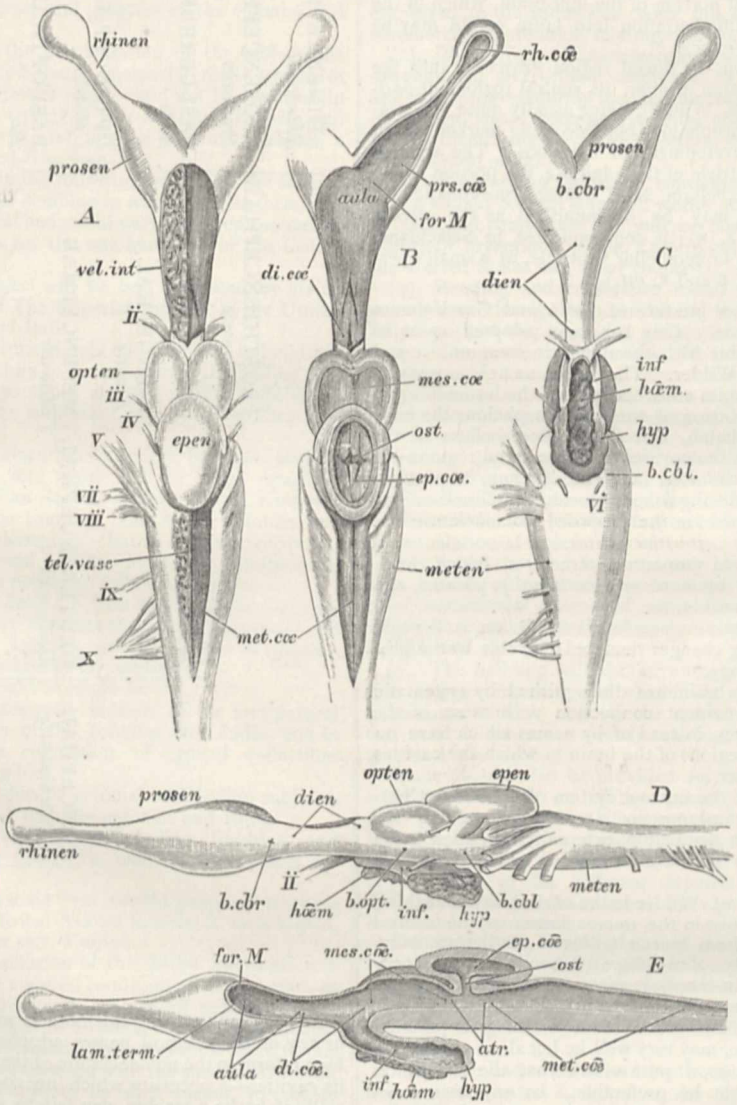

FIG. 2.—Five views of the brain of *Scymnus lichia* (nat. size). A, dorsal view of the brain, entire, save for the removal of the velum interpositum (*vel.int*) and tela vasculosa (*tel.vasc*) on the right side. B, the same, with the cavities opened from above. C, the entire brain from below. D, the entire brain from the left side. E, longitudinal vertical section. The letters have the same significance as in Fig. 1, except *hæm*, hæmatosac (saccus vasculosus); *vel.int*, velum interpositum; *tel.vasc*, tela vasculosa; and *ii–x*, cerebral nerves.

five encephalomeres, which I propose to call respectively the *prosthiencephalon* (= prosencephalon of Quain, *Vorderhirn*) and *diencephalon* (= thalamencephalon), derived from the protencephalon; *mesencephalon* (identical with the deuterencephalon), *epencephalon*, and *metencephalon*, formed by the constriction of the primitive tritencephalon. The cavities of these five brain-segments will be the *prosthio-*, *dia-*, *meso-*, *epi-*, and *meta-cœles* (Fig. 1, B).

(*d*) In the next stage of differentiation of the fore-brain, the prosthiencephalon gives rise dorsally to the two cerebral hemispheres: I propose to follow Owen and Huxley in calling them the *prosencephala* (Fig. 1, C and D; Fig. 2, A—E, *prosen*); their cavities, or lateral ventricles, being named *prosocœles* (*prs.cœ*). The median portion of the prosthiencephalon, after separation of the prosencephala, may be called the *basi-cerebrum* (*b.cbr.*); its cavity, the *aula*, is Y-shaped, communicating by its unpaired posterior limb with the diacœle, by its paired anterior limbs with the prosocœles through the *foramina of Monro* (*for.M*), or *portæ*. The two prosencephala may be spoken of collectively by the old name, *cerebrum*, which, as Pye-Smith remarks,[1] "ought to be strictly limited to the hemispheres with the corpus callosum, corpora striata, and fornix."

[1] "Suggestions on some Points of Anatomical Nomenclature" *Journ. of Anat. and Phys.*, xii. (1878), p. 154.

From each prosencephalon is budded off an olfactory lobe or *rhinencephalon*, containing a cavity, the *rhinocœle*, and usually divisible into a stem-like portion, or *crus*, and a dilated extremity, or *bulb*.

(*e*) The mesencephalon becomes differentiated dorsally into the paired optic lobes, or *optencephala*, the cavities of which, or *optocœles*, are frequently clearly distinguishable from the remaining median portion of the mesocœle, or *iter*, with which they communicate by small apertures, the *pylæ*. In many fishes, however, although the optic lobes are well formed, the mesocœle shows no distinction into iter and optocœles (cf. Fig 2, B and E). The unpaired ventral portion of the mid-brain, which in the lower forms shows no differentiation into crura cerebi may be distinguished as the *basi-opticus*.[1]

(*f*) In the epencephalon the dorsal region grows out into the cerebellum, or epencephalon proper, its ventral region, or *basi-cerebellum* (præ-oblongata, Wilder), being usually quite indistinguishable from the metencephalon, but becoming marked off in the Mammalia by the development of the pons. The anterior portion of the fourth ventricle of the adult, *i.e.* the portion corresponding to the basi-cerebellum, is of course epencephalic and not metencephalic, and may be distinguished as the *atrium* (Fig. 1, C and D; Fig. 2, E): it communicates, in Selachians, with the epicœle proper, or cerebellar ventricle, by a small aperture, the *ostium* (Fig. 2, B and E, *ost.*).[2]

It will be noticed that a mixture of Latin and Greek names occurs in the above scheme. This has been adopted so as to interfere as little as possible with the names in common use and with those proposed by Wilder. The Latin names, moreover, are introduced with a certain consistency; *e.g.* the basi-cerebrum is the median unpaired portion of the protencephalon, the basi-opticus of the mesencephalon, and the basi-cerebellum of the epencephalon; similarly, the cavities of these basal regions are respectively the aula, the iter, and the atrium, the main "ventricles" being all distinguished by names of Greek origin.

The advantages claimed for the proposed nomenclature are the following:—

(*a*) Names are given to important structures which have hitherto been designated by more or less lengthy phrases, *e.g.* basi-cerebrum, aula, mesocœle, &c.

