THURSDAY, JULY 16, 1885

THE BIRDS OF LANCASHIRE

The Birds of Lancashire. By F. S. Mitchell, M.B.O.U. Illustrated by J. G. Keulemans, Victor Prout, &c. Pp. xviii. 224. (London: Van Voorst, 1885.)

IMPORTANT as are the services which the writers of county faunas have rendered to the study of British ornithology every one knows, or ought to know, that such works have a very variable value. In some cases the geographical position of the county concerned is such as to invest its avifauna with high interest quite apart from the manner of its treatment, which may be, and in a few instances that we could but will not name, has been of a slovenly character. Or again, local considerations may be comparatively insignificant, and yet the book, from the combined knowledge and skill of the author, will be a great and positive gain to zoological literature. Thus it follows that the most pretentious works not unfrequently fall short of even a moderate standard of excellence, while that is attained or even surpassed by others put forward with unpresuming modesty. It gives us great pleasure to express our opinion that the little book now before us, "The Birds of Lancashire," falls well within the latter category. Its author, Mr. Frederick Shaw Mitchell, is known to have been engaged in its preparation for several years, and that he has used those years of preparation to good purpose almost every page in the book testifies. We have especially to commend his introductory remarks, which prove that he has taken the proper and philosophical view of the duties of a faunistic monographer, while the rest of the book shows how efficiently he has discharged them according to that view.

In these days the county of Lancaster, or at least its southern half, with its swarming population, its tall chimneys expelling tons upon tons of soot, and, still worse, volumes of noxious vapours, its once limpid streams drunk up by countless manufactories and returned to their channels befouled with deleterious compounds, presents almost as poor a field for the outdoor naturalist as can well be found in the United Kingdom. Nor does its geographical situation offer the ornithologist much promise for the pursuit of his study. Its coast-line, though extensive as that of English counties goes, is formed by the recess of a land-locked sea; and notwithstanding that as yet we really know little of the routes taken by birds in their migrations, there is nothing to induce the belief that any much-frequented route will be found to skirt Morecambe Bay, the sand-hills of Blackpool, or the estuaries of the Ribble and the Mersey. Nor do the hills of its interior, though rising to the height of nearly 2000 feet, and even exceeding that in the northern detached district of Furness, which contains the much admired Coniston Water and Windermere, add greatly to the attractiveness of a county which has the disadvantage of lying on the wrong side of our island—for we take it to be undeniable that in England birds, both as individuals and as species, decrease in number as we pass from the eastern to the western coast.

"The vast increase of population, and the scientific farming which drains every marsh, substitutes for every bosky nook a rigid bank and paling mathematically drawn, are the chief causes of the decrease both in species and individuals which has taken place in the manufacturing districts; but it is astonishing how many still flourish among the teeming millions which dwell there, and should it be possible for air and water to become more pure, there is no doubt that, except in the immediate vicinity of buildings, little further diminution would occur.

"The way in which birds are driven away by the extension of buildings, and by the conversion of a rural into an urban locality, may well be instanced by the case of Peel Park, Salford, which is one in point. Mr. John Plant has kindly permitted me to use his notes, which have been carefully kept since 1850, and which show the following results:—

		Personally observed.		Breeding.
1850-60	...	71 species	...	34 species
1860-70	...	42 ,,	...	— ,,
1870-75	...	19 ,,	...	8 ,,
1876-80	...	15 ,,	...	— ,,
1881	...	13 ,,	...	— ,,
1882	...	5 ,,	...	2[1] ,,

Mr. Plant considers that the main causes are not so much simply the presence of more people and greater disturbance by them, as the destruction of natural food, and loss of protective foliage, from the vitiated atmosphere, and makes the melancholy prophecy that, if the same thing goes on for another ten years, there will not be a large tree alive in the park."—*Introductory*, p. iii.

Yet Mr. Mitchell does not think that on the whole birds in Lancashire are decreasing, and remarks that "the greater scarcity of the Goldfinch, for instance, which feeds on the thistles of waste lands, is balanced by the greater plentifulness of the Hawfinch, which prefers a more cultivated country." The extensive range and increasing numbers of the species last mentioned of late years throughout the whole of England is indeed a matter that is at present quite unaccountable. But Mr. Mitchell goes on to say that "if the game-preserver will lay aside some of his truculence in respect of species which occasionally diminish his stock, if the denizens of towns will discourage the bird-catching fraternity, and be content to only hear the Linnet and the Bullfinch in their natural haunts, and if the specimen hunter will try to be content with skins which are not *local*, there is no reason to expect any approach to extinction of species which are now on the list." Here we would remark that not much harm comes from bird-catching if the law now existing be obeyed, and that without it few "denizens of towns" would ever hear the song of any bird; but we quite agree with what our author says as to the game-preserver and skin-collector. From the results of somewhat extensive observation in many parts of England it is clear that the absolute extermination of both Kestrel and Sparrow-Hawk—the last of the birds-of-prey which can be said to inhabit this country generally—will be accomplished in a very few years, and even our three species of Owl—in spite of the Act which nominally protects them—are likely to suffer the same fate. Mr. Mitchell no doubt recognises the fact, as every impartial observer must do, that, birds-of-prey excepted, the system of strict game-preserving affords an incalculable amount of protection to all other birds; but the "local specimen-hunter" is usually a pestilent character indeed—one who without any counterbalancing merit simply flatters his own vanity, degrades an interesting not

[1] Starling and House Sparrow.

to say instructive study, and induces his fellow-subjects to break the law by the price he offers for his "rarities."

Passing to another part of our theme we wish to mention our author's remarks on the valueless nature of nearly all the ordinary records with regard to the migrations of birds. Many we are sure must have felt the truth of the following statements; but we do not recollect having before seen it so explicitly put forth, and congratulate Mr. Mitchell on perceiving its importance. He says:—

"The fact is, that very few of the observations, now so numerously made, as to the movements of summer migrants, are worth anything at all; and if data are to be collected on land of value commensurate with those now being collected on information from lighthouses, &c., by the committee appointed by the British Association, it will be necessary for the observer to fulfil something like the following conditions: firstly, that he should be continuously engaged out of doors; secondly, that he should be entirely familiar, not only with the plumage of the birds, but that he should be able to recognise most of them when flying, and be thoroughly acquainted with their song, their call and alarm notes; and thirdly, that he should have a knowledge of the food requirements of each species, and be able, for instance, to infer, from the plentifulness of such and such an insect, that such and such a bird may be expected to feed on it. Such a conjunction can only be found in few individuals; but if every man in his leisure field-walks would, and especially in connection with meteorological conditions, note the other natural circumstances at the time of his first seeing a spring arrival, a mass of information would be got together, invaluable for the discovery of the laws of geographical distribution; and until something of the sort is done, and such information sifted and compared, I believe those laws will remain, as they are now, dubious and conjectural."—*Introductory*, pp. ix. x.

In the bibliographical portion of his work Mr. Mitchell shows himself to be well read, and the selections he makes from the writings of his predecessors seem to be exceedingly judicious. If he errs at all, which we do not say is the case, it is on the side of conciseness, and we can imagine that many readers who have not access to a good library would be better pleased had his extracts occasionally been longer, so that, should his little book reach a second edition, as it well deserves to do, this point might be borne in mind by the author; though we cannot find it in ourselves to blame him on this account, knowing the tendency to superfluity which prevails among the ornithological writers of the present day. One unquestionable merit Mr. Mitchell possesses. He is free from the wish to exaggerate the importance of his subject, and is certainly not bent on making out a numerous list of the birds of his county, as so many compilers of local faunas have done, by giving fresh life to the most doubtful reports which profess to record impossibilities. In one case, indeed, he seems to us to have transgressed; but he may be pardoned for not being aware of the profound mistrust that was entertained nearly five-and-twenty years since by well-informed persons in regard to some statements that were then made in a certain auction-catalogue. The Swallow-tailed Kite should disappear from his list. Lancashire, however, indubitably boasts the possession of the only existing "British-killed" specimens of the Black-throated Wheatear and the Wall-Creeper—though an example of the latter is known to have been obtained in Norfolk nearly one hundred years ago—and accordingly a coloured figure (by Mr. Keulemans) of each of these species is introduced. Some carefully drawn illustrations of decoys, as well as several other ingenious modes of netting or snaring wild birds, are also given, and these add not a little to the interest of the book; for, with the exception of the plates in Rowley's not very accessible "Ornithological Miscellany," we are not aware of any representation of the mode of capture by "fly-nets," while we think neither the "douker-net" nor the "snipe-pantle" has ever been figured before; and with respect to this last term, which Mr. Mitchell derives "from the Anglo-Norman 'panter = a net or snare,'" we may observe that Olina in 1622, and Willughby after him, calls a certain kind of net used in taking starlings, woodcocks, and other birds *pantiera*—a word which seems to exist now in Italian as *pantera*.[1] Of course a work on the birds of Lancashire could not be complete without a reference to Gerarde and the Pile of Foulders, whereon bernacles turned to geese; but we are glad to see that Mr. Mitchell abstains from sneering at the old herbalist's credulity, as so many modern writers have done, though we must point out to him that in these days to speak of a bernacle as "a species of multivalve" is to use a somewhat vague if not inaccurate expression. Let us add that a map of the county and, so far as we have tested it, an excellent index are among the merits of this satisfactory little book.

A CATALOGUE OF CANADIAN PLANTS

Geological and Natural History Survey of Canada. Alfred R. C. Selwyn, LL.D., F.R.S., F.G.S., Director. "Catalogue of Canadian Plants. Part II. Gamopetalæ." By John Macoun, M.A., F.L.S., F.R.S.C. 8vo, 200 pp. (Montreal: Dawson Brothers, 1884.)

ALTHOUGH this is only a catalogue of names and localities, it is a work of much interest and one that has been greatly needed by European botanists and botanical geographers. The flora of the north temperate zone in both hemispheres is so very similar in general character that nearly half of the genera of the Canadian area and a large number of the species reach to it all the way from Britain across Europe and through Siberia, and the remarkable longitudinal differentiation of the flora of the United States renders it a matter of much interest to be able to trace out the dispersion of the species through the more northern areas of the Continent. The "Flora Boreali-Americana" of Sir Wm. Hooker is now forty years old, and all that has since been worked out about the Canadian species and their distribution has never been put together and published so that it was available for general use. The first portion of the present Catalogue, which was issued in 1883, contained the Polypetalous natural orders; including naturalisations the number of Polypetalous genera was 243, and of species 907. The present part contains the Gamopetalæ, and carries up the number of genera to 498, and of species to 1811. So that the total number of flowering plants now known in British North America may be estimated at about 3000 species against 10,000 or 12,000 now known in the United States. One of the most remarkable points

[1] See also Prof. Skeat's "Etymological Dictionary" (p. 415) *sub voce* "Painter," for instances of its use by Chaucer and others.

about the Canadian flora is how extremely few species enter into it that are not found in the United States. The general question of the characteristics of the North American flora was fully discussed by Dr. Asa Gray in an address to the biological section of the British Association at Montreal, which was published in the issue for November, 1884, of the *American Journal of Science*. Two of its leading characteristics as compared with Europe are the abundant development of peculiar types of Compositæ and Ericaceæ. It is to this present catalogue that we must turn for full details on such matters as these in application to the northern area. One of the most curious instances of a locality for a well-marked plant widely distant from its main area is furnished by the occurrence of *Calluna vulgaris* in very small quantity in Newfoundland, Cape Breton Island, and Nova Scotia. It is not known on the American continent, and the genus *Erica* is entirely absent. A large number of common European plants, such as *Bellis perennis*, *Chrysanthemum Leucanthemum*, *Tussilago Farfara*, *Hyoscyamus niger*, and *Anagallis arvensis* are fully naturalised in Canada. Some British species, such as *Gentiana Amarella* and *Hieracium umbellatum* are represented in Canada by varieties mostly readily distinguishable from the European type. Of plants alpine in their European range which are widely spread in British North America we have instances in *Loiseleuria procumbens*, *Arctostaphyllos alpina*, *Linnæa borealis*, *Lobelia Dortmanna*, *Vaccinium uliginosum*, and *V. Vitis-idæa;* and of plants of wide European and British dispersion at a lower level in *Campanula rotundifolia*, *Achillea Millefolium*, *Viburnum Opulus*, *Pyrola minor*, and *Andromeda polifolia*. Mr. Macoun has consulted Dr. Asa Gray and Dr. Sereno Watson on all points of doubtful identification, and used the same nomenclature and standard of specific limitation. J. G. B.

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.*]

The Zoology of Dr. Riebeck's "Chittagong Hill Tribes."—The Gayal and Gaur

In Nature for June 25 (*ante*, p. 169) there appeared a review of the late Dr. Emil Riebeck's "Chittagong Hill Tribes." The contributions of the specialists who are entitled "the foremost naturalists of Germany" are mentioned as "separate monographs of great value."

This is no stinted praise, and as one of the separate monographs, that on the zoology, by Dr. Julius Kuhn, is especially noticed, I took the earliest opportunity of reading what I anticipated would prove a very interesting essay on the fauna of a rather imperfectly-known region.

I will only say that I was disappointed. The zoological "monograph" consists of four pages, two and a half of which are taken up by Dr. Kuhn's remarks on the gayal and gaur. These are the only portions deserving notice; the remaining page and a half contain notes, all trivial, and some seriously incorrect, on skulls of a rhinoceros, a bear, and a monkey, of only one of which a specific determination is attempted, and in that instance the name given is, I believe, wrong. Perhaps these notes are not by Dr. Kuhn, for his observations on the gayal (*Bos frontalis* v. *gavæus*) and the gaur (*B. gaurus* v. *cavifrons*) show some acquaintance, though an imperfect one, with the literature of the subject. Your reviewer credits Dr. Kuhn with the discovery that "the gayal or wild ox of Bengal, Assam, and Further India does not differ specifically from the gaur of India proper," and Dr. Kuhn writes apparently under the impression that the occurrence of the gaur east of the Bay of Bengal is not known. The range of the gaur throughout Assam, Tipperah, Chittagong, Burmah, and the Malay peninsula has, however, been well known for thirty years at least, and has been repeatedly described by Cantor, Blyth, Jerdon, and other naturalists, whilst the head of a Tenasserim gaur was well figured nearly fifty years ago in the *Journal* of the Royal Asiatic Society (vol. iii., 1836, p. 50). The fact that the wild gaur is called gayal by the natives of some parts of India is also not new. The name by which the tame gayal, *Bos frontalis*, is generally known in the country is not *gayal*, but *mithan*.

Dr. Kuhn's principal object is to show that the gayal may be a domesticated race of the gaur. It would be impossible to do justice to the subject without going into considerable detail, but the first stage in the inquiry is one to which no reference is made by Dr. Kuhn. This is the question whether *Bos frontalis*, the gayal, exists as a distinct species in the wild state, as stated by Lambert, Colebrooke, Horsfield, Blyth, and others, or whether, as lately urged by Mr. J. Sarbo (*Proc.* Z.S., 1883, p. 142), there is no such thing as a wild gayal. A very valuable contribution to the history of these animals was published twenty-five years ago by Blyth in the *Journal* of the Asiatic Society of Bengal, vol. xxix. p. 282, in a paper "On the Flat-horned Taurine Cattle of South-East Asia." This paper was, I think, subsequently republished in either *Land and Water* or the *Field*, but I am not certain. One most important circumstance mentioned by Blyth on apparently excellent authority is that the gaur is kept tame in the interior of the Chittagong hills, and, as a tame animal, is quite distinct from *Bos frontalis*. If this is the case hybrids are very likely to occur, for the gayal breeds freely with the much less nearly allied zebu, and such hybrids may account for the occurrence of forms intermediate between the gayal and gaur. An indication that such forms exist is, so far as I can see, the only evidence brought forward by Dr. Kuhn in favour of the gayal being a domesticated race of the gaur, his main argument; his supposed discovery that the tame gayal and wild gaur inhabit the same country being a singularly fine example of a *nidus equæ*.

It will, I hope, be understood that these observations apply solely to the zoological portion of Dr. Riebeck's work; though, in connection with this, in another part of the book, I remark that Plate 14, Fig. 2, which represents a rodent's—probably a squirrel's—skull, is called in the explanation of the plate "the skull of a musk-deer"! Your reviewer's opinion of the work is doubtless founded on the anthropological and ethnological portions; I only dissent from the views expressed as to the zoological monograph. W. T. Blanford

July 11

"The Fauna of the Seashore"

In the abstract of Prof. Moseley's interesting lecture on "The Fauna of the Seashore," published in the current number of Nature (p. 212) several agents are referred to as competent to call into play the tendencies to vary which are embodied in each species. These, whether suggested by Prof. Lovén or the author of the lecture, include—light and shade, temperature, currents, food, enemies, favourable condition of water for respiration, and the variation of conditions produced by tides. I venture to think that one very important factor in the variation of the marine fauna, if not the most important, has been left out of the list: I refer to marine waves.