(*b*) The systematic brain-nomenclature of Quain is brought up to date by introducing changes rendered desirable by the progress of animal morphology.

(*c*) The cavities of the brain are distinguished by systematic names which have an evident connection with those of the encephalomeres themselves, instead of by names which have no relation either with the regions of the brain in which the cavities occur, or with one another.

(*d*) The description of the nervous system of the lower Chordata is simplified. For instance, in *Amphioxus*, one may say that the neuron shows no distinction externally into encephalon and myelon, but that the neurocœle is dilated anteriorly into a small encephalocœle.

While agreeing with Prof. Wilder in the advisability of making the changes proposed above in the nomenclature of the central nervous system, I differ from him in failing to see the necessity, or, indeed, the desirability, of making all binomial names monomial. Such names, for instance, as anterior commissure, corpus callosum, lamina terminalis, which are not misleading, and which do not require to be connected with homologous parts by a consistent nomenclature, may very well be left alone; although, if one could start *ab initio*, I quite admit that the substitutes proposed by Wilder might be preferable. In any case, however, his name *pseudocœle* is thoroughly deserving of adoption as a substitute for the misleading appellation, "fifth ventricle."

Prof. Wilder's suggestion that *encephalon* should be Anglicised into *encephal* is worthy of consideration, especially as the word ought to be written *encephalos*, and it would be an advantage to get rid of the incorrect neuter termination. I have adopted the abbreviated form in the following table, which shows at a glance the nature of the proposed scheme of nomenclature. The names of the various divisions of the nervous system are printed in capitals, those of the corresponding cavities in italics.

NEURON *Neurocœle*	ENCEPHAL *Encephalocœle*	PROTENCEPHAL *Protocœle*	RHINENCEPHALS *Rhinocœles*
			PROSENCEPHALS (CEREBRUM) *Prosocœles*
		PROSTHIENCEPHAL *Prosthiocœle*	BASI-CEREBRUM *Aula*
		DIENCEPHAL *Diacœle*	OPTENCEPHALS (OPTIC LOBES) *Optocœles*
		DEUTERENCEPHAL *Deuterocœle*	BASI-OPTICUS *Iter*
		MESENCEPHAL *Mesocœle*	EPENCEPHAL (CEREBELLUM) *Epicœle* (definitive)
		TRITENCEPHAL *Tritocœle*	BASI-CEREBELLUM *Atrium*
		EPENCEPHAL *Epicœle*	
		METENCEPHAL *Metacœle*	
	MYELON *Myelocœle*		

My object in writing this note is not so much to get my own or any other system of names adopted, as to urge the necessity for a reform in the nomenclature of the central nervous system and its cavities—a necessity which no comparative anatomist, especially if he be a teacher, can fail to see. Recent investigations of the skull, shoulder-girdle, urinogenital organs, &c., of Vertebrates have necessitated corresponding changes in nomenclature, and similar changes are constantly being made among the various Invertebrate groups. It would certainly be a great boon, both to teachers and students, if a like reform could be generally adopted for the Vertebrate nervous system.

Dunedin, N.Z., September 15 T. JEFFERY PARKER

[1] "Critics will no doubt object to using an adjective as a substantive, but how far this is admissible is entirely a matter of usage," &c. (Pye-Smith, *loc. cit.*, p. 174, note).

[2] *Cerebellum* is one of the few names in the older brain-nomenclature which presents no ambiguity, so that the only reason for giving it a Greek synonym is the logical satisfaction of having a similar set of names for all the great divisions of the brain. Strictly speaking, the word epencephalon, being synonymous with *cerebellar segment*, ought not to be used for the cerebellum itself, and *hyperencephalon* might be used instead, with *hyperocœle* for cerebellar ventricle.

THE IMPERIAL INSTITUTE

THE following is the report of the Committee appointed by H.R.H. the Prince of Wales to prepare a scheme for the proposed Imperial Institute:—

The committee appointed by your Royal Highness to frame a scheme for an Imperial Institute intended to commemorate the

fiftieth year of Her Majesty's reign beg leave to submit to your Royal Highness the following report.

They do not fail to remember that the scheme which your Royal Highness indicated in your letter of September 13 last to the Lord Mayor of London had its origin in the remarkable interest excited by the recent Exhibition, by which not only the material products, resources, and manufactures, but the loyal feeling of the great colonies and possessions of Her Majesty's Empire, were illustrated in a most signal manner.

The object, therefore, which naturally suggested itself first to the committee was the development, with some necessary modifications, of your Royal Highness's idea of creating a permanent representation of the resources and progress of the colonies and India.

On pursuing, however, the consideration of the subject, the committee became persuaded that a memorial really worthy of the jubilee year of Her Majesty's reign could not be confined in its objects to any one part or parts of Her Majesty's Empire, and that it must in some form and degree also comprehend a representation of the United Kingdom.

Their desire, therefore, in the following outline of the scheme which they recommend is to combine in a harmonious form, and with a view to some practical and useful purpose, a representation of the colonies and India on the one hand and of the United Kingdom on the other.

They submit that this object will be best indicated by giving to the memorial the title of The Imperial Institute of the United Kingdom, the Colonies, and India.

They think that the Institute should find its home in buildings of such a character as worthily to commemorate the jubilee year of the Queen's reign, and to afford accommodation suitable for an institution combining the important objects which they now proceed to describe.

It is obvious that several departments of the Institute, such as the hall, conference rooms, &c., which will be found described under the Colonial and Indian Section and the United Kingdom Section respectively, will be common both to the colonies and India and to the United Kingdom: but as others have special relation to a particular portion of Her Majesty's dominions, it will be found convenient to make the following division.

A. *Colonial and Indian Section.*—The object of the Colonial and Indian Section will be to illustrate the great commercial and industrial resources of the colonies and India, and to spread a knowledge of their progress and social condition.

To this end provision should be made for—

(1). The display in an adequate manner of the best natural and manufactured products of the colonies and India, and in connection with this the circulation of typical collections throughout the United Kingdom.

(2). A hall for the discussion of colonial and Indian subjects, and for receptions connected with the colonies and India.

(3). The formation of colonial and Indian libraries, and establishing in connection therewith reading, news, and intelligence rooms.

(4). The incorporation in some form into the proposed Institute of the Royal Colonial and Royal Asiatic Society, if, as is hoped, it be possible to bring about such a union.

(5). The collection and diffusion of the fullest information in regard to the industrial and material condition of the colonies, so as to enable intending emigrants to acquire all requisite knowledge. Such information might be advantageously supplemented by simple and practical instruction. An emigration office of this character should be in correspondence with the provincial towns, either through the free libraries or by other means, so that information may be readily accessible to the people. These objects would be greatly facilitated if, as may be hoped, the Government should consent to the transfer to the buildings of the Institute of the recently formed Emigration Department, which would, by a close connection with the Institute, largely increase its usefulness.

Facilities might be afforded for the exhibition of works of colonial and Indian art.