The action of waves on the littoral fauna is not only extremely severe, but it is of constant recurrence; and failure to resist it does not merely involve some minor disadvantage or inconvenience to the object attacked, but its very existence.

A point commonly overlooked by naturalists is the severity of the wave-action arising from the reciprocal character of the wave-currents. Human bipeds occasionally experience the inconvenience of a shifting current when encountering opposing blasts of wind at some street corner during a gale. The marine littoral fauna, living in a much denser medium, encounter two analogous currents for every passing wave heavy enough to affect the bottom, and have to encounter these currents without cessation for the days or weeks the storm may last. Any failure to resist this inexorable enemy on the part of the shallow water denizens of the sea or any encroachment on exposed areas during fine weather by animals unfitted to meet the storm will incur the penalty of death.

The prime necessity for every member of the littoral fauna is the power of resisting the attacks of waves; and every development and variation undergone by such littoral fauna must of necessity have been carried out under the immediate control of waves.

If, as Prof. Moseley tells us, it was in the "littoral zone . . . that all the main groups of the animal kingdom first came into existence," we may go further and say that these main groups were modelled by the ceaseless action of waves, as these in their turn were brought into being by winds raised by solar heat. Thus the early stages of evolution can be carried back directly, by the two short links of wind and wave, to the sun itself.

One point that I have never published myself or seen recorded by others, is the curious conflict that may be observed between wave- and tidal action. For example, a shell with a wide bathymetrical range, from tide-marks to, say, fifty fathoms, may evince a tendeney towards the elaboration of a useful form and sculpture, in the deeper water; whereas, between tide-marks the two daily checks to growth arising from the fall of the tide would immediately check any such variation in sculpture, and the altered form would no longer be best suited to the along-shore conditions.

Moreover, as the form best suited to tide-marks is often in conflict with that best suited to deeper water, the form of a species living between tide-marks might soon diverge from that of the same species frequenting deeper water. As a possible instance I would adduce the case of *Trochus zizyphinus* and *T. granulatus*. These gasteropods have always, I believe, been considered distinct species; but I have in my possession specimens from about fifteen fathoms, showing a distinct passage between the smooth zizyphinus and the sculptured granulatus, and this both in outline and sculpture.

I regret that I have been unable to obtain odontophores of the intermediate forms to ascertain if they confirm the passage from the one species into the other. It is, I think, evident that though *T. zizyphinus* can retain its form in deep water, *T. granulatus* could not retain its symmetrical granulated sculpture were it to invade the tidal strand.

The variety of method exhibited by the littoral fauna in resisting wave-currents affords a most interesting subject of research. Take for instance an exposed ledge of rock—no hypothetical one—with sturdy limpets living on it, the fragile *Pholadidea papyracea* living in it, and the hardy little *Littorina obtusata* clinging to the sea-weed. A storm attacks the trio, and tests their several methods of defence. The limpet is safe on the rock, the Pholadidea in it, and the Littorina, though at once washed off its feeble support, is safe, thanks to its solid shell, from the utmost violence of the storm. The tenacious hold of the limpet on the solid rock and the feeble adherence of the Littorina to the sea-weed indicate very opposite methods of meeting a common danger.

In conclusion I would put in a plea for working-models of the sea in some of our new aquariums. When one sees in a tranquil tank such a fish as the gurnard with its far-spreading feelers ready to steady itself amid swinging wave-currents, one would like to see its machinery brought into action. A gentle swinging motion could be easily imparted to the waters of a tank, and under such conditions the observer would see the animals use the special appliances they possess for resisting or evading their most formidable enemy.

ARTHUR R. HUNT

Torquay, July 6

"New System of Orthography for Native Names of Places"

ALLOW me room for a few remarks on the Royal Geographical Society's "New System of Orthography for Native Names of Places," just published in your number for July 2. The Society has earned the thanks of the public for grappling with the neglected and vexatiously inconsistent question of place-name spelling. Attention was called by myself to this subject in *Notes and Queries* of May and July, 1884, and I can take no exception to the vowel and consonant system suggested by the Society, save to the retention of the un-English letter *x* and to one other particular.

This latter exception deals with the statement contained in paragraph (2) that "no change will be made in the spelling of names that have become by long usage familiar to English readers—as Calcutta, Cutch, Celebes, Mecca, &c." Now, why make even these exceptions to the excellent rules laid down? Exceptions are always a nuisance, and in the cases of justifiable reforms prove more often than otherwise the means whereby the benefits of such reforms are frustrated altogether. A little more boldness by the Society in grasping the nettle is wanted; and while an improved alternative spelling would soon become familiar to the public, the help given by this concession to logical consistency would encourage reforms both here and in other fields. The attempt to consider the public convenience here illustrated is, I believe, unnecessary; while the seeking to preserve historical spellings, as with other historical and venerable anachronisms, comes to this—that the progress of reform is continually becoming hidebound and stunted, if not stopped altogether, by the impossible attempt to energise distinct stages of growth at one and the same time. It is earnestly to be hoped that the Geographical Society, upon whom the mantle of "Bahnbrecher" in spelling reform has suddenly fallen, will do the wise thing here, and boldly declare against all "exceptions" to wholesome, justifiable improvement.

The need for, and the influence on other departments of spelling reform, of bold action on the part of the Society is illustrated by the retention of the letter *x*. In any reform scheme of the spelling of English place-names—the next urgent question to the above—the abolition of this letter will stand in the fore-rank of improvements. Witness its mischievous working in "Boxted" (Buckstead), "Hoxton" (Hogston in 1790), "Oxted" Ockssteadl), Huxtable (Huckstable), &c.!

N.

July 9

Recession of Niagara Falls in 133 Years

THE fallacy of Lyell's guess at the rate of recession was always plain if we referred to the first accurate account, that of the Swedish traveller Kalm, in *Gent. Mag.*, January, 1751; since which the gorge has both been enlarged full 100 acres, and had miles of its bed deepened many feet. In p. 16, col. 1, A, he said: "Canoes can go yet half a league above the beginning of the carrying place, . . . but higher up it is quite impossible, the whole course of the water, for two leagues and a half up to the great fall, being *a series of smaller falls, one under another.*" Now plainly this whole series have so levelled their bed that the main falls now descend some 160 feet instead of the "137 feet" that he repeatedly maintained (col. 2, E) to be the utmost the engineers, "with mathematical instruments," then admitted. But as for the plan, he is yet more definite. P. 16, col. 1, E: "The river (or rather strait) runs here from south-south-east to north-north-west, and the rock of the great fall crosses it, not in a right line, but forming almost the figure of a semicircle or horse-shoe." (Prof. Tyndall has well remarked that, the upper stream having probably been always much wider than the gorge, the chief fall has always been concave; but Kalm's view makes it appear very slightly so, and we know that very flat segments are, by a perspective illusion, commonly thought semicircles or even "horse-shoes.") "Above the fall, in the middle of the river, is an island, lying also south-south-east and north-north-west, or parallel with the sides of the river; its length is about 7 or 8 French arpents (an arpent being 120 feet). The lower end of this island is just at the perpendicular edge of the fall." He proceeds to tell how this island, once thought inaccessible, had been the scene of the heroic rescue, twelve years before, of two Indians by two others. Then, p. 18, col. 2, F.: "The breadth of the fall, as it runs in a semicircle, is reckoned to be about 6 arpents. The island is in the middle of the fall, and from it to each side is almost the same breadth" (barely 350 feet then, but in his engraving not half that). "The breadth of the island at its lower end is two-thirds of an arpent or thereabouts." His view makes it but *one*-third the height, *i.e.*, one-third of "137 feet."

Now this mere reef, about 900 feet by less than 80, was plainly one whose length the falls were reducing. Is there the least ground for holding they have ever reduced Goat Island (now ten times larger than that) or will reduce it one rood? But, prolong "Luna Islet" north-north-west till 900 feet long, and you will have the site, I submit, of Kalm's middle rock, barely 350 feet from the point Mr. Wesson marks, on Fig. 2, "New York Shore," and about as much from a Canadian point west-south-west of it. As for Goat Island, it cannot, in his time, have yet been touched by the falls, but may be one of those the hunters had habitually visited above. His description can be so well plotted on this last survey that the amount of gorge excavated since 1750 should be knowable to an acre. The west fall, then, only slightly the larger, has ever since been widening, lowering its edge, and getting more of the stream; so that the east one, comparatively stationary, retaining its height and decreasing in volume, must dry up, and its bed and all the isles become part of New York State. E. L. GARBETT

July 11

Sky Glows

EVER since the sunsets of 1883 and last year there has been at times an abnormal glare both before and after sundown. But I have seen nothing in the way of twilight effect so strange as that of Monday evening, the 6th, when about 10 p.m. a sea of luminous silvery white cloud lay above a belt of ordinary clear twilight sky, which was rather low in tone and colour. These clouds were wave-like in form, and evidently at a great elevation, and though they must have received their light from the sun, it was not easy to think so, as upon the dark sky they looked brighter and paler than clouds under a full moon. A friend who was with me aptly compared the light on these clouds to that which shines from white phosphor paint. This effect lasted for some time after 10 p.m., and extended from west to north, the lower edge of the clouds, which was sharply defined, was about 12° above the horizon. ROBT. C. LESLIE

6, Moira Place, Southampton, July 8

Black and White

MY daughter has two terriers, one black, the other white; she has noticed that in the dusk of the evening the black dog is much more visible than the white one, and has asked me the reason for this fact. I cannot properly explain why a white or light coloured garment shows much less in the dusk than a dark coloured dress, but this is a well-known fact to all sportsmen who shoot ducks at night, when it is their custom to wear a night shirt or other white dress over their ordinary costume. When the black and white dogs are playing together in the dusk of evening, the black dog can be distinctly seen when the white dog, at the same distance, is quite invisible. Will you please explain this? WM. E. WARRAND

Bught, Inverness, July 8

"Foul Water"

DURING a brief stay at Beaumaris in June 1883, and again in June 1884, I had frequent opportunities of observing the "gelatinous masses" mentioned by Mr. Shrubsole as occurring in large numbers at Sheerness-on-Sea. I first noticed them in 1883, while procuring a supply of water for my marine tanks at home. They then existed in very large numbers, and as I had no means of filtering the water before returning to Manchester, I almost expected to find it "foul" upon my arrival. I was, however, agreeably disappointed. The "gelatinous masses" had settled at the bottom of the jars, and were apparently dead. While at Beaumaris I subjected a few specimens to microscopical examination, but being busy with other work did not learn more than is given in Mr. Shrubsole's description.

Manchester HERBERT C. CHADWICK

Earthquake-Proof Buildings

UNLESS my memory plays me very false a number of lighthouses secured against earthquake shocks by saucers and balls were built in Japan just about twenty years ago from the designs of Mr. Stevenson of Edinburgh. WM. MUIR

The London Institution, Finsbury Circus, E.C.

THE QUESTION OF CIVIL AND ASTRONOMICAL TIME

ONE of the points made at the Washington Congress was that if Universal Time (surely Earth-Time or Prime Meridian Time would be a better term) were generally accepted, astronomical time might be abolished, astronomers accepting the new day of twenty-four hours commencing at midnight.

Since the Congress the question naturally has been well considered, and we think it desirable that we should now refer to some of the most important opinions which have already been given, not only as regards the desirability of the change, but as to the time at which that change should be brought about.

Among the first to accept the resolution was the Astronomer-Royal, for theinternal use of the Observatory of Greenwich. Many opinions were collected at an early date and forwarded by Mr. Chandler, the Secretary of the U.S. Navy to the Senate. This action grew out of an order of Commodore Franklin, the Superintendent of the U.S. Naval Observatory, to adopt the new time on January 1, 1885; this was communicated to Prof. Newcomb, the Superintendent of the *American Nautical Almanac*, and drew a reply from Prof. Newcomb, from which we make the following extract:—

"(1) The Conference expresses the hope that as soon as may be practical the astronomical and nautical days will be arranged everywhere to begin at mean midnight.

"(2) That east longitudes shall be counted as plus and west longitudes as minus.

"The first of these recommendations proposes a change in the method of counting astronomical time which has come down to us from antiquity, and which is now universal among astronomers. The practice of taking noon as the moment from which the hours were to be counted originated with Ptolemy. This practice is not, as some distinguished members of the Conference seem to have supposed, based solely upon the inconvenience to the astronomer of changing his day at midnight, but was adopted because it was the most natural method of measuring solar time. At any one place solar time is measured by the motion of the sun, and is expressed by the sun's hour angle. By uniform custom hour angles are reckoned from the meridian of the place, and thus by a natural process the solar day is counted from the moment at which the sun passes over the meridian of the place or over the standard meridian. For the same reason sidereal time is counted from the moment at which the vernal equinox passes over the meridian of the place, and thus the two times correspond to the relation between the sun and the equinox.

"It would appear that the Conference adopted the recommendation under the impression that the change would involve nothing more than the current method of reckoning time among astronomers, and could therefore be made without serious inconvenience. A more mature consideration than time permitted the Conference to devote to the subject would, I am persuaded, have led that distinguished body to a different conclusion.

"A change in the system of reckoning astronomical time is not merely a change of habit, such as a new method of counting time in civil life would be, but a change in the whole literature and teaching of the subject. The existing system permeates all the volumes of ephemerides and observations which fill the library of the astronomer. All his text-books, all his teachings, his tables, his formulæ, and his habits of calculation are based on this system. To change the system will involve a change in many of the precepts and methods laid down in his text-books.

"But this would only be the beginning of the confusion. Astronomical observations and ephemerides are made and printed not only for the present time, but for future generations and for future centuries. If the system is changed as proposed the astronomers of future generations who refer to these publications must bear the change in mind in order not to misinterpret the data before them. The case will be yet worse if the change is not made by all the ephemerides and astronomers at the same time epoch. It will then be necessary for the astronomers of the twentieth century, using ephemerides and observations of the present, to know, remember, and have constantly in mind a certain date different in each case at which the change was made. For example, if, as is officially announced, the Naval Observatory introduces the new system on January 1, 1885, then there will be for several years a lack of correspondence between the system of that establishment and the system of the American Ephemeris, which is prepared four years in advance.

"It is difficult to present to others than astronomers who have made use of published observations the confusion, embarrassments, and mistakes that will arise to their successors from the change. The case can be illustrated perhaps by saying that it is of the same kind as—though in less degree than—the confusion that would arise to readers and historians in the future if we should reverse or alter the meaning of a number of important words in our language with a result that the future reader would not know what the words meant unless he noticed at what date the book was printed. The words would mean one thing if printed before the date of change, and another if printed after.

"It is worthy of attention that even the republican Government of France in 1790, which adopted a new calendar, did not venture to change the old system in its astronomical ephemeris.

"I see no advantage in the change to compensate for this confusion. If astronomical ephemerides were in common use by those who are neither navigators nor astronomers the case would be different. But, as a matter of fact, no one uses these publications except those who are familiar with the method of reckoning time, and the change from astronomical to civil time is so simple as to cause no trouble whatever.

"The change will affect the navigator as well as the astronomer. Whether the navigator should commence his day at noon or midnight, it is certain that he must determine his latitude from the sun at noon. The present system of counting the day from noon enables him to do this in a simple manner, since he changes his own noon into the astronomical period by the simple addition or subtraction of his longitude. To introduce any change whatever into the habits of calculation of uneducated men is a slow and difficult process, and is the more difficult when a complex system is to be substituted for a simple one. I am decidedly of the opinion that any attempt to change the form of printing astronomical ephemerides for the use of our navigators would meet with objections so strong that they could not be practically overcome.

"The second conclusion which I wish to consider is that which proposes to reverse our method of assigning algebraic signs to the longitudes by counting east longitudes as plus, and west longitudes as minus. The present system was adopted some forty years ago in Germany as being the most natural, because longitude was measured upon the earth by the apparent motion of the sun and stars from east to west, and it seemed most natural to count the direction of this motion as algebraically positive. This system has been adopted in the American Ephemeris since its origin, and all its tables and formulas which involve the application of longitudes have been constructed on this principle. To reverse this method will cause error and confusion to every one using the Ephemeris without, as far as I can see, the slightest compensating advantages. I am therefore of opinion that it should not be adopted.