It is also considered desirable that means should be provided, not for a general exhibition, but for occasional special exhibitions of colonial and Indian produce and manufactures. At one time a particular colony or portion of the Empire may desire to show its progress; at another time a general comparison of particular industries may be useful. Whilst the permanent galleries would exhibit the usual commercial or industrial products of the several colonies and India, the occasional exhibitions would stimulate and enlist the sympathies of colonial and Indian producers, and keep up an active co-operation with the industrial classes of this country.

B. *United Kingdom Section.*—The leading objects of this Section will be to exhibit the development during Her Majesty's reign and the present condition of the natural and manufactured products of the United Kingdom, and to afford such stimulus and knowledge as will lead to still further development, and thus increase the industrial prosperity of the country.

We submit that these objects may be carried out by making provision for the following purposes:—

(1). Comprehensive collections of the natural products of the United Kingdom, and of such products of other nations as are employed in its industries, with full scientific, practical, and commercial information relating thereto.

(2). Illustrations of manufactured products, typical of their development and present condition, of trades and handicrafts, and their progress during the Queen's reign, including illustrations of foreign work when necessary for comparison; together with models illustrating naval architecture, engineering, mining, and architectural works.

(3). A library for industrial, commercial, and economic study, which should contain standard works and reports on all subjects of trade and commerce. It will be desirable also to include a library of inventions of the Empire, and, as far as possible, of the United States and other countries.

(4). Reading and conference rooms supplied with English, colonial, and foreign commercial and technical periodicals, and a fully-equipped map room for geographical and geological reference. The conference rooms would be of value for meetings of Chambers of Commerce and other bodies of a kindred nature.

(5). The promotion, in affiliation with the Imperial Institute, of commercial museums in the City of London and in the commercial centres of the provinces. To these the Institute would contribute specimens, samples, and exhibits of the commercial products likely to be specially valuable in particular localities. There should also be an organisation to connect the Imperial Institute with the provincial centres by lectures, conferences, the circulation of specimens, and other means.

It is hoped that the Institute may lead to the organisation of high schools of commerce, such as are now established in the chief commercial towns of most Continental countries, but which have, as yet, unfortunately no existence in the United Kingdom.

(6). The building will also advantageously afford accommodation for (*a*) comparing and examining samples by the resources of modern science, and (*b*) the examination of artisans under the various schemes already existing for the promotion of technical education.

Space should also be provided for occasional exhibitions of separate industries, or of the special industries carried on in great provincial centres: for example, there might at one time be an exhibition of iron manufactures, at another of pottery, at another of textile fabrics, &c., which would tend to stimulate improvement in the different departments of industrial life. This object might be assisted by separate exhibitions of the handiwork of artisans.

The committee, having detailed the general nature of their suggestions under these heads, desire to add that they do not anticipate the exhibits in the collections remaining unchanged. They contemplate that as improvements are made from time to time the later and better results would displace those out of date.

They have had to consider how the space should be distributed between the United Kingdom on the one hand and the colonies and India on the other, and they recommend that whatever portion of the buildings is not required for purposes manifestly common to both should be allotted to the two sections fairly in equal parts.

C. *Government of Institute.*—The committee recommend that a new body, entirely independent of any existing organisation, should be created for the government of the Institute. This body should be thoroughly representative of the great commercial and industrial interests of the Empire. The colonies and India should have a fair share in the government of the Institute, and each colony should have special charge of its own particular department, subject, of course, to the general management of the entire institution.

The method of carrying this out would be prescribed by the Charter, after full consideration by Her Majesty in Council.

D. *Site.*—The committee, being fully conscious of the advantage

of a central position for the Institute, have considered the various possible sites, and have, as far as has been within their power, obtained estimates of their cost.

To carry out the several objects which the committee have indicated, a large space is necessary. The committee have been unable to find any such suitable site in the central parts of London, except at a cost which, looking at the probable amount of subscriptions, would, after the purchase of the ground, leave a sum wholly inadequate for the erection and maintenance of the buildings, and for carrying out the objects of the Institute.

The site of about five acres recently secured for the New Admiralty and War Offices is valued at 820,000*l.*, or rather over 160,000*l.* per acre. That now vacant in Charles Street, opposite the India Office, is less than an acre, and would cost at least 125,000*l.*; probably another acre might be secured by private contract, so that the value of a limited site in this position would not be less than 250,000*l.* It has been suggested that a single acre not far from Charing Cross might be obtained for 224,000*l.* Two and a half acres on the Thames Embankment have been offered for 400,000*l.*; and it is stated that six acres might be procured from Christ's Hospital at 600,000*l.* Another good central position has been suggested, consisting of two and a half acres, which has been valued at 668,000*l.*

It is, of course, probable that these sites might be obtained at somewhat less than the prices asked, but, allowing for this, it is obvious that the purchase of any adequate area would involve the expenditure of a quarter to half a million.

The committee have therefore been forced to abandon the hope of obtaining a central site within the limits allowed by any probable subscription.

The attention of the committee was then drawn to the property at South Kensington belonging to the Commissioners for the Exhibition of 1851. This property was bought out of the profits of that Exhibition, with the express object of offering sites for any large public buildings which might be required for the promotion of science and art.

Under these circumstances, the committee submit to your Royal Highness that the Imperial Institute may well establish a claim for the grant of a site of sufficient magnitude on property bought and reserved for public institutions of this character.

Though sensible of the objections that may be urged against the situation at South Kensington, the committee think that the advantage must be obvious of obtaining a sufficient site virtually free of cost, so that the whole of the subscriptions may be devoted to providing a building for and establishing and maintaining the Institute.

The committee, while guided in the recommendation of a site by the considerations they have indicated, think it right to add that there are some incidental advantages connected with that at South Kensington.

In that locality are combined the City and Guilds Technical College, the Royal College of Music, and the Government Museums and Schools of Science and Art, which ought to be in immediate proximity to an Imperial Institute of the character which we have described.

The technical character of the collections and exhibitions of the Imperial Institute has a natural connection with the collections of science and art in the Government Museums.

E. *General Observations.*—An Imperial Institute for the United Kingdom, the Colonies, and India, would fail in its chief object if it did not constantly keep in view that it ought to be a centre for diffusing and extending knowledge in relation to the industrial resources and commerce of the Empire.

The necessity for technical education is now fully appreciated, because the competition of industry has become, in a great measure, a competition of trained intelligence. The committee, however, do not recommend that the Imperial Institute should aspire to be a college for technical education. Many of the large towns in Great Britain have recently established colleges or schools of science and art. The Imperial Institute might serve to promote technical education in these, and to unite them with colleges of larger resources which have been founded or formed branches for the purpose in the metropolis. It is too much to hope that an active co-operation of this character between the provincial centres and London could be at once undertaken by the Imperial Institute. But the committee bear in mind that, in their last report, the Commissioners of 1851 have indicated an intention to assist in carrying out such a scheme. If the Commissioners would contribute three or four thousand pounds annually, it would be possible to establish scholarships which might enable promising candidates of the working classes to attend the local institutions, and even, when it was desired, to complete their technical education in colleges of the metropolis. In addition to this aid, the Imperial Institute might be able, in other ways, to promote the foundation of scholarships both in connection with the colonies and provincial centres, in the hope of still further extending these benefits to the working classes.