"I respectfully submit that in view of these considerations no change should be made in the mode of reckoning time employed in the publications of this office until, by some international arrangement, a common date shall be fixed by all nations for the change."

Prof. Newcomb adds a list of changes in the *American Nautical Almanac* required when the astronomical day is reckoned from midnight.

"Page 1 of each month: The numbers on this page being given for Greenwich apparent noon, the question whether they shall remain unchanged or be given for Greenwich apparent midnight will have to be decided by competent authority.

"Page 2 of each month to correspond with the new mode of reckoning these numbers would be given for mean midnight, which would change the whole page.

"Page 3 of each month: Nearly the same remark applies to these pages as to page 2. When the change is made there will be a discontinuity of half a day in the comparison of the sun's longitudes before and after the change.

"Page 4 to correspond strictly to the new reckoning, the columns noon and midnight on this page would have to be interchanged. This might lead to errors on the part of the computer accustomed to the old system inadvertently forgetting the change which had been made. If not made the system would be a mixed one.

"Pages 5 to 12: All the numbers on these pages will be differently arranged when the hours are counted from midnight.

"Pages 13 to 18: The lunar distances will have to be given for midnight on the first column of the left-hand pages, and for noon on the first column of the right-hand pages, thus reversing the placing of the numbers on the two pages.

"Planetary ephemerides: These will naturally have to be given for midnight instead of noon, and the signification of all the numbers will therefore be different. There will also be a discontinuity of half a day in the progression of the series of epochs at the time the change is made.

"Moon's longitude and latitude: The indications of the times given in this part of the Ephemeris will be altered by half a day. The result would be that a computer inadvertently forgetting the change would take out a result half a day in error.

"Sidereal time of mean noon: Wherever this quantity was given throughout the Ephemeris it would, on the new system, have to be replaced by the sidereal time of mean midnight.

"Transit ephemerides: These would remain unaltered except the column of mean time of transit, which would be changed by 12 hours.

"Changes of nearly the same kind as in the planetary ephemerides would have to be made in giving the predictions of phenomena."

The following extract gives the gist of Commodore Franklin's reply to Prof. Newcomb's objections:—

"So far as the counting of astronomical time from antiquity is concerned, it is the argument of conservatism which desires no change in an existing order of affairs; yet, assenting to this argument, we might refer to a still remoter antiquity—to the time, not of Ptolemy, but of Hipparchus, the 'founder of astronomy,' who reckoned the twenty-four hours from midnight to midnight, just as the Conference has proposed.

"While it is unquestionably true that some confusion may occur, yet the liability to it will be almost entirely with the astronomer, who, through his superior education and training, could easily avoid it by careful attention to the ephemerides he was using. During the years of change, before the ephemerides are constructed in accordance with the new method, it will only be necessary to place at the head of each page of recorded observations the note that the time is reckoned from midnight, to call attention to the fact, and thus obviate the danger of error.

"It is an undeniable fact that the educated navigator finds the conversion of time a simple matter, yet experience has demonstrated that to the mariner who is not possessed of a mathematical educatian there is a decided liability to the confusion which is so greatly deprecated by all who are interested in this subject. I believe that to all navigators, at least to all English-speaking ones, the new method will prove itself decidedly advantageous.

"As is well known, for many years navigators kept sea time, by which the day was considered to begin at noon, preceding the civil day by twelve and the astronomical date by twenty-four hours. The change to civil time now kept on board ship was effected readily and without friction, so that the recommendation of the Conference regarding the commencement of the nautical day has already been largely anticipated. The navigator is concerned not with his longitude but with his Greenwich time, having obtained which he can take from the *Nautical Almanac* the data he seeks whether given for noon or midnight, and when the ephemerides shall have been made to conform to the new system there will be one time in common use by all the world.

"It seems to me eminently proper that the nation which called the Conference should be among the first to adopt its recommendations, and while it might possibly be better to wait until an entire agreement has been entered into by the astronomers of all nations, yet the fact that the first and most conservative observatory in the world has acceded to this proposal of the Conference would seem to be a sufficient reason why we should not wait for further developments. In deference, however, to the views so well advanced by Prof. Newcomb, and in view of the fact that the President has recently transmitted the proceedings of the Conference to Congress, as well also of the desirability of securing uniformity among the astronomers of our own country at least, I have suspended the execution of the order for the present with the view of communicating with those engaged in kindred work in order to ascertain their sentiments on the subject."

The replies received to Commodore Franklin's circular may be summarised as follows:—

Mr. STONE, Leander McCormick Observatory—

Change should be made completely on January 1, 1885.

Prof. NEWTON, Yale College—

Change desirable, may begin at once for internal use, and any communication from an observatory should state precisely what time is adopted.

Prof. PICKERING, Harvard College—

A general agreement more important than the mode of reckoning; will follow Greenwich absolutely.

Mr. HARRINGTON, Ann Arbor—
Will do as Greenwich does.

Prof. HOLDEN, Washburn Observatory—
Begin in 1890.

Prof. YOUNG, Princeton—
Begin January 1, 1885.

Mr. SWIFT, Warner Observatory—
Begin January 1, 1885.

Prof. LANGLEY, Alleghany—
Begin January 1, 1885.

Mr. PORTER, Cincinnati—
Begin January 1, 1885.

Prof. PRITCHETT, Washington University Observatory—
Wait a year at least for general concensus.

Prof. PETERS, Clinton. We extract his letter:—

"I have, from the beginning, attached very little importance to the object and the proceedings of the International Meridian Conference.

"The suggestions and recommendations which have been the result refer principally to things that are already in existence; for example, the reckoning of geographical longitudes east and west from Greenwich is in practice with most nations. The proposition to count the hours of the day from 0 to 24 also in civil life will scarcely ever be adopted, for nobody (except perhaps sick people lying in bed) will have patience enough to count the striking of the clock up to 24, not to speak of the greater liability of miscounting the strokes and of the difficulty in reading off the turret dial if the circle be divided into twenty-four parts. But what concerns astronomers directly is the change proposed by the Conference in the beginning of the astronomical day, in regard to the introduction of which you ask for my views. It is quite unimportant, of course, whether we begin from noon or from the preceding midnight; the reasons for taking the former as the starting-point exist no longer. Our clocks nowadays are not regulated, as in former times, by observing the culmination of the sun, and with the telescopes of increased size observations are continued not during the night alone, but are carried on as well in day-time, so that a break in the date at midnight is hardy more grievous than one at noon. While thus we might readily conform with the proposal of the Conference, and put our clocks back by twelve hours, we ought to hesitate nevertheless very much to do so at once, especially for two reasons: First, a general agreement and understanding among astronomers (not of the United States alone but of all nations) should be had; otherwise it would become necessary for avoiding confusion to add to every observation we publish some such words as 'old-style time' or 'new-style time.' The subject undoubtedly will be discussed in the astronomical periodicals, and in societies representing our science. If authorities such as the Royal Astronomical Society, the German Astronomical Gesellschaft, the larger active observatories, &c., agree in favour of the change, the system of reckoning the astronomical day from midnight will soon be adopted universally. But a partial proceeding seems highly objectionable. Second, if we make a change in the time-keepers of the Observatory now, the use of the astronomical ephemerides, as they lie computed before us, will be made in many respects heavy. Take, for example, the places of the fixed stars, which are given for upper culmination from ten to ten days. When the sidereal day begins before noon, its date in the new arrangement of the solar day is changed. And every star place that we wish to take out of the ephemeris, therefore, requires some additional attention and reflection as to the corresponding date. In the *American Nautical Almanac*, where the tenths of the solar day are given, this inconvenience, to be sure, is not so great; we need only to diminish our argument by 0·5 day for having that of the table. A similar reduction of the argument must be made in using the lunar ephemeris, and of course in all the data expressed in solar time. In this way a source for at least possible mistakes is opened, and I think it therefore desirable that the change in the *Nautical Almanacs* should *precede* that in the observatories. The *American* as well as the *British Nautical Almanacs* are published as far as 1887, inclusive; the next or the next two following years may be under preparation.

"These considerations together lead me to the conclusion that it seems *not* advisable to introduce the change in the beginning of the astronomical day *before* the year 1890."

More recently two European astronomers have recorded their opinions. Prof. Struve in a pamphlet,[1] and Prof. Oppolzer in the *Monthly Notices*. The former thus expresses his views:—

"In regard to the change in the beginning of the astronomical day, thinks that the question before astronomers is not only of giving up a long-established custom, with consequent changes of rules of many years' standing, but it also involves a serious interruption of astronomical chronology. Without a doubt the astronomer would have to make a decided sacrifice in conforming to the wish of the Conference; but, after all, this sacrifice is no greater than our forefathers made when they changed from the Julian to the Gregorian calendar—a sacrifice to convenience of which we are still made sensible whenever we have occasion to go back to early observations.

"We need have little hesitation in making a similar sacrifice if it will prevent discordance between the civil and scientific custom of reckoning time, particularly troublesome where astronomical establishments come in contact with the outer world.

"Prof. Struve states that the Pulkowa Observatory is prepared to adopt the new time, the only question being as to the epoch when the change should be introduced in the publications of the Observatory. He is inclined to recommend that this should be deferred until some agreement can be reached by astronomers, and until the new time is adopted in the Ephemerides. This might be for the year 1890, or perhaps, better still, at the beginning of the next century."

Prof. Oppolzer's opinion is as follows:—

"When once such a universal time is introduced for all purposes it is quite natural that the question must arise, if there is indeed so great a necessity to retain in astronomy, and only in astronomy, a different reckoning of time. I fail to see this necessity, and I do not think that it would cause any serious trouble or confusion if a change were to be made in our astronomical reckoning; whilst a special mode of reckoning time in one science only, when all others use the generally-adopted standard, will, without doubt, be a source of error and confusion.' He then takes up in some detail the objections urged against the proposed change by Prof. Newcomb, and he discusses the changes which would be necessary in the Ephemerides. Prof. Oppolzer proposes to give practical effect to his views by adopting the new reckoning of time in an extensive list of 8000 solar and 5200 lunar eclipses which he is now preparing for publication."

Science, in an article on this subject, concludes as follows:—

"It is difficult to see how this matter will finally be decided. It is evidently a question for astronomers to settle among themselves; but so far they seem to be very evenly divided. For instance: out of some twenty-seven astronomers whose opinions, more or less decided, have been accessible for a count, thirteen seem inclined to favour the proposed change, while fourteen are opposed to it. And among the *pros* are Adams, Struve, and Christie; among the *cons*, Newcomb, Foerster, and Auwers."

MR. FREDERICK SIEMENS'S GAS LAMP

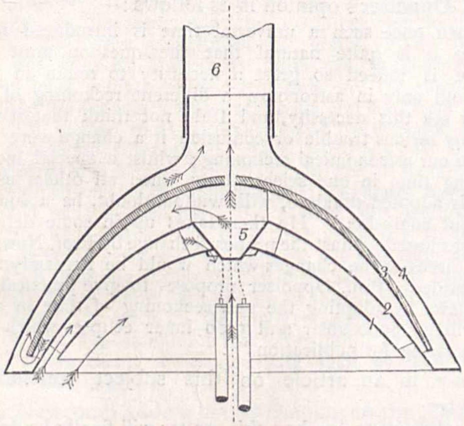
THE illuminating power of the most novel appliances for the production of light having, for economical reasons, been made more and more intense, and therefore more injurious to the eyesight, it follows that the eye must be protected as much as possible from the direct action of the light, with the least possible loss or diminution of effect. In other words, rooms should be lighted only by means of indirect rays or diffused light, the source of light itself not being directly visible. This is, in the author's opinion, a consideration of the highest importance as regards artificial illumination, which has only as yet received partial attention.

Until lately three main points only have been considered in any lighting application—viz. that the apparatus employed should be simple both in its construction and in its use; that the light should be of sufficient intensity for

[1] "Die Beschlüsse der Washingtoner Meridianconferenz."

the purposes required; and that the first cost and the maintenance of the plant employed should be very moderate. In public estimation, simplicity is the first *desideratum;* and hence a simple and direct form of illumination has always been preferred to a more complicated arrangement, even when the latter has been found more economical as regards first cost and maintenance, and more brilliant in its effects. At the present time, however, in addition to these requirements, a purer atmosphere and a more pleasant temperature in our apartments are desired, which matters received very little or no attention in former days, when people were content with a simple dim light, and took little interest in sanitary matters. The regenerative gas-burner may be regarded as a combined lighting and ventilating apparatus, by the employment of which the close oppressive atmosphere, so unpleasant at large gatherings, may be entirely avoided. In fact, it is the outcome of the demand for cooler and purer air in our apartments, combined with light of high intensity.

The lamp has been designed with a view to protect the eyesight from the direct action of the source of light, without diminishing its power; its construction will be understood from the following description:—Four hoods, 1, 2, 3, 4, of sheet iron or other suitable material, are arranged within one another in such a manner that the products of combustion travel downward between



2 and 3, and upward between 3 and 4, while the air to be heated for feeding the flame passes upward between 1 and 2. On the uppermost hood, 4, a chimney, 6, is provided, while the hood, 3, is shortened below so as to allow a clear passage for the products of combustion from the space between 2 and 3, to that between 3 and 4, and thus to the chimney. The hood, 2, carries at its apex an inwardly projecting outlet, 5, through which the products of combustion pass away as described, first downwards and then upwards, through the passages between the three upper hoods, into the chimney. The lowest or innermost hood, 1, is open, so that the air may pass upwards between the hoods, 1 and 2, as indicated by the arrows, to fill the inner space of the hood with heated air. The inner surface of this hood acts as a reflector, and in its focus are placed one or more fishtail burners of the usual type. As soon as the hood, 2, becomes sufficiently heated, through the action of the products of combustion passing between it and 3, the air between 1 and 2 will become heated, and, diminishing in its specific gravity, will automatically rise and fill the upper portion of the cone inside the hood, 1. By this arrangement the gas-jets burn within an atmosphere of heated air, with which they are consequently permanently supplied; the temperature of the air increasing with that of the gas-flames, and the brilliancy of the light increasing in the same ratio. The action is perfectly automatic, for, as the products of combustion pass away through the chimney 6, fresh heated air comes in at the same rate into the inner space of the hood 1 containing the gas-flames, to occupy the space which would otherwise be filled with cold air from the atmosphere below. The hot air which is supplied from the column of heated air formed between the hoods 1 and 2 will, on account of its *lower specific gravity*, always fill the upper space inside the hood 1, thus preventing the cold air of the atmosphere, which is at least three times as heavy, from rising inside the hood, 1, above a certain level, even in case of a disturbance in the atmosphere of the room. Thus no glass partition to exclude the cold air is required. The flame reflects its light directly downwards, as also from the inner surface of the hood, there being consequently an entire absence of shadows.

The light can be more or less concentrated or diffused, as desired, by varying the shape of the hood or reflector used. In some cases, where it is required to diffuse the light widely, or to diminish the downward radiation of heat, a bell-shaped glass, with its apex upwards, and its surface curving parabolically in the downward direction, may be employed, so as to cause all the rays of light it receives either to be refracted or to be reflected horizontally. If it is only desired to reduce the intensity of the downward radiation of heat, clear glass should be employed; if, however, it is also desired to diffuse the light, opaque glass is requisite, and the light may be thus more or less diffused, as may be required. The glass bell is suspended on a wire net of large mesh attached to a metal ring below, upon which and upon the netting the glass rests, so that, in case of accident, the broken glass would not fall below. It allows of free access to the flame, and does not form an integral part of the apparatus, so that its employment will not cause any particular trouble or inconvenience. As the intensity of the light depends entirely upon the up-current of heated air, the hoods may have any shape most suitable for the reflector and for the purpose of diffusing the light, provided that the height of the column of hot air between the hoods 1 and 2 be not relatively diminished.

The following tests of this lamp have been made:—The burners or jets removed from the dome were tested with the rays horizontal. The consumption of gas was 20 cubic feet per hour, and the illuminating power 57·5 candles, or 2·875 candles per cubic foot. They were then placed at an elevation of 1 foot 6 inches perpendicularly over a plain glass mirror placed at an angle of 45°, and in a line with the disk of the photometer. The distance from the standard light to the glass reflector was 18 feet 6 inches, which, added to the 1 foot 6 inches that the burners were placed above the reflector, made together 20 feet, the distance at which the light to be tested has to be fixed from the standard light in the photometer employed. In this case the consumption was again 20 cubic feet per hour, and the illuminating power was found to be 55 candles, or 2·75 candles per cubic foot; so that it would appear that there is an absorption by the glass in reflection of 4·35 per cent. The burners having been fixed in the dome reflector, the lamp, thus arranged, was tested again as in the last experiment. The consumption of gas was 20·5 cubic feet per hour, and the illuminating power 62·5 candles, or an average of 3·048 candles per cubic foot of gas, or 3·180 candles per cubic foot if the 4·35 per cent. found to be absorbed by the glass are added. The difference between 2·875 and 3·180 candles, or 0·305 candle, per cubic foot gives the increase of light due to the use of the reflecting cone. After burning for some time the lamp was again tested, the consumption of gas was found to be reduced to 15·5 cubic feet per hour, and the illuminating power to be increased to 115 candles, being an average of 7·42 candles per cubic foot; or, allowing for loss by absorption, 7·74 candles per cubic foot. The difference between this and 3·180 candles, or 4·560 candles, gives the gain in light per cubic foot of gas due to the regenerative arrangement, the gas burning within a highly-heated atmosphere.

Date.	Particulars of Burners.	Pressure of Gas.	Consumption in cubic ft. per hour.	Candle-power.	Candle-power per cubic ft. of gas.	Corrected for loss by mirror.
May 6, 1885.	Gas jets taken out of lamp	Ten-tenths	20·0	57·5	2·875	...
,,	Same jets raised 18 inches to reflect light on mirror[1]	,,	20·0	55·0	2·750	...
,,	Same jets burning in cold lamp	,,	20·5	62·5	3·048	3·180
,,	Same jets burning in hot lamp	,,	15·5	115·0	7·420	7·740

Of course light may be diffused or transmitted indirectly by other means than those described, though not perhaps in a more simple or economical way. The electric light has been to a certain extent already treated in a similar way by suspending arc lights at great altitudes, and by means of reflectors concentrating the light down upon certain areas. The intention has been, by this means, to illuminate whole towns or districts of towns from single sources of light. This can, in the author's opinion, be done if the concentration of the light is effected in a different way from what has been hitherto attempted—viz., by the employment of very much larger reflectors. In this way the loss of light sideways and the deep shadows that have been produced will be avoided. It matters very little at what height the light is placed, the chief question being what area has to be illuminated; and then the form of reflector suitable for the purpose can be easily determined upon.

In conclusion, it must be remembered that illumination from above downwards is in nearly all cases the preferable mode of distributing light, as Nature herself proves in having one light only, the sky being the diffusing agent by which the most perfect distribution of light is effected. Nature possesses, indeed, a gigantic reflector in the atmosphere and clouds; and the author has endeavoured to imitate Nature's reflector in a way suitable to our imperfect means and conditions, and to the circumstances of each individual case.

THE VOYAGE OF THE "CHALLENGER."[2]

II.

THE plan adopted in the narrative of the cruise gives the reader a good idea of the course of the voyage, the nature of the researches carried on, and the manner in which these researches have been followed up by the more detailed studies of the experts into whose hands the collections were afterwards placed. But it is necessarily desultory. We are led from station to station, from chemical to biological work, from physics to ethnology, from deep-sea temperatures to the anatomy of sea-slugs, with a rapidity and suddenness that are a little bewildering. Still, the general impression of the far-reaching aims of the expedition, of the skill and completeness with which the work was done, and of the enormous mass of new material obtained, is no doubt deepened by the difficulty or impossibility which the narrators have obviously experienced in giving within the brief compass of their chapters anything like a comprehensive digest of what the *Challenger* voyage accomplished in regard to the problems of the great deep. The reader must resign himself to be carried along as the naturalists of the expedition themselves were, and to listen to their story of what they saw and found.

In our notice of last week we left the *Challenger* at the Cape of Good Hope. From that station she strikes out boldly into the Southern Ocean, giving us glimpses of the Prince Edward and Marion Islands, with their proofs of recent volcanic action, the Crozet Islands and Kerguelen. In this part of the voyage the trawlings are extraordinarily rich, between one and two hundred animals coming up at each haul, representing nearly all the marine groups, and, with few exceptions, belonging to genera and species discovered now for the first time. Among the more interesting forms of life are various crinoids, the mention of which leads to a summary from Dr. P. A. Carpenter and Prof. L. von Graff of their Reports upon the additions to our knowledge of the recent crinoids made by the expedition Fig. 4). The figures of the living *Pentacrinus* remind the

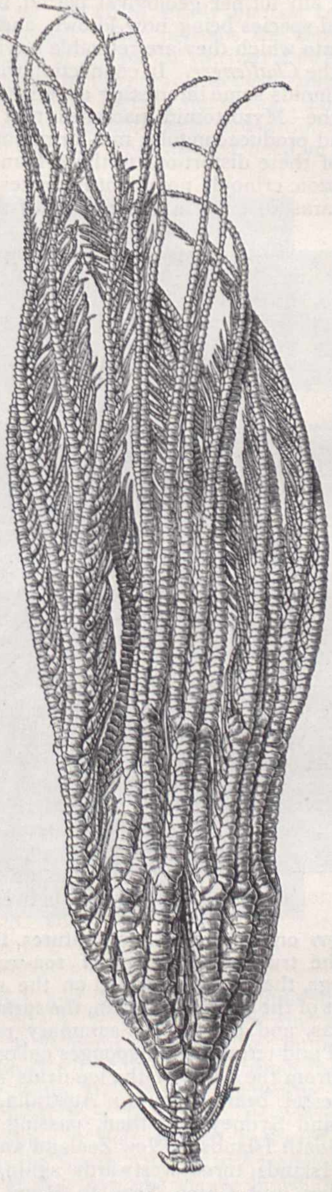


FIG. 4.—*Metacrinus Wyvillii*, P. H. Carpenter.

[1] This shows a loss of 4·35 per cent. owing to absorption by mirror.

[2] "Report on the Scientific Results of the Voyage of H.M.S. *Challenger* during the years 1873-76." Prepared under the direction of the late Sir C. Wyville Thomson, and now of John Murray. "Narrative," vol. I., 1885. Continued from p. 207.

geologist of the familiar Liassic *Extracrinus*, and give a singularly antique aspect to the fauna. Not less interesting is the living *Rhizocrinus*, which is a dwarfed and degraded descendant of the well-known chalk fossil *Bourgeticrinus*, as this in turn appears to have been a dwarfed representative of the Pear-encrinites of the Jurassic rocks. The genus *Bathycrinus*, previously known only from a single immature specimen, is now shown to have a wide extension in the Atlantic, but is not known in the fossil state. While the stalked crinoids have been dying out, the Comatulæ, or Feather-Stars, are probably more abundant now than at any former geological period, no fewer than four hundred species being now known, and three of the six genera into which they are referable having been discovered by the *Challenger*. In connection with the subject of recent crinoids some interesting observations are given regarding the Myzostomid parasites that infest these creatures and produce singular mal-formations. The resemblance of these distortions to those found upon many fossil Palæozoic crinoids no doubt indicates the presence of similar parasites even in the waters of the Palæozoic oceans. From the rich trawlings below water we are led by the narrative to the abundant bird-life of the Southern Ocean and to the conclusions regarding the structure and affinities of the Petrels reached by that able and lamented naturalist, the late Mr. W. A. Forbes.

From the pages of the narrative a good notion of Kerguelen with its snowfields and lavas, and Heard Island with its ice-cliffs and glaciers can be obtained. The profusion of life in these southern waters is not a little remarkable—sponges, alcyonarians, holothurians, ophiurids, asterids, echinids, annelids, amphipods, polyzoa, gasteropods, cephalopods, and many other invertebrates. But the *Challenger* now pushes southward to the Antarctic ice-cliffs, and as these seas are but little known, full details of this part of the navigation are given, with the soundings, dredgings, trawlings, and temperature observations taken along the route. Numerous woodcuts, phototypes, and chromolithographs of icebergs observed in the Antarctic Ocean are inserted, and a special chapter is devoted to the history of exploration in these seas, and to an account of observations made by the scientific staff of

Fig. 5.—New Volcano, Camiguin Island.

the *Challenger* on Antarctic temperatures, the density of sea-water, the true composition of sea-water ice, Antarctic icebergs, the deposits formed on the sea-bottom in the icy tracts of the Southern Ocean, the surface organisms of these seas, and a detailed summary regarding the hexactinellid and tetractinellid sponges collected.

Escaping from the perils of the ice-fields and Antarctic gales the vessel bears away to Australia, touching at Melbourne and Sydney and then, passing between the North and South Islands of New Zealand and northwards to the Fiji Islands, turns westwards again, through the Coral, Celebes and China Seas to Hong Kong. The account of this portion of the voyage is enriched with descriptions of numerous groups of animals collected during the expedition, particularly macrurous and brachyurous crustaceans, butterflies and moths, medusæ, starfishes, amphipods, lamellibranchs, annelides, calcareous and horny sponges. The next track, from Hong Kong by Manila, Zebu, and the Admiralty Islands to Japan, takes up nearly 100 pages of the narrative. Among the more interesting observations recorded are those relating to the volcano of Camiguin Island, which burst forth upon a low plain in the summer of the year 1871 and in four years and a half rose to 1,950 feet in height, with abundant discharge of steam and with glowing lava at its summit (Fig. 5). The mountain is a dome-shaped mass rising from the seashore. It consists of various andesitic lavas but seems to possess no crater, resembling in this respect some of the trachytic domes of Auvergne. The lava is described as having apparently "issued from a central cavity and boiled over, as it were, till it set into the form of the dome." Probably the volcano is an example of the extravasation of viscous lava in successive shells, of which the outer are pushed outwards and upwards by the arrival of fresh material from below, as illustrated experimentally by Reyer. Mr. Busk supplies a *résumé* of his Report on the Polyzoa of the expedition. Professor E. Perceval Wright gives one on the Alcyonaria; Dr. Rudolph Bergh, one on the Nudibranchs; Professor Turner, one on the crania of the Admiralty and other Pacific Islanders; Professor G. O. Sars, one on the Schizopods and other crustaceans.

From Japan we are transported to the centre of the Pacific Ocean, and learn much by the way regarding the distribution of temperature in this vast expanse of water. A series of soundings taken from lat. 40° N. to lat. 40° S. affords a section of the very centre of the ocean through the volcanic peaks of Hawai and Tahiti. Perhaps no single part of the sounding work of the expedition offers a more impressive example than this of the boldness and success with which the problems of the deep sea can now be attacked. Down the middle of the widest and deepest ocean on the face of the globe a line of temperature soundings is taken with as much precision as if it had been an inland lake, and information is obtained that furnishes a clear picture of the depth of the water, the form of the bottom, and the manner in which the layers of different temperatures are superposed upon each other from the surface downwards. A careful survey of the coral-reef of Tahiti by Lieutenant Swire and Mr. Murray suggested to the latter observer the view which he has already published—that this reef and coral-reefs in general may be formed by the outward growth of the living coral upon a *talus* of coral-rock broken off by the waves, and do not prove subsidence as was believed by Darwin. Among the corals, briefly described by Mr. Moseley, probably the most beautiful of the madrepores is the delicately fragile *Leptopenus* trawled from a depth of 2,160 fathoms between Juan Fernandez and Valparaiso (Fig. 6). Prof. Hubrecht of Utrecht supplies some notes on the *Nemertea* in anticipation of his detailed Report on this subject. A summary is given of Mr. H. B. Brady's studies of the *Foraminifera*, which are so abundant in the surface waters and play so important a part in the formation of deep-sea deposits; and a digest of the Report of Dr. G. S. Brady on the copepod and ostracod crustaceans. But perhaps the most generally interesting section of this part of the narrative is that which treats of the nature of the organic deposits now forming on the floor of the deeper parts of the ocean. The important results obtained by the *Challenger* expedition in this novel department of enquiry have already been made familiar

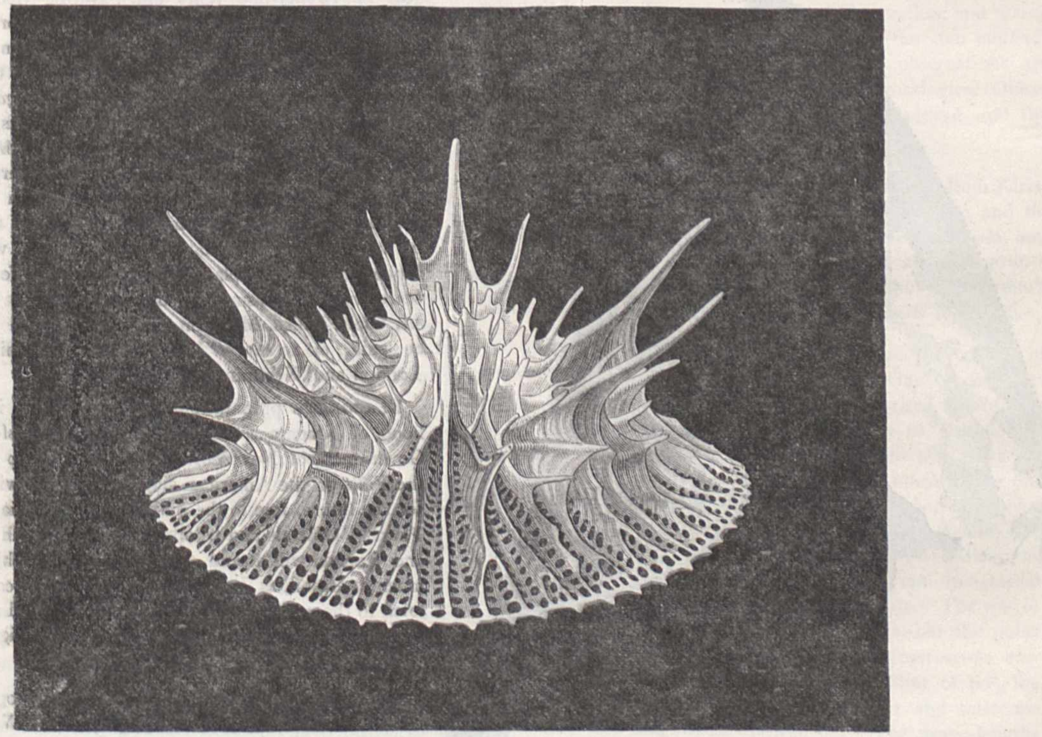


Fig. 6.—*Leptopenus hypocœlus*, Moseley.

by the writings of Messrs. Murray and Renard. But the reader will be glad to have them re-stated in the official account of the voyage, and to find them so admirably illustrated with woodcuts and a lithographic plate, which enable him to realise exactly the nature of the evidence for the extreme slowness of deposition at these great depths and so far from land. From no fewer than 116 sharks' teeth brought up with over two bushels of manganese nodules in a single haul from a depth of 2,385 fathoms, Fig. 7 has been selected for illustration. It differs in no essential particular from the tooth of *Carcharodon megalodon*, so common in Tertiary strata, except that it shows no large base.

Quitting Valparaiso, the *Challenger* pursues a southerly track to Port Otway, and then winding through the long line of sounds between the islands and the mainland passes through Magellan Strait to the Falkland Islands, and thence to Monte Video. During this part of the narrative we learn from Dr. Hoek what he has found out regarding the Cirripedes and Pycnogonids obtained during the cruise; from Mr. F. E. Beddard regarding the Isopods; from Mr. R. B. Watson about the Scaphopods and Gasteropods; from Mr. J. R. Henderson about the Anomurous Crustaceans; from Dr. Günther respecting the deep-sea fishes; and from Prof. E. Selenka regarding the *Gephyrea*. The course is then shaped eastward from Monte Video, across the South Atlantic to Ascension, and during the account of this *traverse* we are shown how the foraminiferal deposits of the deep sea were collected and investigated, and are supplied with a useful summary of the results arrived at by Messrs. Murray and Renard regarding deep-sea deposits in general, illustrated with an excellent coloured plate, which, in default of the actual objects themselves, brings their characters very clearly before the eye. As the narrative proceeds with the account of the homeward voyage from Ascension, we are told about pelagic diatoms, marine infusoria, coccospheres, rhabdospheres, bathybius, and the land-plants collected during the whole of the cruise, till at last the voyage ends at Spithead, on May 24, 1876. From the start on December 7th, 1872, till that date the vessel had traversed 68,890 nautical miles, and at intervals as nearly uniform as possible had established 362 observing stations.

The final chapter gives a summary of the results obtained by the officers of the Expedition, and by experts subsequently employed in the investigation of the density of sea-water, the composition of the salts of the ocean, the geographical and bathymetrical distribution of specific gravity, the carbonic acid, nitrogen, and oxygen present in sea-water, and a discussion of meteorological observations in their bearing upon oceanic circulation.