In conclusion, the committee submit that an Imperial Institute such as they have sketched in broad outline would form a fitting memorial of the coming year, when Her Majesty the Sovereign of this Empire will celebrate the jubilee of her happy reign. It would be an emblem of the unity of the Empire, embracing as it does all parts of the Queen's dominions, and tending to promote that closer union between them which has become more and more desired. It would exhibit the vast area, the varied resources, and the marvellous growth, during Her Majesty's reign, of the British Empire. It would unite in a single representative act the whole of her people; and, since both the purpose and the effect of the Institute will be to advance the industrial and commercial resources of every part of the Empire, the committee entertain a confident hope that Her Majesty's subjects, without distinction of class or race, will rejoice to take part in offering this tribute of love and loyalty.

—Herschell (Chairman), Carnarvon, Revelstoke, Rothschild, G. J. Goschen, Lyon Playfair, Henry James, Henry T. Holland, H. H. Fowler, C. T. Ritchie, Fred. Leighton (President of the Royal Academy), Ashley Eden, Owen T. Burne, Reginald Hanson (Lord Mayor), J. Pattison Currie (Governor of the Bank of England), John Staples, Frederick Abel (Vice-President of the Society of Arts), J. H. Tritton (Chairman of the London Chamber of Commerce), Nevile Lubbock, Henry Broadhurst.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Cambridge.—At the annual election to scholarships and exhibitions in St. John's College, for candidates who have not yet commenced residence, the following awards were made:—

Foundation Scholarships: (80*l.*) to A. Vaughan, University College School, and H. Reeves, Surrey County School; (50*l.*) to O. W. Owen, Liverpool Institute (all for Mathematics); (60*l.*) to J. T. Hewitt, South Kensington School of Science, for Chemistry.

Minor Scholarships: (50*l.*) to G. T. Bennett, University College School, and W. J. Dobbs, Wolverhampton School, for Mathematics, and to R. A. Lehfeldt, for Physics.

Exhibitions to J. J. Alexander, Queen's College, Belfast, for Mathematics, and to F. F. Blackman, St. Bartholomew's Hospital, for Physiology and Botany.

SCIENTIFIC SERIALS

The articles in the *Journal of Botany* for November and December are mostly descriptive. Mr. H. N. Ridley concludes his description of the Monocotyledonous plants collected in New Guinea by Mr. Forbes, including a number of new species; Mr. J. G. Baker, his synopsis of the Rhizocarpeæ, with a monograph of *Pilularia;* and Dr. Trimen, his valuable account of the flora of Ceylon and its relations to the climate of the island.—Mr. J. G. Baker describes some new species of Liliaceæ from the Cape of Good Hope.—The other original papers refer to the distribution of British plants.

Nuovo Giornale Botanico Italiano for October.—G. Venturi describes several species of moss new to the Italian flora, or rare or critical species.—L. Macchiati, on the extra-floral nectaries of the Amygdaleæ, describes nectariferous glands on the leaf-stalk of *Persica vulgaris*, *Cerasus vulgaris*, *Prunus domestica*, and *Amygdalus communis*. These agree in function with the extra-floral nectaries in other European plants, in serving as a protection against the attacks of caterpillars; while in the case of natives of Tropical America, their purpose is invariably to protect against the attacks of the ant *Oecodoma*, by attracting other ants, enemies to this species. The author records a diurnal periodicity in the amount of nectar exuded from the glands, which reaches its maximum early in the morning, its minimum in the afternoon.—B. Scortechini describes several

new species of Scitamineæ from the Malayan peninsula, including a new genus, *Lowia*.—Prof. T. Caruel has a note on the fruit and seeds of the cacao.—P. Severino describes the variety *purpurea* of *Aceras anthropophora*, and the micro-chemical reactions of the purple cells.—Two teratological papers complete the list: on viviparity and prolification in *Spilanthes caulirrhiza*, by Dr. F. Tassi; and teratological notes (on *Aegle sepiaria*, *Lysimachia ephemerum*, and *Saxifraga crassifolia*), by C. Massalongo.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 16.—"On a Varying Cylindrical Lens." By Tempest Anderson, M.D., B.Sc. Communicated by Prof. A. W. Williamson.

The author has had constructed a cylindrical lens in which the axis remains constant in direction and amount of refraction, while the refraction in the meridian at right angles to this varies continuously.

A cone may be regarded as a succession of cylinders of different diameters graduating into one another by exceedingly small steps, so that if a short enough portion be considered, its curvature at any point may be regarded as cylindrical. A lens with one side plane and the other ground on a conical tool is therefore a concave cylindrical lens varying in concavity at different parts according to the diameter of the cone at the corresponding part. Two such lenses mounted with axes parallel and with curvatures varying in opposite directions produce a compound cylindrical lens, whose refraction in the direction of the axes is zero, and whose refraction in the meridian at right angles to this is at any point the sum of the refractions of the two lenses. This sum is nearly constant for a considerable distance along the axis so long as the same position of the lenses is maintained. If the lenses be slid one over the other in the direction of their axes, this sum changes, and we have a varying cylindrical lens. The lens is graduated by marking on the frame the relative position of the lenses when cylindrical lenses of known power are neutralised.

Lenses were exhibited varying from 0 to − 6DCy, and from 0 to + 6DCy.