In this notice we have endeavoured merely to convey to the general reader some notion of the contents of the two portly volumes which contain the official narrative of the most important scientific expedition which has ever

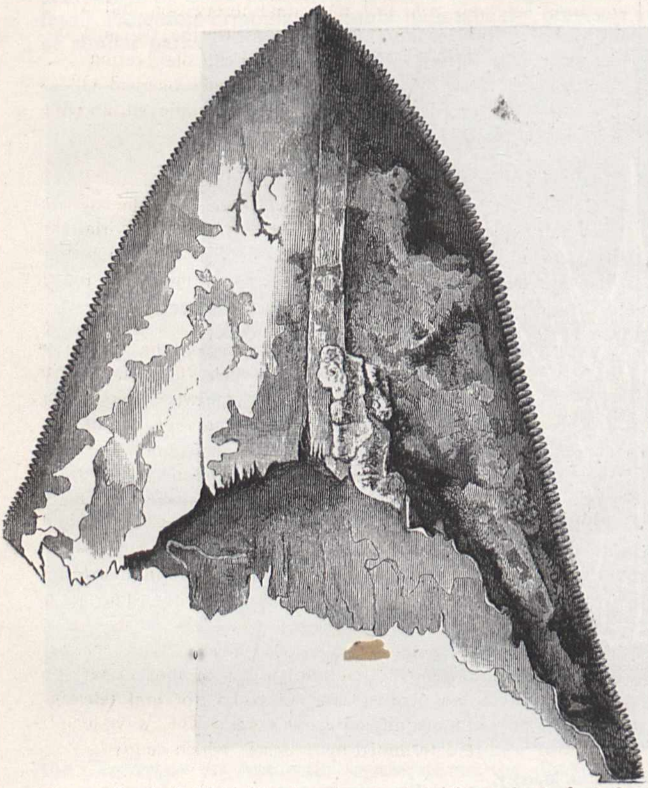


FIG. 7.—Tooth of a Shark (*Carcharodon megalodon*) from a depth of 2385 fms.

been despatched by any Government for the investigation of the depths of the ocean. The materials are not yet ready for a complete digest of the whole work achieved. But it would have been an important addition to the value of the Narrative had the authors endeavoured to give such a digest as far as the materials are now in their hands, marking those portions regarding which the final reports had not been received. Such a summary, carefully arranged in subjects and with precise references to the detailed Reports for fuller information, would have been of great service to those who cannot follow all the technical details of the Reports, as well as to the specialists who wish to learn to what source they have to turn for their own requirements. Let us hope that in a future edition of the narrative this want will be supplied. Meanwhile no one can rise from the perusal of these volumes without an admiration for the solid, painstaking, and conscientious way in which their compilation has been accomplished. They are not light reading, but they abound in material of general interest and form a fitting record of the great Expedition which they chronicle.

NOTES

THE fourteenth meeting of the French Association will take place on August 12 at Grenoble. M. Verneuil, Member of the Academy of Medicine, will be President. The public lectures will be "On the New Gallery of Palæontology of the Paris Museum," by M. Cotteau, ex-chairman of the Geological Society of France, and by M. Rochard, General Inspector of the Marine, on "The Victualling of France." A large number of medical questions will be dealt with in the several sections of the congress. The Ferran cholera experiments are sure to be discussed at full length. Numerous excursions will take place in the Alps under competent guidance as far as Chambery.

IN the course of the present summer the *Geological Magazine* will be twenty-one years old. During that period Dr. H. Woodward has been one of its editors, and for almost the whole time the principal editor, on whom the burden of the work has fallen. Further, the arrangement made with the publishers, in order to secure the continuance of the *Magazine*, would have actually resulted in pecuniary loss, but for illustrations presented by authors. Of the ability with which the *Magazine* has been conducted, and of its value to geologists, there can be no question. A committee has been formed, with Prof. Bonney as chairman, to give expression to their sense of the services which he has rendered to geology by presenting him with a testimonial, of which a piece of plate will, at any rate, form a part. The secretary and treasurer of the committee is Mr. G. J. Hinde, 11, Glebe Villas, Mitcham, Surrey, to whom subscriptions may be paid, or to the "Woodward Testimonial Fund," at the London and Westminster Bank, Limited.

ELABORATE preparations have been made in the neighbourhood of Niagara Falls for the formal transfer to-day to the Government of New York State of the strip of land adjoining the Falls on the American side. This strip will be thrown open for the future, free to the public, as "The Niagara International Park." Officials and troops representing both New York State and Canada will attend the ceremonies. This transfer attracts much attention, as it renders America's great cataract free henceforth to the world. We have already alluded at some length to the acquisition of the Falls and immediate neighbourhood by the State.

THE annual meeting of the Royal Archæological Institute will be held at Derby from Tuesday, July 28, to Wednesday, August 5, inclusive. The presidents of the three sections will be:—Antiquarian, the Rev. J. C. Cox, LL.D.; Historical, the Dean of Lichfield; Architectural, the Right Hon. A. J. Beresford-Hope.

THE observations made at the Ben Nevis Observatory have been received to the end of June. During the twelve months ending with June the rainfall, snow, and hail have been measured with all possible care every hour. During the year the whole of the rainfall, inclusive of melted snow and hail, amounts to 152·15 inches. Averaging the monthly falls from June, 1881, the mean annual rainfall on the top of Ben Nevis is 145·73 inches, which is thus the largest mean annual rainfall of any place at which rain has been observed in Scotland. The largest rainfall in any single month was 25·30 inches in December, 1884, and the smallest 4·85 inches in April, 1885. Falls of an inch a day, or upwards, are of comparatively frequent occurrence, having been recorded during one day in seven out of the 365 days. On two of the days upwards of four inches of rain was measured at the Observatory.

A TELEGRAM from Cooktown to Berlin, July 8, announces the arrival there of the New Guinea Company's steamship *Samoa*, with Dr. Finsch on board, who is returning to Europe from his recent exploring expedition along the unknown portions of the coast of Kaiser Wilhelm's Land (New Guinea) which are situated between Astrolabe Bay and Humboldt Bay. Dr. Finsch reports the discovery of several good harbours and of a navigable river. The land is suitable both for agriculture and stock-raising. The natives were friendly.

THE Comptroller-General of patents, designs, and trade marks has issued, in the form of a Parliamentary paper, his report, the second since the passing of the Act of 1883. That the new Act has worked well in the interest of inventors may be seen from the fact that the number of applications for patents, which had risen, with some variations, almost constantly in the course of thirty years, from 1211 in the year 1852, to 6241 in 1882, leaped with a bound to 17,110 in 1884. The increase is, in fact, as between the years 1883 and 1884, no less than 195 per cent. Seventy-nine per cent. of the applications were made by persons resident in the United Kingdom—namely, 12,356 being residents in England and Wales, 901 in Scotland, and 254 in Ireland. Of the rest the largest numbers were from the United States, 1181, from Germany 890, and from France 788. Residents from twenty-seven other countries also made application to the office, thirteen such countries being British possessions, from which 175 applications were made, and three, it may be added, were made from Egypt. Only three appeals were made in the course of the year against the decision of the Comptroller, so that it may be taken that his decision is almost invariably satisfactory to applicants. The receipts of this office amounted to 103,827*l*., of which 88,996*l*. were for patents' fees, 3477*l*. for designs' fees and stamps, 7014*l*. for trade-marks' fees, and more than 4000*l*. for the sale of publications. The chief payments made were 36,225*l*. for salaries—all of which are set forth in detail in the report—and 17,000*l*. to Messrs. Eyre and Spottiswoode for printing. There was a surplus income of nearly 40,000*l*.

THE International Telegraph Congress, which meets in Berlin on August 10, will be attended by delegates from all the European states, and from Brazil, British India, Dutch India, Egypt, Algeria, Cochin China, Japan, Natal, New Zealand, Persia, Siam, Cape Colony, South Australia, and Victoria, as well as from all the great cable companies. The chief subjects of deliberation will consist of various technical questions, including more especially a general reduction of tariffs.

THE Council of University College, London, have instituted a Professorship of Electrical Engineering, and have appointed Dr. J. A. Fleming thereto. Dr. Fleming retains his connection as advising electrician with the Edison and Swan Electric Light Company.

WE give the following extracts from Prof. Adams's report to the Senate as to the proceedings in the Cambridge Observatory for the year ending May 26, 1885:—The total number of observations made with the transit circle during this interval, for determinations of right ascension and north polar distance, is 3253. These include 658 observations of clock stars made on 152 nights; 69 observations of Polaris at the upper transit involving 151 circle readings, and 73 observations at the lower transit involving 180 circle readings; 11 observations of stars compared with Wells's Comet; and 2442 observations of zone stars made on 100 nights, the greater number at five or seven wires, and all, without exception, read off with four microscopes. For instrumental adjustment the Nadir Point was observed 203 times, the level 203 times, and the collimation 207 times. Twenty pairs of observations for flexure of the transit telescope made June 18 to 23, 1884, give for the coefficient $-0''\cdot651$; this will need confirmation, as it differs considerably from the former determination, $-0''\cdot936$. The observations of clock stars and those of Polaris are completely reduced, and the mean places for January 1 obtained up to the end of 1884. The true apparent places of all the other stars observed in 1884 is also obtained both in Right Ascension and North Polar Distance. As regards the observations of former years:—The mean R.A. and N.P.D. of the Zone Stars are obtained up to December 12, 1877, and the true apparent R.A. and N.P.D. to the end of 1882, and the reductions are far advanced in 1883. The reductions from mean to apparent place at date are calculated to the end of 1882. The means of transits and microscope readings are deduced up to the present time. The intervals of R.A. wires used in the reductions for 1884 were obtained from 63 observations of Polaris made January 18 to July 10, 1884: (1), by taking the mean of the intervals for Polaris and the mean of the declinations, and using the formula $\sin E = \sin P \cos \delta$; (2) by deducing the equatorial intervals from each individual observation, and taking the mean of the results. The intervals by the two methods almost exactly agreed. The meteorological observations are communicated daily by telegraph to the Meteorological Office. The sunshine recorder has been regularly employed, and the records sent at intervals to the office.

COL. PRJEVALSKY telegraphed to St. Petersburg from Kiria, in Khotan, on June 20, that during April and May he and his party had explored the region between Lob Nor and Kiria, and that, leaving stores at the latter place, he was about to go into the neighbouring Tibetan mountains, whence he would return to Kiria at the end of August, and then come back to Russia.

PROF. THALÉN, whose classical researches on the spectra of the metallic elements have won for him such wide renown, has recently published a new memoir on, and a revised list of, the lines of iron, presented to the Royal Society of Upsala last September (published by Berling, Upsala). The new work has been done by means of a gramme dynamo, and much higher dispersion than that employed in 1864. An upper carbon pole being rejected on account of the spectrum of "acetylene," about which we have heard so much in this country, and which we now know to be due to carbon vapour, three tubes of iron 15 mm. in external diameter were used to prevent fusion of the points. The size of the laboratory did not permit the use of a lens, but the poles were placed in a horizontal position. The spectroscope employed had six and sometimes nine prisms of flint of 60°, the focal length of the object-glasses of collimator and telescope being 81 cm. and magnifying power 62. The wave-lengths have also been re-determined by a process which he gives.

Bulletin No. 8 (1885) of the U.S. Department of Agriculture (Division of Entomology) is occupied by a particularly interesting memoir by Prof. C. V. Riley on the occurrence of "Periodical Cicada" (*C. septendecim*). This insect is one of the marvels of entomology, because ordinarily a period of seventeen years elapses between the deposition of the egg and the appearance of the perfect *Cicada*, and practically all but a few weeks of that period are passed in the preparatory underground larval condition. But even such a Methusaleh amongst insects is liable to have its development hastened (and its whole life thereby shortened) by temperature, for Prof. Riley discovered that (principally in the Southern States) there is also a thirteen-year brood of the same species, although each condition impinges on the domain of the other. That the larva sometimes penetrates to a great depth is shown by the fact that the perfect insects, true to time, once came through the floor of a cellar 5 feet deep, a building having been erected over the site of their underground quarters; in another instance the larvæ were found 10 feet below the surface.

Occasionally, at very long intervals, the 17-year and 13-year forms appear simultaneously. Such an event as regards one of the largest broods happened in the year 1647, again in 1868, and will not again occur till 2089. But it must not be supposed that the broods are simultaneous over all the United States; they vary according to locality, so that somewhere or other there is nearly always a brood on the wing. Prof. Riley has, through his agents, collected information from many states, and for thirty-two different districts is able to predict the particular year of appearance during the next 13 and 17 respectively in these districts. 1887, 1890, and 1892 are the only years omitted as not likely to produce the Cicadas. One would imagine that in the course of 17 years a larval *Cicada* must occasion great damage to the roots of trees, &c., but it would seem that any damage in this way is as nothing compared with that inflicted on the foliage by the perfect insect during its brief existence.

AN air-balloon railway is about to be constructed on the Gaisberg, near Salzburg, a mountain of no great height, but offering a magnificent view over the beautiful neighbourhood of the town. The balloon, which will have grooved wheels on one side of its car, will ascend a perpendicular line of rails, constructed on the principle of the wire-rope railway invented years ago for the Righi, but never realised.

M. FOUQUÉ has established at Meudon Observatory, with the kind assistance of M. Janssen, an apparatus for registering electrically the propagation of earthquakes in underground layers. Experiments have been made by the fall of a weight of 600 kilogrammes from 7 metres; the results having been deemed satisfactory, measures are being taken for procuring the fall of 900 kilogrammes from 9 metres, which represents a shock of 81,000 kilogrammes. A steam elevator will be procured for further investigations.

AT the recent distribution of prizes at University College, Dundee, Prof. Gairdner, of Glasgow, strongly advocated the formation of a School of Medicine in Dundee. Dr. Gairdner not only urged the duty of setting a medical school afoot, but he showed how in some ways a new school may be made more attractive and more efficient than the old, so as both to supply the educational needs of its own neighbourhood and even to draw students from a distance also. Tradition, prejudice, and the vested interests of professors make all reform slow in the old Universities, and cause many changes which are admittedly desirable to seem well-nigh impossible of attainment. The matter in which Prof. Gairdner chiefly indicated the possibility of reform is the present separation of practical from theoretical instruction and the long delay in bringing a student face to face at the bedside with disease. In a new school, he thought, the attempt should be made to give men hospital instruction from the very beginning of their student life; to illustrate to them in the wards what they are at the same time learning in the lecture-room in chemistry, anatomy, and physiology; and to give the longest possible training to hand and eye and ear in the subtle discrimination of disease.

THE University College of Wales at Aberystwith was the scene of a destructive fire during Wednesday night last week, which resulted in the loss of two lives, including Prof. James Macpherson, and serious injury to three other persons. The College buildings were the largest and handsomest in the Principality, having been built at a cost of 80,000*l.*, and they include the necessary rooms and offices for the education of a large number of students. The flames spread with alarming rapidity, and in a short time had complete hold of the museum, library, professors' rooms, and students' apartments. By great exertions all the articles of value in the museum and library were removed. The Principal's residence and examination hall escaped, but the northern wing was gutted. The College was insured for 10,000*l.*, but the damage will amount to 40,000*l.*

A TELEGRAM from Simla, July 9, states that shocks of earthquake continue to be felt in Cashmere at intervals of two or three days. A severe shock occurred at Srinagar on the 4th inst.

A SEVERE earthquake, which lasted for some time, and was felt, with varying intensity, over the whole province, occurred at Calcutta on Tuesday morning, at twenty-three minutes past six. Some of the shocks were very serious, and the walls of a number of houses were cracked, causing the utmost alarm to the inhabitants.

THE death is announced, at the age of forty-seven years, of Mr. N. W. Posthumus, director of the Higher Burgher School at Amsterdam, one of the founders of the Dutch Geographical Society, and from the beginning its secretary and one of the editors of its *Journal*. Many contributions to the "Tijdschrift Aardrijkskundig-genootschap" are due to him.

WE have received from the Observatory of Brussels the volumes of the *Annales* of the Royal Observatory there, giving the documents and observations made on the Transit of Venus in 1882 by the Belgian party ordered to Texas. Drawings are given of the contacts, which require careful study; almost everything but the "black dip" was seen in a Dolland of 11 cm. aperture.

THE American Government have forwarded a consignment of catfish to the National Fish Culture Association with a view to their being acclimatised to the waters of this country. They arrived per s.s. *Britannic* in perfect condition, all being alive, which, considering the long voyage they had been subjected to, is remarkable. The catfish is a very valuable food-fish, and would assume a high rank amongst the freshwater fishes of our waters if cultivated. Pending their removal to the Fish Culture Establishment of the Association at Delaford, they are being exhibited at the Aquarium of the Inventions Exhibition, where they attract considerable attention.

SEVERAL of the picked dogfish in the tanks of the Aquarium at the Inventions Exhibition brought forth young last week. They lived for several days, but ultimately died.

A FURTHER stock of landlocked salmon were turned into the Thames on Thursday last by the Thames Angling Preservation Society, in the presence of various gentlemen interested in the matter. This species is exactly suited to this river, being non-migratory, for salmon once quitting for the sea the polluted water of the Thames are not likely to return thereto.

WE have received a new edition of Mrs. Lankester's "Wild Flowers Worth Notice," revised, improved, and increased in size. Allen and Co. are the publishers.

"FACE and Foot Deformities" is the title of a book of curious interest, by Mr. Frederick Churchill, C.M., published by J. and A. Churchill.

THOSE interested in glaciology should read Prof. Forel's little *brochure* on "Les Variations Périodiques des Glaciers des Alpes," separately reprinted from the *Jahrbuch* of the Swiss Alpine Club (Staempli, Berne).

DR. J. E. TAYLOR's latest contribution to popular science is "Our Common British Fossils and where to find them" (Chatto and Windus). A prettily illustrated book of a similar character is Mr. F. G. Heath's "Where to find Ferns," published by the S.P.C.K.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii* ♂)

from South Africa, presented by Mr. G. C. Barnes; an American Badger (*Taxidea americana* ♀) from North America, presented by Mr. F. J. Thompson; a Common Fox (*Canis vulpes* ♀), British, presented by Mr. Christopher Heseltine; a Rufous Rat-Kangaroo (*Hypsiprymnus rufescens* ♀) from New South Wales, presented by Miss Laidlaw; a Red-throated Amazon (*Chrysotis collaria*) from Jamaica, presented by Mrs. S. Waite; three Rufous-vented Guans (*Penelope cristata*) from Central America, presented by Mr. G. H. Hawtayne, C.M.Z.S.; a Leopard Tortoise (*Testudo pardalis*) from South Africa, presented by Mrs. Henrietta Hodges; two Crowned Horned Lizards (*Phrynosoma coronatum*) from North America, presented by Master Chas. E. Napier; a Cinereous Vulture (*Vultur monachus*), European, a Nonpareil Finch (*Cyanospiza ciris*) from North America, deposited; an Axis Deer (*Cervus axis* ♂), a Mule Deer (*Cariacus macrotis* ♂), three Long-fronted Gerbilles (*Gerbillus longifrons*), seven Mandarin Ducks (*Œx galericulata*), four Chilian Pintails (*Dafila spinicauda*), bred in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *JULY* 19–25

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

At Greenwich on July 19

Sun rises, 4h. 7m.; souths, 12h. 6m. 1·2s.; sets, 20h. 5m.; decl. on meridian, 20° 47′ N.: Sidereal Time at Sunset, 15h. 56m.

Moon (at First Quarter) rises, 13h. 10m.; souths, 18h. 28m.; sets, 23h. 38m.; decl. on meridian, 10° 33′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	6 3	13 34	21 7	16 27 N.
Venus	5 56	13 31	21 6	17 6 N.
Mars	1 18	9 33	17 48	23 23 N.
Jupiter	7 44	14 41	21 38	10 23 N.
Saturn	2 8	10 18	18 28	22 32 N.

Occultations of Stars by the Moon

July	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
20	o^2 Libræ	6	22 58	0 1*	136 272
22	29 Ophiuchi	6	22 31	23 1	33 356

* Occurs on the following day.

Phenomena of Jupiter's Satellites

July	h. m.		July	h. m.	
20	21 21	III. tr. egr.	22	21 4	II. tr. egr.
22	20 55	I. tr. ing.	23	21 9	I. ecl. reap.

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

A TEACHING UNIVERSITY FOR LONDON

An extraordinary meeting of the Convocation of London University will be held on the 28th inst., when the report of the Special Committee appointed on February 24 to consider the question of a Teaching University for London will be presented by Lord Justice Fry, who will also move the following resolutions:—

1. That the report of the Special Committee and the scheme therein comprised be received and adopted.

2. That the Senate be requested to consider and approve the said scheme, and to take such steps as they may think fit to carry the same into effect.

3. That a Committee of this house, consisting of five members, be appointed to confer with the Senate in respect of the said scheme in case the Senate shall desire such conference.

The following is the scheme for the constitution of the University proposed by the Special Committee:—

1. The University to consist of—(1) Senate; (2) Convocation; (3) Constituent Colleges; (4) Faculties; (5) Boards of Studies, with the Queen as Visitor.

I.—Senate

2. To consist of:—(1) Chancellor; and (2) Vice-Chancellor (to be appointed and retain office as at present); (3) the Chairman of Convocation *ex officio*; (4) and not more than thirty ordinary members (including the Vice-Chancellor), of whom six shall be nominated by the Crown, six shall be elected by Convocation, and three shall be elected by each of the four Faculties. And if and when the following bodies respectively shall become Constituent Colleges—one shall be nominated by the President of University College, London; one shall be nominated by the Principal of King's College, London; one shall be nominated by the President of the Royal College of Physicians of London; one shall be nominated by the President of the Royal College of Surgeons of England; one shall be nominated by the Chairman of the Council of Legal Education, and one shall be nominated by the President of the Incorporated Law Society.

3. The nominating bodies to determine for themselves on what recommendation the nominations shall be made.

4. One-third of each of the groups of six and three members of the Senate to retire each year; such one-third to be those who have been longest in office, or, when several have been in office for the same period, to be ascertained by ballot.

5. The six representatives of colleges to serve for three years.

6. Power to fill up occasional vacancies.

7. Power to re-nominate and re-elect.

8. In the first place, the faculty and college members to be added to the existing Senate; but no new members to be appointed by the Crown or Convocation till the number of Crown and Convocation members respectively has fallen below six, and then only so as to bring the number up to six.

II.—Convocation

9. To remain unchanged.

III.—Constituent Colleges

10. The Constituent Colleges to consist of the following bodies in or near London:—(*a*) such bodies as may be named in a schedule to be settled by a joint committee of the Senate and Convocation; (*b*) such other bodies being colleges or institutions incorporated by Royal Charter, or otherwise established on a permanent and efficient footing, in which the majority of the students are of the age of seventeen years at least, as the Senate with the concurrence of the faculty or faculties interested may from time to time admit.

11. Admission as a constituent college shall be subject to such terms as may be agreed upon between the body becoming a constituent college and the joint committee or the Senate with the concurrence aforesaid (as the case may be).

12. The constituent colleges shall be arranged in three groups—viz. (*a*), those colleges which are principally intended to occupy the entire time of their students; (*b*) those colleges in which lectures are given of the most advanced kind, whether professional, literary, or scientific; (*c*) those colleges which are intended to aid the evening studies of persons engaged in business, or otherwise do not fall under either of the preceding groups.

13. By the terms of agreement on the admission of such constituent college the following points shall be determined:—(*a*) The group to which it shall belong; (*b*) the faculty or faculties to which it shall belong; (*c*) the number of members of the faculties to represent the college; (*d*) the class or classes of professors or teachers in the college who are to take part in the election of members to represent the college.

14. In a college of the first and second group the number of its representatives on the faculties shall *prima facie* bear a larger proportion to the total number of professors and teachers in the college than in the case of a college in the third group.

15. A constituent college and the Senate with the concurrence of the faculty or faculties interested may revise the terms of the agreement between the University and the constituent college.

16. No person shall be eligible as a member of a faculty representing a college unless he be in the class of professors or teachers in that college and capable of taking part in the election of members to represent that college.

17. Power to be given to the Senate with the concurrence of the faculty or faculties interested—(*a*) to diminish or increase the number of teachers in a college who shall be members of a faculty or faculties; (*b*) for good cause to remove any college from being a constituent college.

18. The affiliation of colleges to the University to cease.

19. The institutions from which the University receives certificates for degrees in Medicine (hereinafter called the recognised Medical Institutions) to retain their right of giving such certificates whether they be or be not constituent colleges.

20. The list of recognised medical institutions to be subject to the existing power of revision, but so that the Senate shall not report thereon without the previous advice of the Faculty of Medicine (see Charter of January 6, 1863, section 37).

IV.—FACULTIES

21. There shall be four faculties—viz. (1) Arts; (2) Laws; (3) Science; (4) Medicine.

22. All departments of knowledge in which examinations may be held by the University, and not included in any of the other faculties, shall be included in the Faculty of Arts.

23. Each faculty shall consist of—(*a*) the representatives of the constituent colleges; (*b*) the examiners in the faculty during their periods of office and three years afterwards; (*c*) such persons eminent in the studies with which the faculty is concerned not exceeding six in number as the faculty may elect and for such periods as they may determine.

24. Each faculty shall elect—(*a*) a chairman for three years; (*b*) three members of the Senate; (*c*) members of a board of studies.

25. The persons to be elected under the last clause must be members of the faculty not being examiners in office, and on ceasing to be members of the faculty or accepting the office of examiner such persons will vacate their seats as chairman or member of the Senate or board.

26. On any matter connected with its subjects a faculty may—(*a*) make recommendations to its board of studies in all matters within the competence of the board; (*b*) represent its views to the Senate.

V.—BOARDS OF STUDIES

27. There shall be a board of studies in each faculty.

28. Each board shall consist of such a number of members being a multiple of three, and not less than six nor more than twenty-one, as the faculty shall from time to time determine, together with one member of Convocation to be elected by Convocation.

29. One-third of the faculty members shall retire each year.

30. The member elected by Convocation shall sit for three years.

31. Power to fill up occasional vacancies.

32. Power to re-elect.

33. Each board shall elect a chairman every year.

34. Each board of studies shall have the following powers and duties:—(*a*) To consider the recommendations of its faculty; (*b*) to consult together on all matters connected with the subjects of its faculty and the examinations therein and the teaching thereof; (*c*) to advise the Senate from time to time as to the institution of new degrees or any change in the degrees, or as to the regulations in force with regard to the degrees and examinations in its faculty (without which advice the Senate shall not act in the said several matters); (*d*) to consult with and advise the examiners in the faculty; (*e*) to represent its views on any matter connected with the subjects of its faculty to the Senate; (*f*) to make by way of report to its faculty such recommendations as it may think fit, with the object of insuring suitable and efficient teaching in the subjects of its faculty, and generally to report to its faculty on all matters connected with its subjects as the board may think desirable; (*g*) to summon a meeting of its faculty for the discussion of any matter relating to its subjects.

35. Boards of studies may, if they or any of them shall from time to time think it desirable, meet and act concurrently on particular subjects.

VI.—EXAMINERS

36. The examiners in each faculty may from time to time make such reports and recommendations to the faculty or its board of studies as they may think fit.

VII.—DEGREES

37. Candidates to be admitted to matriculation and all degrees other than degrees in the Medical Faculty without regard to the place of their education.

38. Candidates for degrees in the Faculty of Medicine to show that they have passed the required course of instruction in a constituent college in the Medical Faculty or in recognised medical institution.

VIII.—GENERAL PROVISION

39. Except so far as altered by the foregoing provisions either directly or indirectly, the existing constitution of the University to be retained.

DANISH RESEARCHES IN GREENLAND

DURING the last few years the Danish Government have despatched several scientific expeditions to her great but sparsely populated dependency, Greenland, for the purpose of exploring it geographically, zoologically, botanically, and mineralogically, while efforts have also been made to learn something of the Norse archæological remains in South Greenland. Glacial researches, too, have been prosecuted and valuable observations made of the enormous ice-field—the inland ice, which fills the entire interior—and of its movements to the sea through the numerous fjords, the birth-place of the greatest icebergs in the northern hemisphere.

The results of these varied researches have only been published after a long delay. It should, however, be stated that the Danish Government have followed a carefully prepared plan on this point, as the Royal Commission appointed for the purpose of supervising the same, consisting of Prof. Johnstrup, Admiral Ravn, and Dr. Rink, have decided that the results of the researches should not be made public until their analysis was completed in every detail. These have been embodied in the work published by the Commission: "Videnskablige Meddelelser om Grönland" (Scientific Informations about Greenland), a publication which has gained one of the gold medals of the French Academy, and of which six or seven volumes have been published. In addition to this work we have received another, equally great, containing 109 tables, with facsimiles in colour of fossil plants found in North Greenland, defined and described by the late Prof. Oswald Heer, of Zurich, who also defined the fossils which Mr. E. Whymper, in 1867, brought home from the Disco Island and the peninsula of Noursoak, an account of which was published in the *Transactions* of the Royal Society, 1869, pp. 445–488, with eighteen lithographed plates.

Last year no less than three Danish expeditions were at work along the Greenland shores.

The first of these, under Lieut. A. Jenssen, known for his wanderings on the inland ice—was engaged in exploring and charting the district on the west coast, between Sukkertoppen and Holsteinborg (65½°–67° N. lat.), where there is a network of little unexplored fjords, between mountains rising from 6000 to 7000 feet in height, penetrating upwards of 100 miles into the broad coast-land.

The results of this expedition were very important, as the flora, fauna, and geology of this part of Greenland were ascertained. Several new plants were brought home, and the flora on a "nunatak," viz. a mountain rising above the inland ice, was collected. Lieut. Jensen is still occupied in finally drawing and describing the explored part of the coast, embracing about 1000 square miles.

The second expedition, under Lieut. J. Holm, is, in its second year, engaged in penetrating from Cape Farewell, along the barren and difficult east coast, always encircled by pack-ice. It comprises four scientists, and has for its object the exploration of the country between the 63° and 70° lat. N., where the formation of the land is much like that of Iceland.

Besides having to explore the east coast as far north as circumstances may permit, two of the members, viz. Lieut. Garde and Dr. Eberlin, have established a station at Nanortalik (lat. 60° N.), where they have, last winter, prosecuted meteorological, magnetical, and auroral observations, being a continuation of those effected during 1882-83 at Godthaab. Observations of ice and sea are also made. The two scientists who have wintered in some spot on the east coast, started, according to latest advice, from Fluidlek (lat 61½° N.), where a depot has been established, at the end of July last year, northwards, in the company of Greenlanders, eighty-two of whom lived on the east coast, and were on their way home from trading on the south coast. There were thirty-six boats in all. Late in July the great glacier Puisortok, which reaches down to the sea, and which in 1830 caused Graah, the only European who had hitherto visited it, so much trouble—was passed without much difficulty. Soon after Tingmiarmint (lat. 62° 40′ N.) was reached, the northernmost place whence we have news of the party. It was their intention to attempt to reach a place, Augmaksalik, in lat. 65½° N., before the winter, where there is a settlement of Greenlanders, but which has never been visited by Europeans. It lies near the place where Nordenskiöld landed in 1883 without seeing any natives. In the spring of the present year the coast will be explored, but we shall have no news of the party until they return home. Lieut. Holm states that the east Greenlanders were very kind and friendly. They were all heathens. They were particularly remarkable for their features, being tall people, generally with dark eyes and hair, and without any trace of the Eskimo. However, that they should be descendants of Norsemen seems hardly probable on account of their uncivilisation and want of religion, Norse language, and traditions. The party at Nanortalik have explored eight great fjords, between lat. 62½° and 60½° N., right to the bottom, without finding the least trace of Norse remains.

The expedition may be expected to return at the end of 1885. There is, however, great probability of the party under Lieut. Holm having to spend another year on these inhospitable shores, where the European, in order to exist, has to live like the Eskimo.

While the above-mentioned two expeditions were chiefly confined to explorations, the third one despatched last entered upon an almost unbroken field for research, viz., the sea on the west coast. Between 1876 and 1879 researches of the Denmark Sound—*i.e.*, the sea between Iceland and Greenland—were effected by the Danish Admiralty Expedition, whereas Davis Strait and Baffin's Bay have only been cursorily studied, as, for instance, by H.M.S. *Valorous* on its return journey in 1875, after having provisioned Sir George Nares, and by the Nordenskiöld Expedition of 1883.