Linnean Society, December 16.—W. Carruthers, F.R.S., President, in the chair.—H.R.H. the Prince of Wales was elected an Honorary Member of the Society.—Messrs. A. Bawtree, F. Justen, T. N. Mukharji, F. W. Oliver, and R. V. Sherring were elected Fellows, and G. Nicholson an Associate, of the Society.—The President announced that Sir George MacLeay, K.C.M.G., had presented to the Society a portrait of the late Rev. W. Kirby, the distinguished entomologist, and the manuscripts and correspondence of his father, Alexander MacLeay (elected F.L.S. 1794), formerly Secretary to the Society. For these acceptable donations, a special vote of thanks was accorded by the Fellows.—Prof. F. O. Bower exhibited a series of photographs illustrating the vegetation of Ceylon.—Mr. E. A. Heath showed a stormy petrel, *Procellaria pelagica*, which was picked up alive in Kensington Gardens on December 9; the bird evidently having been driven inland by the great storm of the previous day.—Mr. D. Morris drew attention to the fresh leaves, and the fibres extracted therefrom, of *Agave salmdyckia* and *A. Ixtli*.—Mr. W. T. Thiselton Dyer showed one of the volumes of "Honzo Zufu" ("Illustrations and Brief Descriptions of the Plants of Japan"), by Iwasatti Tsanemasa, which consists of ninety-six volumes containing 2000 coloured figures. Only two or three copies of this important botanical work are known to be complete, as a great part of it only exists in the original native hand-work.—The President exhibited a spike of maize from an ancient Peruvian grave, also samples of prehistoric wheat from ancient British and Romano-British burial-mounds in Wiltshire.—Mr. G. J. Romanes read a paper on the sense of smell in dogs, a report of which we hope to give in a future number.—Mr. C. T. Druery gave a communication on a new instance of apospory in *Polystichum angulare*, var. *pulcherrimum*. He infers that the formation of the prothallus is preceded by a very different series of phenomena from those already recorded. In the one case the prothalli are simple extensions of the cellular substance of the tips of the pinnules commencing at points quite beyond the venation, and produce no root-hairs unless brought into contact with the soil. In the other case, however, the prothallus is a direct outgrowth of the tip of a veinlet, and at once produces root-hairs in abundance long before it assumes any other characteristic of a prothallus, and finally the resulting prothallus is much thicker in substance.—A paper was read on apospory and allied phenomena, by Prof. F. O. Bower. The term "sporal arrest" is applied to all cases where such spores do not come to functional maturity. The arrest is often, but not always, followed by substitutionary or correlative vegetative growths: these take the form of buds, similar to the sporophyte which produced them, and then would be termed cases of "sporophytic budding"; but in other cases the correlative growths may assume the characters of the oophyte or prothallus. Where this happens, the phenomenon is termed "apospory." This direct transition from the sporophyte to the oophyte was *induced* some ten years ago in certain mosses, by Pringsheim and Stahl; and it is now described in detail in two ferns, an *Athyrium* and a *Polystichum*. Both plants were found some years ago growing wild, and the fact of the transition was recognised by Mr. Druery and Mr. Wollaston, and has been already published by the Linnean Society. The present paper describes these and similar phenomena in detail, and shows how in the *Polystichum* at least four different modes of origin of the oophytes may be distinguished, two being in connection with the sorus, while two are at points apart from the sorus, and may even occur on fronds which bear no sori at all. The latter part of the paper is occupied by comparing these phenomena with others already known in higher and lower plants. The general conclusion is that the whole phenomenon of apospory is to be regarded rather as a sport than as a reversion bearing deep morphological conclusions with it.

Chemical Society, December 2.—W. Perkin, F.R.S., Vice-President, in the chair.—Mr. Forbes Rickard was formally admitted a Fellow of the Society.—The following papers were read:—Bismuthates, by M. M. Pattison Muir and Douglas J. Carnegie.—The action of inorganic compounds on living matter, by James Blake, M.D.—Morindin and morindon, by T. E. Thorpe, F.R.S., and T. H. Greenall.—The hydration of salts: cadmium chloride, by S. U. Pickering.—The decomposition of sodium carbonate on fusion, by S. U. Pickering.—Derivatives of tolylbenzene, by Thomas Carnelley, D.Sc. (Lond.), and Andrew Thomson, D.Sc. (Edin.).—The amount of chlorine in rain-water collected at Cirencester, by Edward Kinch, Royal Agricultural College, Cirencester.—Some analogous phosphates, arsenates, and vanadates, by John A. Hall, student in the Laboratory of Owens College.—Agricultural experiments with iron sulphate as a manure during 1886, by A. B. Griffiths, Ph.D.

Royal Meteorological Society, December 15.—Mr. W. Ellis, F.R.A.S., President, in the chair.—Mr. G. R. Farncombe, B.A., Mr. C. E. B. Hewitt, B.A., and Capt. S. Trott were elected Fellows of the Society.—The following papers were read:—On the proceedings of the International Congress of Hydrology and Climatology at Biarritz, by Mr. G. J. Symons, F.R.S. This Congress was held in October, and was divided into three sections, viz. Scientific Hydrology, Medical Hydrology, and Climatology, Scientific and Medical. The total number of papers read was 109. An Exhibition was also held in connection with the Congress. The excursions were of primary importance to the medical men, and extended over a period of three weeks. The places visited were: Bayonne, Cambo, Dax, Arcachon, Pau, Eaux-Bonnes, Eaux-Chaudes, Cauterets, Lourdes, Bagnères-de-Bigorre, Luchon, Ussat, Ax, Montpellier, Cette, Boulou, Amélie-les-Bains, La Preste, Banyuls-sur-Mer, and Thues.—Report on the phenological observations for 1886, by the Rev. T. A. Preston, M.A., F.R.Met.Soc. The weather was, on the whole, very ungenial and everything much retarded; it was also very fatal to insect life, so that the complaints on this head have been far less than usual. Bush fruits were *very* abundant; strawberries and peas were spoilt by drought in many places; stone fruits, except plums, were not abundant; plums were extraordinarily plentiful, so much so that they realised nothing in the markets, the cost of picking and carrying often being more than they realised; apples were very poor, from the destruction of the bloom by heavy rain. Hay was good and plentiful, and well harvested; corn and other grain were not up to an average: root-crops were, as a rule, remarkably good.—A criticism of certain points of Prof. Langley's researches on solar heat, by Prof. S. A. Hill, B.Sc., F.R.Met.Soc. These experiments were carried out at Mount Whitney, in Southern California, during 1881.—Account of the

hurricane of March 3–4, 1886, over the Fiji Islands, by Mr. R. L. Holmes, F.R.Met.Soc. This storm was the most destructive that has ever been known to occur in the Fiji group. The lowest barometer reading was 27·54 inches at Vuna, in Taviuni. The storm was accompanied by a great wave from 18 to 30 feet in height, which swept over the land and caused an immense amount of damage. It was reported that fifty vessels were wrecked and sixty-four lives lost during this hurricane.—Results of meteorological observations made at the Military Cemetery, Scutari, Constantinople, 1865-85, by Mr. W. H. Lyne. The annual mean temperature is 58°·4; the highest temperature registered was 103°·6 on June 22, and the lowest 13°·0, on January 25, both in 1859. The annual rainfall is 29·29 inches; the greatest fall in one day was 4·06 inches on September 25, 1866.

Physical Society, December 11.—Prof. McLeod, Vice-President, in the chair.—W. Natanson, Ed. Natanson, the Hon. R. Abercromby, Jul. Verteimer, and H. M. Elder were elected Members of the Society.—The following papers were then read:—On the influence of change of condition from the liquid to the solid state on vapour-pressure, by Prof. W. Ramsay, Ph.D., and Sydney Young, D.Sc., read by Dr. Young. The authors refer to some experiments published in *Wiedemann's Annalen*, vol. xxviii. p. 400, by W. Fischer, on the above subject, which show that the vapour-pressure of ice and solid benzene are less than those of water and liquid benzene at the same temperatures. By using the formula $p = a + bt + ct^2$ to express the relation between the pressure and temperature of saturated vapours, Fischer arrives at the absurd result that the vapour-pressure of liquid benzene is not identical with that of solid benzene at melting-point. If the above formula be replaced by $\log p = a + bat$, it is shown that the anomaly disappears. The authors have measured the vapour-pressures of solid and liquid benzene by the dynamical method, and obtain results agreeing closely with those of Fischer determined statically. They also calculate the vapour-pressure of solid benzene from that of the liquid, using the formula—

$$P_{t-1} = P - (P'_t - P'_{t-1})\left(\frac{V_{t-\frac{1}{2}} + F_{t-\frac{1}{2}}}{V_{t-\frac{1}{2}}}\right),$$

where Pt and $P't$ are the vapour-pressures of the solid and liquid at temperature t, $V_{t-\frac{1}{2}}$ = heat of vaporisation of liquid, and $F_{t-\frac{1}{2}}$ = heat of fusion of solid at temperature $t - \frac{1}{2}$. The numbers so obtained are in accordance with those determined experimentally.—On the nature of liquids as shown by the thermal properties of stable and dissociable bodies, by the same authors, read by Prof. Ramsay. From experiments on the vapour-density and heat of vaporisation of stable and dissociable bodies, the authors arrive at two important results: (1) that for stable bodies, such as alcohol and ether, the density of their saturated vapours increases with rise of temperature, whereas for bodies such as acetic acid and nitric peroxide the vapour-density attains a minimum at a certain temperature, and increases with either rise or fall of temperature; (2) the heat of vaporisation of alcohol decreases with rise of temperature, but that of acetic acid attains a maximum at about 110° C., and decreases with rise or fall of temperature. From these results the authors seek to prove that the difference between stable liquids and their vapours consists in the relative proximity of the molecules, this proximity being greater in liquids than gases, and that the molecules of stable liquids are not more complex than those of their gases. Prof. Pickering dissented from this view, and thought that the molecules of liquids are aggregations or compounds of those of the gases. In answer to inquiries by the authors, Mr. Lewis Wright said that bodies which rotate the plane of polarisation of light when in the liquid state also rotate it in a proportionate degree when gaseous; and Capt. Abney remarked that stable liquids and their vapours give similar absorption-spectra, whereas those of dissociable bodies differ considerably. Both these facts seem to support the view put forward by the authors.—An account of Cauchy's theory of reflection and refraction of light, by Mr. James Walker, M.A. This paper is intended as a statement of the work previously done in the subject, and gives references to the original papers and "reproductions," &c., which will be of great value to persons studying this important branch of the theory of optics.—Mr. Shelford Bidwell exhibited and described a voltaic cell, in which the electrolyte is dry peroxide of lead. It consists of carefully dried peroxide placed between plates of lead and sodium, and gives a comparatively strong current, which passes from the sodium to the lead within the cell.

CAMBRIDGE

Philosophical Society, November 8.—Mr. Trotter, President, in the chair.—The following communications were made:—On the cœlum and body-cavity of Peripatus and the Arthropoda, by Mr. A. Sedgwick.—Note on the "vesicular vessels" of the onion, by S. H. Vines, M.A. Christ's, and A. B. Rendle, St. John's. In investigating the vesicular organs with the object of determining whether or not the transverse walls are perforated so as to place the cavities of successive segments in communication, the authors observed that, in the quiescent winter condition of the bulb, there are patches of callus—easily made conspicuous by staining with corallin—on the transverse walls. From this they infer that the transverse walls are perforated, the canals through them being open in the active, and closed by callus in the quiescent, condition of the bulb, just as is the case with sieve-tubes. This inference has, however, to be confirmed by an investigation of the bulb in the active condition. The authors also observed that each segment of a vesicular vessel contains a large nucleus.—On *Epiclemmydia lusitanica*, a new species of Alga, by Mr. M. C. Potter. During August and September, the author, with assistance from the Worts Travelling Scholars' Fund, investigated the life-history of a new species of Alga, now named *Epiclemmydia lusitanica*, which lives on the backs of the tortoises inhabiting the pools of Southern Europe. This Alga, which to the naked eye appears as small green roundish patches, is found to consist of a number of cells closely applied to tortoise-shell, but which are only a few layers deep, here and there penetrating into the tortoise-shell and causing it to flake off. The cells next to the tortoise-shell always force their way into any available crack, where they divide, and thus penetrate to some depth into the shell of the tortoise, and finally cause it to be flaked off. The Alga is reproduced by means of zoospores formed in the external layer of cells. These zoospores are all exactly similar, and swim about for a considerable time, after which they come to rest and germinate.—On a peculiar organ of *Hodgsonia heteroclita*, by Mr. Walter Gardiner. The author gave some account of the gland-bearing organs which are found in *Hodgsonia*—one in the axil of each of the foliage leaves. A study of the development of these organs demonstrates that they are peculiarly modified leaves, or rather bracts, since they are associated with the rudimentary flower-bud. They are doubtless identical with the similarly modified bracts which occur in connection with the fully developed flowers. The glands are found on the lower surface of the bract, and belong to the same type as those of *Luffa*, although of a distinctly higher order. Glands of a similar nature also occur on the under surface of the foliage leaves and on the sepals. The substance secreted by the glands is most probably of the nature of nectar, and the whole structures are to be regarded as extra floral nectaries. Having shortly described their histology, the author proceeded to make some remarks upon their function. A careful survey of the various gland-bearing genera of the *Cucurbitaceæ* and *Passifloraceæ*, and a comparison of such cases as those presented by *Passiflora quadrangularis* and *Passiflora fœtida*, placed it, in his opinion, beyond doubt that the function of the extra floral nectaries of the two orders is to attract certain insects—probably ants—which are of service to the plant in protecting it from the attacks of other and harmful insects, such as caterpillars, which are accustomed to creep up the narrow stem for the purpose of devouring or otherwise injuring the young growing shoots. As regards the fertilisation of *Hodgsonia*, the author showed that there were special contrivances to prevent the animal which fed upon the nectar of the flower from obtaining that of the extra floral nectaries, and *vice versâ*, and stated that, considering all the circumstances of the case, it was exceedingly probable that fertilisation was accomplished through the agency of a large night-flying moth.

EDINBURGH

Royal Society, December 20.—Sir W. Thomson, President, in the chair.—The Chairman communicated a paper, by the Rev. J. H. Sharpe, on a remarkable case of stream-lines in two-dimensional fluid motion. The body which produces the stream-lines is symmetrical about an axis, and consists of a semicircular head, with another portion the form of which is given by a transcendental equation.—A note on knots, by Mr. A. B. Kempe, was communicated by Prof. Tait. This paper is pre-

liminary to a detailed investigation of knots by an entirely new process.—Sir W. Thomson discussed the ring-waves produced by throwing a stone into water. This investigation constitutes an extension of Poisson's and Cauchy's results. The wave-velocity is directly proportional to the square root of the wave-length, and the group-velocity is one half of the wave-velocity. —Sir W. Thomson also gave an investigation of the waves produced by a ship advancing uniformly into smooth water. His results show that there is practically no disturbance of the surface outside lines drawn from the ship making an angle of 19° 28′ on either side with the direction of motion. When tested by experiment the angle obtained was 19° 13′.—Dr. T. Muir communicated a paper, by Mr. P. Alexander, on the expansion of functions in terms of linear, cylindric, and spherical, &c., functions by a new and very general method.—In a paper on even distribution of points in space, Prof. Tait replied to certain criticisms made on his results regarding the foundations of the kinetic theory of gases.