The vessel employed for last year's researches was the *Fylla* gun-boat, in command of Capt. C. Normann. The scientific staff were—Prof. E. Warming, botanist; Mr. Th. Holm, zoologist; and Dr. H. Topsöe, chemist and mineralogist. The hydrographical researches were made by the officers; and for the purpose of examining the flora and fauna of the sea the expedition was provided with trawls and scrapers of most improved American pattern, and, for the deep-sea researches and measurements of temperature, with a Sigsbee's sounding-apparatus with wire rope and a good collection of the necessary instruments. For the determination of the temperature of the sea, thermometers by Negretti and Zambra were mostly used, some of which were fitted with the splendid automatic reversing apparatus invented by Capt. Magnaghi, of the Italian Navy, and some with one constructed by Capt. G. Rung, of the Copenhagen Meteorological Institute, by which the turning of the instruments is effected at a given time by the simultaneous freeing of a weight running in the line. The Miller-Casella thermometers, with which the expedition were furnished, were used very little, on account of the existing high bottom temperatures.

For fetching water from various depths, water-carriers on Sigsbee's (American), Ekman's (Swedish), and Rung's (Danish) principles were used, the latter being a new invention, which was very practicable for lesser depths, as it not only brings the sample of water required, but also gives the exact temperature, a thermometer being hidden in the axis of the vessel, the mercury column of which is broken as soon as it is full.

The *Fylla* left Copenhagen at the end of May, and arrived, at the end of June, at Godthaab, a colony with 300 to 400 Eskimo inhabitants, on the west coast of Greenland, in lat. 64½° N. Hydrographical researches were commenced early by following the edge of the Polar ice from Cape Farewell, which, during the summer, filled the southern and eastern parts of Davis Strait in vast quantities, and by studying the position of the ice-belt and the composition of the water inside and outside the ice current.

We have no space to give a detailed account of the movements of the expedition in the Greenland seas; it must be sufficient to state that the expedition, being chiefly stationed at Holsteinborg (67° N. lat.), visited most of the Danish settlements in Central Greenland, its field of research lying between 64° and 70° N. lat., and from the innermost creek at Disco Bay (about 50° W. long.) to the middle of Davis Strait,—*i.e.*, to about 57½° W. long. An attempt to get further west, and, if possible, reach the coast of America at Cape Walsingham and Cumberland Bay, had to be abandoned on account of the enormous ice-masses which were encountered there in July, and which, in the middle of August, when the *Fylla* was on her return journey, had, in 67° N. lat., approached within 50 to 60 miles of the shores of Greenland, which is very unusual at that season.

The deep-sea researches consisted in sounding, trawling, and scraping, both on the extensive banks which, between 62° and 68° N. lat., nearly everywhere surround the shores of Greenland with a deep channel between them and the coast, and in the Davis Strait.

The researches did not extend to very low depths, the greatest found being only about 900 fathoms south-west of Godthaab, while on the *bridge* connecting Greenland with Cape Walsingham, at the place where Davis Strait is narrowest—in about lat. 67° N.—depths of 400 fathoms only were struck. In the Disco Bay, where no soundings had previously been taken, a depth varying from 200 to 270 fathoms was found, and it has been discovered by the *Fylla* Expedition that at the mouth, at a depth of 180 to 190 fathoms, a barrier separates this basin from Davis Strait, and thus prevents icebergs of a greater draught from passing from the great fjord of Jacobshavn into the ocean. Judging by the results of the measurements of icebergs effected during recent years in this fjord by Prof. Steenstrup and Lieut. Hammer for the purpose of ascertaining the proportion between the part above and the part below the surface of the water, it has been found that only icebergs with an *average* height above the surface of 150 feet can float over this threshold, the proportion between the part above and the part below water being 1 to 8·8—*i.e.* 1 : 8·41 for blistered glacier ice, and 1 : 9·23 for glacier ice without blisters. For sea-water ice with a water saltness of 3·3 per cent. the proportion is only 1 : 5·29.

The numerous samples of water taken from the surface, bottom, and intermediary depths, during the voyage have not yet been thoroughly analysed, and before this has been done, it is hardly possible to say anything definite as to the currents at various depths. This much is, however, certain—that a comparatively warm current of water fills the eastern and central parts of the narrowest portion of Davis Strait—as far as the western ice limit—but that the highest temperature of the same, when the depth is more than a couple of hundred fathoms, is not, as is generally the case, found at the surface, *but nearest the bottom*, and that the coldest layer seems to lie between 30 and 100 fathoms. As an example may be taken the following series of temperatures obtained in lat. 67° 07′ N. and long. 56° 31′ W. on July 8, 1884, the temperature of the air being ÷ 1°·9 C.

At the surface	+2°·8 C.
,, 10 fathoms	1·9
,, 30 ,, ...	0·9
,, 100 ,, ...	1·1
,, 200 ,, ...	3·6
,, 362 ,, (bottom)	4·2

Similar conditions were also found everywhere in Disco Bay, but the surface water in this confined basin was considerably warmer, while the bottom temperature was proportionately lower.

We will give an example from lat. 69° 14′ N. and long. 52° 54′ W., on the morning of July 23, the temperature of the air in calm sunny weather being +10°·2 C. in the shade :—

At the surface	+7°·7 C.
,, 5 fathoms	7·1
,, 10 ,, ...	4·2
,, 20 ,, ...	1·4
,, 30 ,, ...	+0·1
,, 50 ,, ...	+0·2
,, 70 ,, ...	+0·1
,, 100 ,, ...	0·6
,, 130 ,, ...	0·9
,, 200 ,, ...	1·8
,, 264 ,, (bottom)	2·1

That the influence of the ice-fjord is here felt at the intermediary depths is obvious even without any chemical analysis of the water of the various layers. It is, however, very remarkable that the surface-temperature in such a high latitude, and in water constantly covered with enormous icebergs, *can*, in the short summer, reach such a height as the above series show. This is, by the bye, so far from being a solitary example that most serial temperatures from this locality, which were, however, all taken in calm weather, and extended over seven days, show a much higher surface-temperature.

The highest temperature was registered off the colony of Christianshaab, in the Disco Bay, in the south-eastern corner, viz. +11°·4 C. at the surface. At five fathoms it fell, however, to 2°·8, and stood from 30 to 100 fathoms at + 0°·2 C. That the icebergs in these waters must melt rapidly, particularly at the water-line, is clear, which was also corroborated by experience, all being deeply furrowed and heeling over.

The trawlings and scrapings extended to a depth of 300 fathoms, and were effected as well in Davis Strait, Disco Bay, on the banks, as in the fjords. The result was considerable, and several varieties of fauna previously unknown in the Greenland seas were caught, as well as some entirely new species. Among the rarest forms may be mentioned *Amblyops abbreviata*, *Mysideis grandis*, and *Boreomysis nobilis*, which are only known in a few species from the west coast of Norway, and *Spirorbis cancellatus*.

The harvest was richest on the banks, as was the case under previous expeditions, and poorest in Disco Bay, where several hauls at a depth of 200 to 250 fathoms brought up absolutely nothing, or only a couple of specimens of the same species. The trawl worked here so far down in the soft black clay, which everywhere covers the bottom, that the line constantly threatened to break. The expedition has brought home a total of 300 specimens of the deep-sea fauna.

During the stay in port the officers of the vessel were engaged in hydrographical labours, chiefly the measuring of certain harbours, and the botanists in excursions into the long, narrow fjords, where the vegetation is richest, but neither the mountains nor the islands were forgotten. The harvest was very rich. Of phanerogams and higher cryptogams alone specimens of 230 varieties were obtained, and five new plants were discovered, among which a new species of Carex, while several were found in entirely new places, whereby their geographical distribution has been increased with several degrees of latitude. Thus, *Linnæa borealis*, for the first time, in 1883, discovered in Greenland, and then in lat. 61° 10', was this year found as far north as 67°. Special attention was also given to the collecting of materials for illustrating the development of the Arctic fauna, which has hitherto been neglected. Great attention, too, was paid to the algæ fauna, although it is very poor in the places visited by the expedition.

The mineralogical harvest of the expedition was poor, for the reason that Greenland has already been thoroughly explored, geologically and geodetically, by such eminent scientific men as Sir C. L. Giesecke, Dr. Rink, Profs. Johnstrup, Steenstrup, and Nathorst, that little more is to be learnt. One object of interest was, however, brought home—viz. a block of ironstone found on the shore of the Disco Island at Uifak, in lat. 69° 20' N., of the same kind as those discovered there by Baron Nordenskiöld some years ago, and which were at first believed to be meteorites, but whose terrestrial origin must now be said to be beyond question, in consequence of Prof. Steenstrup having discovered nickel iron in lumps of all sizes, of exactly the kind as that contained in these blocks in the great basalt strata of the Disco Island. The block which weighs about 1800 lbs., has been presented to the Mineralogical Museum at Copenhagen, where it will be mounted, with those already brought thither from the same locality.

The scientific material collected by the expedition is under treatment, but considerable time must elapse before the final result is ascertained.

This spring another expedition has been despatched to Greenland, being the tenth since 1876. It is commanded by Lieut. Jensen, and has for its object, besides natural history and photographical studies, the survey of the west coast between Sukkertoppen and Godthaab, lat 65½°—64° N. This is the last stretch of the west coast which remains to be surveyed, and if Lieut. Jensen succeeds in finishing the work this year, the entire west coast of Greenland from lat. 59½° to 72½° N. will have been surveyed and charted.

That the Danes are proud of the accomplishment of this great and difficult work is only natural.

THE ROYAL SOCIETY OF CANADA

THE fourth annual meeting was held at Ottawa on May 26 and following days to the 29th inclusive; the President, T. Sterry Hunt, LL.D., F.R.S., in the chair. The following papers were read in Section III. (Mathematical, Physical, and Chemical):—On the analysis of silk, by Dr. H. A. Bayne, Royal Military College. The author selected samples of pure silk and linen and cotton (their purity being carefully determined beforehand by the use of the microscope), and after removing dressing material, colouring matter, &c., by ether and dilute hydrochloric acid, submitted all four samples to the action of a large number of reagents in order to determine to what extent solvents of silks affect other fibres also. The result of a large number of analyses showed that, for mixtures of silk and wool, basic zinc chloride is the most reliable reagent; while for mixtures of silk and cotton or linen, Lœwe's alkaline glycerine solution of oxide of copper gives the most trustworthy indications.—Mémoire sur l'introduction et l'interprétation rationelle des quantités négatives et des quantités imaginaires dans le calcul, by Dr. D. Duval.—Classification of natural silicates, by Dr. T. Sterry Hunt, F.R.S.—Blowpipe reactions on plaster tablets, by Prof. Haanel. This was in continuation of previous investigations.—Note on the quantitative blowpipe assay of Cinnobar, by Prof. Haanel.—On the determination in terms of a definite integral of the value of the expression—

$$\frac{1}{\underline{|m+n}}\left\{\left(x+\frac{n}{2}\right)^{m+n}-n\left(x+\frac{n}{2}-1\right)^{m+n}+\ldots\right.$$
$$(-1)^r\frac{\underline{|n}}{\underline{|n-r}\,\underline{|r}}\left(x+\frac{n}{2}-r\right)^{m+n}+\ldots+$$
$$\left.(-1)^n\left(x-\frac{n}{2}\right)^{m+n}\right\}$$

the series to be continued only as long as the quantity raised to power $m+n$ is positive, n being a positive integer, and m a positive integer, zero, or a negative integer numerically less than n; and on the deduction therefrom of approximate values in certain cases, by C. Carpmael, M.A. In this paper, after pointing out that the investigation of M. Cauchy fails when m is zero or an integer, although he assumed without comment that it would hold, the author proceeds to determine the values of a number of "extraordinary integrals" and obtains results different from those obtained by M. Cauchy, although his final approximate values agree with them if we correct certain numerical errors in Cauchy's results. — The geognosy of crystalline rocks, by T. Sterry Hunt, F.R.S.—Concernant la théorie de M. Steckel sur la veine liquide contractée, by C. Baillargé.—On tidal observations in Canadian waters, by A. Johnson, L.H.D., showing the very imperfect state of our knowledge of the tides, and the need of systematic observations on both the Atlantic and Pacific coasts.—On iron ores from Central Ontario. This paper comprises a series of analyses of magnetic and other iron ores from the counties of Peterborough and Hastings in the province of Ontario, with brief references to the conditions of occurrence of the various deposits from which the ores were taken, by Prof. Chapman.—A commentary on section ix. of Newton's "Principia," by Prof. Cherriman, M.A.—The density of weak aqueous solutions of certain salts, by Prof. MacGregor, D.Sc.—Redetermination of the difference of longitude between the observatories of McGill College, Montreal, and Harvard Observatory, by Prof. W. A. Rogers (Harvard) and Prof. McLeod (McGill College).—Redetermination of the differences of longitudes of Montreal, Toronto, and Coburg, by Messrs. Carpmael, M.A., McLeod, M.E., and Chandler, M.A.—Notes on (1) Clausius's theory of the virial; (2) the motion of a rigid body with one point fixed; (3) the equation of energy in generalised coördinates.—Geometrical methods in optics, by Prof. Loudon.—Notes on the economic minerals of New Brunswick, with a revised list of mineral localities in the province, by Prof. Baily. This paper being of the nature of a catalogue of localities, was not read before the Section.—Geology of Cornwallis or McNab's Island, Halifax Harbour, by Rev. Dr. Honeyman. A study of the local geology in which special reference was made to the occurrence of amygdaloidal boulders which were considered to have been derived from the vicinity of Cape Blomidon.—A Catalogue of Canadian Butterflies, with notes on the distribution of the genera, by W. Saunders. Explained merely in a few remarks, not being suited for reading in full.

The following papers were read in Section IV. (Geological and Biological):—On the Mesozoic floras of the Rocky Mountain region of Canada, by Sir W. Dawson.—Fossil plants from the Trias and Permian of Prince Edward Island, by Sir W. Dawson.—Illustrations of the fauna of the St. John group (third part), by G. F. Matthew. This paper was in continuation of former communications. It describes a large number of Cambrian forms, particularly trilobites, and discusses the relations of the subdivisions of the Cambrian of the vicinity of St.

John with those of the same formation in Europe.—On the Wallbridge Hæmatite Mine, as illustrating the mode of occurrence of certain ore deposits, by Prof. Chapman. The particular mine referred to has been practically worked out, and in the process a clear idea of its character has been gained. It is found to be a "stockwork," or irregular mass, and not, as had been supposed, a vein. Prof. Chapman regards it as typical of a large class of deposits in the vicinity.—On Cambrian rocks of the Rocky Mountains, by Dr. G. M. Dawson. These rocks are the oldest of those shown in the mountains between the 49th parallel and the Bow River. They are of great thickness, and include at one horizon red beds with pseudomorphic salt crystals, suncracks, &c. Fossils have so far been obtained from four localities only, and these appear to indicate the horizon of the Prospect Mountain group as olevellus shales of Eureka, Nevada.—On the geology of South-Eastern Quebec, by Thos. Macfarlane.—On the geology of Thunder Cape, Lake Superior, by Thos. Macfarlane. The last two papers were read merely by title, Mr. Macfarlane adding a few explanatory remarks.—Notes on the geology and fossils of Prince Edward Island, by Francis Bain, communicated, with remarks on the fossils, by Geo. Wm. Dawson. The paper contained the results of explorations by Mr. Bain, with mention of fossil plants found by him in different parts of Prince Edward Island. It appeared from these observations and fossils that the red and grey sandstones and shales of which the island is composed are divisible by superposition and fossils into three groups: (1) the Permo carboniferous as originally established by Sir Wm. Dawson, with local additions made by subsequent observers; (2) a formation regarded by Mr. Bain as probably Permian, and corresponding to the Lower Triassic of Dawson and Warrington's report; (3) an overlying series, probably Triassic, and corresponding to the Upper Trias of the above report. Sir Wm. Dawson discussed the evidence of the fossil plants as bearing upon the above views.

In Sections I. and II. the following (among others of a more or less literary character) were read:—(1) Population française du Canada de 1608 à 1631; (2) A travers des registres du XVII. siècle, by the Abbé Tanguay.—The manifestation of the æsthetic faculty among primitive races, by Dr. Daniel Wilson. This paper discusses the evidence of the æsthetic faculty, and the practice of imitative art among ancient and modern uncivilised races. The archæological investigations in European prehistoric remains showed a nearly universal absence of imitative art throughout the whole Neolithic period and the subsequent age of bronze. But behind this lay the vastly more remote age of the Cave-men of Southern France, with their singular indications of remarkable artistic skill. This the author compared with such evidences of imitative art as are familiar to us in the work of many native American aborigines, and stated his reasons for tracing all alike to efforts at sign-language and ideographic expression of facts and thought. This was illustrated from an analysis of native Indian languages in their terms for giving expression to the language of art.—Palæolithic dexterity, by Dr. Daniel Wilson. In this paper Dr. Wilson drew attention to the ingenious profile drawings now familiar to us as the products of the ancient Cave-men of Southern France, and showed that by the direction of the profiles they were divisible into right and left-hand drawings. In so far as the examples can yet be adduced, the right-hand drawings are to those of the left hand as about two to one. The percentage of left-hand drawings is thus greatly in excess of what would now be found. But it probably shows at that extremely remote period the bias of prevalent usage which, however originating, has sufficed to determine the nearly universal predominance of the preference for the right hand within the whole historical period.