MANCHESTER

Literary and Philosophical Society, November 2.—Prof. Osborne Reynolds, LL.D., F.R.S., Vice-President, in the chair.—The following papers were read:—Measurements of the magnetic induction and permeability in soft iron, by H. Holden, B.Sc.—The action of hydrochloric acid gas upon certain metals, by J. B. Cohen, Ph.D., F.C.S.—Capillary constants of benzene and its homologues occurring in coal-tar, by J. B. Cohen, Ph.D., F.C.S., all communicated by Dr. A. Schuster, F.R.S.

SYDNEY

Linnean Society of New South Wales, October 27.—Prof. W. J. Stephens, F.G.S., President, in the chair.—The following papers were read:—Catalogue of the described Coleoptera of Australia (part vi.), by George Masters. The present part contains all the known Scolytidæ, Brenthidæ, Anthribidæ, Bruchidæ, and Cerambycidæ of Australia, making the total number of species catalogued up to the present time, 6231. The next part, which will be published early in next year, will complete the Coleoptera.—Descriptions of new Lepidoptera, by E. Meyrick, B.A., F.E.S. In this paper descriptions are given of sixteen new species of Australian Lepidoptera belonging to fourteen genera, of which six are new. Among them is *Thalpochares coccophaga*, of which, at the December meeting of the Society, Mr. Masters exhibited specimens of both moths and larvæ, and called attention to the singular habits of the latter, which feed on a species of Coccus infesting a Macrozamia, living concealed in a cocoon-like shelter formed of the exuviæ of the Coccus, and finally pupating therein.—On the flowering seasons of Australian plants, by E. Haviland, F.L.S. This paper enumerates 113 species of plants observed in flower in the neighbourhood of Sydney during the month of July of this year, and is intended to be the first of a series of papers on the subject, by means of which it is hoped that the flowering seasons of at least the plants of the county of Cumberland will eventually be recorded.—Notes on the Rutaceæ of the Australian Alps, by James Stirling, F.G.S., F.L.S. Fourteen species of Rutaceous plants are enumerated as occurring in the region of the Australian Alps, of which one belongs to the genus Zieria, two to Boronia, nine to Eriostemon, and two to Correa. Remarks are also made upon the climatic and other conditions under which the plants occur, and the origin of their specific differences.—On a probably new species of tree-kangaroo from North Queensland, by C. W. De Vis, M.A. The name of *Dendrolagus bennettianus* is proposed for a supposed new species of tree-kangaroo of which one specimen was obtained in the Daintree River District. It lived in captivity for a time, but was subsequently killed, and its skin, unfortunately deprived of everything else but the bones of the hands and feet, was subsequently submitted to Mr. De Vis, who, after comparing it with two skins of *D. lumholtzi*, Collett, has no doubt that it is distinct from its compatriot, and is more nearly allied to *D. dorianus*, Ramsay. As full a description as is possible under the circumstances is given in the paper.—Dr. Ramsay exhibited a specimen of an apparently new species of Monacanthus, presented to the Australian Museum by Mr. G. R. Eastway. He also exhibited eggs of *Ptilonorhynchus violaceus* and *Rhynchæa australis*, and read notes on the subject.—Mr. A. J. North exhibited eggs of *Menura victoriæ*, Gould, from South Gippsland, and of *Geronticus spinicollis*, Jameson, from Hillston, N.S.W.—Mr. Whitelegge exhibited some magnificent specimens of the Alga *Claudea Bennettiana*, Harvey, hitherto known only from one small specimen. It was found abundantly near the Heads of Port Jackson during a recent trawling excursion in connection with the Australian Museum. Some of the specimens taken were nearly 1 foot in diameter. Mr. Whitelegge also exhibited a fine specimen of *Eozoon canadense*, and slides of it and of the above-mentioned Alga under the microscope.

PARIS

Academy of Sciences, December 20.—M. Jurien de la Gravière, President, in the chair.—Addendum to the note of December 6 on the conditions determining the form and density of the earth's crust, by M. Faye. In reply to M. de Lapparent's further objections to his theory, the author gives more detailed explanations regarding the phenomenon of compensation between land and water, pointing out that to this compensation is due the persistence of the original ellipsoidal figure of the globe.—On the phosphorescence of alumina, by M. Edmond Becquerel. The experiments here described point to different conclusions from those recently arrived at by M. Lecoq de Boisbaudran, while confirming those deduced from the author's earlier researches.—On some dispositions by means of which birefractive photometers may be realised without polarising the light, by M. A. Cornu. Without dispensing with the simpler apparatus of geometrical optics, the author describes several readjustments, which enable him to obtain double images of variable intensity in accordance with a well-known law, without having recourse to the employment of polarised light.—Remarks on M. Hugoniot's notes on the flow of gases, published in the *Comptes rendus* of November 15 and 22, by M. G. A. Hirn. The author replies briefly to the objections urged against his conclusions by M. Hugoniot, and still rejects the kinetic theory of gases, which he persists in regarding as one of the most fatal errors of modern science.—Observations in reference to Dr. Philip Paulitschke's "Researches on the Ethnography and Anthropology of the Somali, Gallas, and Hararis," by M. de Quatrefages. These observations, accompanying presentation of a copy of Dr. Paulitschke's work to the Academy, dwell especially on the great scientific interest presented by the mixed Negroid populations of Eastern Africa to the student of anthropology. These peoples are regarded as the outcome of an extremely ancient crossing between the Negro and the White races, the latter being represented chiefly by the African Semites.—Considerations on deep-sea fishes, and especially on those belonging to the sub-order Abdominalidæ, by M. Léon Vaillant. These remarks have special reference to the captures made by the *Talisman* Expedition, which included no less than 3800 true fishes, and which, combined with the researches of Günther, Gill, Cope, Goode, and Bean, already supply materials for a rough classification of these marine Vertebrates.—On the copper present in the grapes and wines yielded by vines treated with various cupreous preparations against mildew, by MM. U. Gayon and Millardet. These researches seem to show that, while the different processes generally exercise some influence on the quantity of copper contained in the grape and vinous fermentation, they appear to have none at all on the quantity of copper which remains in the wine after fermentation. The clear wine, after perfect clarification, contains no appreciable quantity of the metal.—Volume, absolute heat, and specific heat of saturated vapours, by M. Ch. Antoine. Taking a special zero for each vapour, simple formulas are established for working out these several volumes.—Note on the Abelian functions, by M. Appell.—On angular acceleration, a problem of pure kinematics, by M. Ph. Gilbert.—On the flow of elastic fluids, by M. Hugoniot. The author here applies to the flow of saturated aqueous vapour the same method already employed by him in the study of the flow of permanent gases.—Apparatus showing the two modes of reflection of a vibratory movement, by M. J. Violle. The apparatus here described has been constructed by M. König, and is perfectly adapted for demonstrating the method employed by Regnault in his great work on the measurement of the velocity of sound.—On some new properties, and on the analysis, of the pentafluoride gas of phosphorus, by M. H. Moissan. Having already indicated a new process for preparing this substance, the author here gives some fresh results terminating his researches on the phosphorated compounds of fluor.—On the relations of the efflorescence and deliquescence of the salts with the maximum tension of the saturated solutions, by M. H. Lescœur. The conditions of the efflorescence and deliquescence of the salts as determined by Debray are here brought into rela-

tion with the maximum tension of the saturated solutions.—Heat of formation of the methylate and ethylate of potassa, by M. de Forcrand.—On the wines and brandies extracted from strawberries and raspberries, by M. Alph. Rommier. By the process here described raspberries are made to yield a wine with over 18 per cent. of alcohol instead of the normal 2 or 2·5 per cent., while the brandy distilled from it retains a highly aromatic flavour. A still more palatable wine, with 16 per cent. of alcohol, is obtained from the fine strawberries grown in the neighbourhood of Paris, the corresponding brandy also preserving the flavour of the fruit.—On the zymotic properties of certain virus: fermentations of nitric substances under the influence of non-aërial virus, by M. S. Arloing. The object of this communication is to show that the virus of non-aërial microbes stimulates the fermentation of albuminoid substances.—Note on the multiplication of *Leucophrys patula*, Ehrenberg, by M. E. Maupas. In a favourable medium, a single individual of these Infusoria, which multiply by fissiparity, is found to increase to over a million in five days. Certain hitherto unobserved irregularities in the process of segmentation are here described.—On the phosphorescence of the Geophili, by M. Macé. As studied on a *Geophilus simplex*, Gervais, this phenomenon appears to be analogous to that of certain Chetopteræ described by Panceri and Jourdan.—On the typical nervous system of the dexter and sinister Prosobranchæ, by M. E. L. Bouvier.—Fresh anatomical and physiological studies on the Glyciphagi, by M. P. Mégnin.—The diseases of the olive, by M. L. Savastano. A brief description of the various forms of hyperplasia and tumours by which this plant is affected.—Remarks on the so-called Calcifugal vegetation, by M. Ant. Magnin. A theory is advanced to explain the presence of these plants in the limestone region of the Jura.—On two rocks in the Vélay and Lyons districts, containing beryl and apatite, by M. Ferdinand Gonnard.—On an experiment undertaken to determine the direction of the currents of the North Atlantic, by Prince Albert of Monaco. The author describes a second excursion on board the *Hirondelle*, during which 510 bottles were thrown into the sea along a course about 500 miles long, and nearly parallel with the twentieth meridian west of Paris. The operation was begun on August 29 and completed on September 5, 1886, and some of the floats have already been picked up at various points on the European seaboard; but the general results are reserved for a future communication.—The periodical showers of shooting-stars and the seismic disturbances of the years 1883, 1884, and 1885, by M. Ch. V. Zenger. During these years, both orders of phenomena are shown to coincide, while they are also frequently accompanied by hurricanes, cyclones, electric discharges, and auroras.

BERLIN

Physiological Society, October 29.—Prof. du Bois-Reymond in the chair.—Dr. J. Munk reported on experiments instituted by him in the course of the last two years with a view of arriving at an experimental decision between the two theories of the secretion of urine: the filtration theory of Ludwig, and the secretion theory of Heidenhain. According to the first theory, the blood-pressure prescribed the measure for the urine secretion; according to the second theory, the urine got secreted from the secretory epithelial cells of the kidneys, and the quantity of the matter secreted was dependent on the rate of movement of the circulation of the blood. The speaker had instituted his experiments on excided but living kidneys, through which he conducted defibrinised blood of the same animals, under pressures which he was able to vary at pleasure between 80 mm. and 190 mm. Fifty experiments on dogs whose blood and kidneys were, during the experiment, kept at 40° C., yielded the result that the blood of starving animals induced no secretion of urine, which, on the other hand, showed itself in copious quantities where normal blood was conducted through the kidney. If to the famished blood was added one of the substances contained as ultimate products of digestion in the blood, such, for example, as urea, then did the secretion ensue. The fluid dropping from the ureter contained more urea than did the blood. That fluid was therefore no filtrate, but a secretion. An enhancement of the pressure of the blood flowing through the kidney had no influence on the quantity of the secretion passing away. An increased rate of movement on the part of the blood, on the other hand, increased in equal degree the quantity of urine. On a solution of common salt or of mere serum sanguinis being poured through the kidney, no secretion followed. All these facts, involving the exclusion of the possibility of a central influence being exercised from the heart or from the nervous system on the kidneys, were deemed by the speaker arguments proving that the urine was secreted by the renal epithelial cells. A series of diuretics was next tried, in order to establish whether they operated in the way of stimulus centrally on the heart or peripherally on the renal cells. Digitalis was a central diuretic. Common salt, on the other hand, was a peripheral diuretic. Added in the portion of 2 per cent. to the blood, it increased the quantity of urine eight- to fifteen-fold. Even in much less doses, it was a powerful diuretic. In a similar manner, if yet not so intensely, operated saltpetre and coffeïne, as also urea and pilocarpine. On the introduction, however, of the last substance into the blood, the rate of circulation was accelerated in an equal measure as was the quantity of urine increased, so that in this case the increase in the quantity of urine was, perhaps, exclusively conditioned by the greater speed in the movement of the blood. On the other hand, the quantity of secreted urine was reduced when morphine or strychnine was administered to the blood. In the case of the application of strychnine, the rate in the current of the blood was retarded in a proportion equal to the reduction in the secretion of the urine. The speaker had, finally, demonstrated the synthesis of hippuric acid and sulphate of phenol in the excided kidney as a function of its cells, by adding to the blood pouring through the kidney, in the first place, benzoic acid and glycol; in the second place, phenol and sulphate of soda. In order that these syntheses might make their appearance in the excided kidney, the presence of the blood-corpuscles was not necessary, though, indeed, the presence of oxygen in the blood was indispensable.

BOOKS AND PAMPHLETS RECEIVED

The Origin of Mountain Ranges: T. M. Reade (Taylor and Francis).—The Six Inner Satellites of Saturn; Appendix 1 and 2: A. Hall (Washington).—Conchylien der Gosaumergel von Aigen bei Salzburg: Dr. L. Tausch (Fischer, Wien).—Ueber die Fauna der Oolithe von Cap. S. Vigilio: M. Vacek (Fischer, Wien).—Jahrbuch der k.k. Geologischen Reichsanstalt, 1886 (Hölder, Wien).—Monthly Summaries and Monthly Means for Year 1885, Imperial Meteorological Observatory, Tokio.—Report of the Meteorological Observations for Years 1876-85 at Imperial Meteorological Observatory at Tokio.—The Arithmetic of Electrical Measurements: W. R. P. Hobbs (Murby).—Zoological Record, vol. xii., 1885 (Van Voorst).—My African Home: E. W. Fielden (Low).—Studies in Social Life: G. C. Lorimer (Low).—The Mechanics of Machinery: A. B. W. Kennedy (Macmillan).—A Strain Indicator for Use at Sea: C. E. Stromeyer.—Report on the Progress and Condition of the Government Botanical Gardens at Saharanpur and Mussoorie for Year ending March 31, 1886 (Allahabad).

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