ON THE OBSERVATION OF EARTH-TIPS AND EARTH-TREMORS

IN a paper read before the Seismological Society of Japan on February 15, 1883, I collected together a number of facts which lead to the belief that districts in all quarters of the globe have from time to time been subject to slow changes in level.

Amongst these evidences may be mentioned the changes which have been recorded by many observers in the position of the bobs of pendulums. That pendulums had not always hung in the same vertical line was sometimes indicated by the position of a multiplying index, and sometimes by the position of the stile of a pendulum as seen through a microscope. Another class of observations have been made by recording the position of a spot of light reflected from a small mirror, the mirror being so suspended that it was caused to turn by the slightest displacement of the pendulum relatively to the earth. A third class of records have been made with horizontal pendulums, the multiplying indexes of which have been observed to move from side to side as if the foundation on which the pendulums rested was being slowly tilted.

A fourth order of observations have been those which have been made with delicate levels, the bubbles of which slowly move along the containing-tubes in a manner difficult to explain. A fifth class of records indicating changes in level are those which have been made by observing the displacement of an image reflected from the surface of mercury.

A sixth kind of records are the changes sometimes observed in the levels of lakes and ponds. At the time of great earthquakes, at places remote from its origin, where there was no perceptible motion of the ground, the water of lakes and ponds have been observed to slowly rise and fall as if the basin in which they rested was being slowly tilted.

To the above six classes of records a number of miscellaneous observations might be added, all of which find an easy explanation if we admit that from time to time there are slow tips in the soil.

Another phenomenon which has been observed is that the surface of the ground is from time to time in a state of tremulous motion. These movements have been noted by observing the stile of a pendulum with a microscope, the end of a light multiplying index attached to a pendulum, the quivering and erratic motion of a spot of light reflected from a mirror connected with a pendulum or reflected from the surface of mercury.

An historical account of the various observations which have been made upon earth-tips and earth-tremors may be found in the reports of George and Horace Darwin to the British Association in 1881 and 1882.

Detailed accounts of the observations made in Italy are contained in Rossi's "Meteorologica Endogena."

An account of a considerable portion of the work which has been accomplished in Japan may be found in the *Transactions* of the Seismological Society, in the reports which from time to time I have had the honour of forwarding to the British Association, and in the pages of NATURE.

As it seems that these phenomena are gradually attracting an increasing attention, it is my intention in the following notes to give a brief account, not so much of the results I have obtained by observing earth-tremors and pulsations, but of the methods by which these results have been obtained, trusting that my experiences may be of value to those who are desirous of experimenting in this direction.

Among the first instruments I employed were microphones in conjunction with telephones and delicately-suspended short-period light pendulums. From time to time the telephones emitted strange sounds. As to what was the cause of these noises I am unable to say. Unless you kept your ear continually at the telephone there did not appear to be any method of obtaining a satisfactory record, so that, after much labour, these instruments were eventually discarded. For very similar reasons the small pendulums which were often in a state of tremor were also discarded.

The next class of instrument which I employed was similar to an apparatus suggested by Sir William Thomson and used by George and Horace Darwin in the Cavendish Laboratory when experimenting on the lunar disturbance of gravity. Any one who has read Mr. Darwin's account of these experiments will recognise the unusually great care which is required by any one who undertakes to make observations with such instruments. As I was without either assistants or a laboratory, and as my instruments were of the roughest description, my attempts at making satisfactory observations altogether failed. I certainly saw that the spots of light were continually shifting in position, but whether this was due to a tip of the soil or simply to contractions and expansions in portions of my instrument, I was unable to determine.

After much trouble and considerable expense, I very reluctantly gave up the pendulums and mirrors, and sought for apparatus of a still simpler kind. Having accidentally read an account of Plantamour's observations with levels, the simplicity of the apparatus induced me to borrow a pair of astronomical levels from the Imperial Observatory and follow his example.

For a long time these levels were installed beneath cases on a column kindly lent to me by the Professor of Natural Philosophy in the Imperial College of Engineering. Here they remained for over a year, after which they made many journeys. At one time they were nearly 13,000 feet above sea-level on the top of the conical Fujisan. At another time they were some hundreds of feet below sea-level at the bottom of the Takashima mine. These observations attracted the attention of the authorities at the Imperial Observatory, who, recognising the bearing they might have upon work which was going on in the observatory, they supplemented my observations with a second set of levels. All the usual precautions were taken to guard against the effects of temperature, and observations were carried out every three hours both day and night for more than a year. As the books of records accumulated, and the curves grew until some of them were 30 to 40 feet in length, experience showed that the errors chiefly due to changes in temperature might be equal to and even exceed the effects which were being sought. Now, I am inclined to an opinion communicated to me in a letter from M. d'Abbadie, who remarked that two levels upon the same column might be parallel, and yet their bubbles might move in

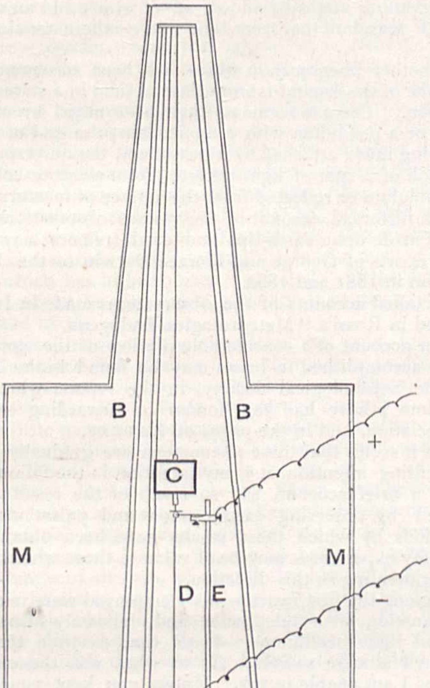


Fig. 1.

opposite directions. Notwithstanding this, the observations of levels have led to some interesting results.

First, there is the fact that level bubbles may wander without there necessarily being a change of level. Second, that level bubbles continue to move long after the sensible motion of an earthquake has ceased, thus giving us a means of observing the movements of long periods which usually bring the phenomenon of an earthquake to a close. After the earthquake the bubble will sometimes take up a position slightly different to that which it had before. Changes in the position of bubbles have been observed a short time before some of our earthquakes. Another result is the fact that the greatest irregularities in the curves showing the position of the bubbles of a level occur when earthquakes are most numerous. This is during the winter months. A last result is the fact that during a typhoon, or when the barometer is unusually low and fluctuating, a level bubble may be distinctly seen to pulsate through a small range, as if there were continuous changes of level going on.

While working with the levels another kind of instrument which I employed was a pendulum suspended from an iron stand, and so arranged that its stile could be viewed in the field of a microscope. By placing a prism beneath the end of the stile, the image of its end could be looked at horizontally, and the motion of the pendulum could be seen in any azimuth. At first I employed two microscopes placed at right angles, but by the adoption of the prism one microscope became sufficient. With these instruments, which are similar to those employed by Messrs. Bertelli, M. de Rossi, and other Italian observers, I verified for myself some of the more important results which had been noted in Europe.

For instance, it was seen that the pendulum was seldom at rest. Storms of tremors would take place with a low barometer. The pendulum did not always vibrate over the same point. It appeared as if there had been a tip in the soil, and the stand of the apparatus had been slightly inclined. These, together with other results which in many respects are little more than repetitions of results obtained by Bertelli, Rossi, and other observers, I have already published. Without attempting to describe other experiments which I have instituted, I will now give a brief description of an instrument which has been reached gradually, and which has given me the greatest satisfaction. From a letter received from M. d'Abbadie, whose researches regarding the change of vertical are amongst the most important yet instituted, I learn that my instrument has many points in common with one employed by M. Bouquet de la Grye. When I first set up this instrument, it was simply as a contrivance intended to make electrical contact, and set certain machines in action at the time of an earthquake. I next employed it as an instrument to record the occurrence of slight earthquakes. In its third form it was used to indicate earth-tremors and devia-

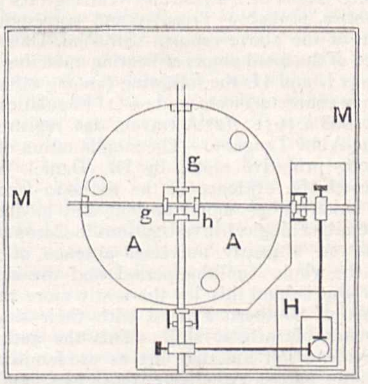


Fig. 2.

tions in the vertical. It will be readily understood from the accompanying sketches, Figs. 1 and 2: A A is a circular disk of cast iron about $\frac{3}{4}$ inches in thickness, resting on levelling screws. Bolted to this is a tripod of angle iron about 5 feet high, B B. This forms the support for a pendulum, C. The bob of this pendulum weighs about 7 lbs. It is made of a brass tube (3 m. diameter and $2\frac{1}{2}$ m. long) filled with lead. This is carried by a fine iron wire 3 feet $3\frac{1}{4}$ inches long, soldered into a small hole in a plate at the top of the tripod. A spike, C, projects from the base of the bob (see Fig. 3). As the bob with its spike were turned in a lathe, the end of the spike, the point of support and the centre of figure of the bob are fairly in a straight line.

A long, light pointer, D, made of a strip of bamboo which has been varnished, is kept in contact with the base of the pointer, as shown in Fig. 3. At the top of the pointer there is a light brass ring, *c*; at the top of this there are two fine needle-points, *a* and *b*. The point *a* is kept in contact with the base of the pendulum by turning the screw T, which raises the flat spring S on which *b* rests. T is carried by a strong stand, E, which rests at three points on A; *ff* is a disk of lead which is nearly equal in weight to that of the pointer below *b*.

In one instrument *a b* is 6 mm. whilst the total length of D is 415 mm. With these dimensions we may suppose that if the base pendulum moved, say, 1 mm., then the lower end of the pointer would move about 68 mm. The values to be given to the defections observed in the pointer have also been estimated by giving a slight turn to one of the levelling screws of the base plate, and thus tipping the plate through a known angle.

Records were at first made by reading a scale of millimetres placed beneath the end of the pointer. Experience showed this method to be inconvenient and without satisfaction. What occurred between the hours of observation was unknown, whilst the records which were made were liable to greater or less errors due to the observer. This led me to seek for some method which would render the observations automatic. To attach a hair to the end of the pointer and let it be dragged across the surface of a smoked glass created too great friction. The necessary appliances for photographic registration were too costly and too troublesome to be employed as I was situated in Japan. A very near approximation to frictionless registration was obtained by sending a current down the pointer, the end of which trailed on the surface of a thick film of iodised starch covering a strip of paper. The strip of paper, which was on a metal tray, moved slowly by clockwork beneath the lower end of the pointer. On taking out the paper I found that the film of starch, with its blue line, could be dried down to form a brown line on the paper. The process was troublesome and the line subject to distortion by the flow of the starch. The next idea was to discharge a spark from the end of the pointer and perforate a band of paper moving beneath the end of the pointer at the distance of about 5 mm. This feature in the apparatus, M. d'Abbadie writes me, is an essential feature in the apparatus of M. Bouquet de la Grye. To avoid losing a record, should the pointer move parallel to the length of the paper, two bands of paper, *g g*, moving at right angles (by means of the clock, H), are employed (Fig. 2). One band passes beneath the other over the surface of a brass plate, *h*. The paper used is the ordinary paper employed in a Morse telegraph instrument. By allowing the hand of a clock to pass every five minutes across a wire the current from two of Thomson's tray-cells is sent through an indirection coil which yields the sparks to perforate the paper. Every hour the hand of the clock makes a long contact by

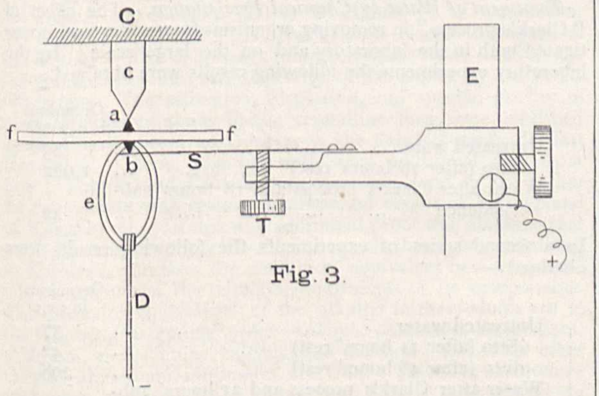


Fig. 3

passing across a small strip of platinum. In this way a large hole is made in the moving bands of paper and the hours are recorded.

To secure myself against error the same secondary current which perforates the paper of one machine is carried by wires to perforate the paper of a second instrument of slightly different construction placed on a stone column in a distant room.

The only work required is to wind the clocks which pull the paper and the clock which makes the contacts. This being done, records are automatically made every five minutes.

Up to the present the records which have been obtained have not been analysed, but certain of the results which they indicate are evident. These are as follows:—

1. Sometimes for days the pointers remain stationary, as is indicated by the sparks being regular and in a straight line (see Fig. 4).

2. Sometimes the pointers are in a state of tremor, and the sparks perforate the paper at many points, giving a line of several millimetres in breadth (see Fig. 5). These tremors may continue for ten or twelve hours. From the diagram, the duration of these tremors and the range of motion can be accurately measured. The instruments in both rooms agree as to the occurrence of tremors and periods of rest.

3. Sometimes the pointer will slowly wander from the straight line, and then slowly return. This usually takes place two or three times in succession. It would seem as if the ground had been slowly tipped through one or two seconds of arc, the period of each tip being from fifteen to sixty minutes (Fig. 6).

In regard to the occurrence of these tips, the instruments in the two rooms only occasionally coincide.

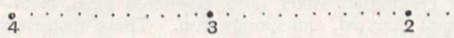
As to whether they are really to be regarded as true disturbances of level, or simply as movements due to local causes, I shall be better able to speak after a more carefal examination of the records.

4. Sometimes I find the bands of paper perforated over their whole breadth by sparks in all directions. This indicates that an earthquake has occurred and the pointer has been swinging (see Fig. 5, about 9.15 p.m.). All these figures have been produced by pricking through from the original diagrams. The clocks which I have used are made from small American spring clocks costing in Japan about 12*s*. each. The total cost of the portion of the apparatus figured, including the case, M, the doors of which and the parts which come in contact with the column are edged with flannel, is about 25 yen, or £4 10. In Europe an instrument of better construction would cost more. One of the columns on which an instrument is placed measures 6 feet by 3 feet and 5 feet high. It is constructed of brick and rests on concrete. The other column, which also rests on concrete, is made of stone. It measures 2 feet 2 inches × 2 feet 2 inches and is also 5 feet in height.

This latter column is rather too slight, as I found that even the pressure of my thumb is sufficient to cause the pointer of the instrument to move several millimetres.

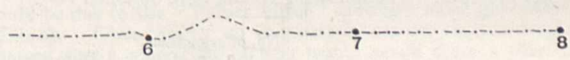
Amongst those who may possibly have a practical interest in this matter are those who have to deal with mines—especially, perhaps, coal-mines.

In the columns of the *Japan Gazette*, in NATURE, in the *Mining Journal*, and other papers, references have been made to the attempt to observe earth-tremors and other phenomena in the Takashima Colliery near Nagasaki. At the conclusion of a



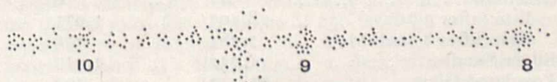
February 24th. 2–4. A.M. (No movement)

Fig. 4



March 28th. 1885. 6 & 7. P.M. (An earth tip?)

Fig. 6.



March 16th. 1885. 8–10. P.M. (Tremors & Earthquake)

Fig. 5.

report to the British Association, 1884, on the earthquakes of Japan, a letter from Mr. John Stoddart, the chief engineer at that mine, tells us that, owing to the working of the mine and other causes, he finds it impossible to make observations with delicate instruments. He therefore proposes to move the instruments to some distant station, assuming that any natural cause which would cause tremors in the mine will be generally felt over a considerable area. As to whether there is a connection between earth-tremors and the escape of gas in collieries, we do not yet know. Mr. Walter Browne, in a paper to the North of England Institute of Mining and Mechanical Engineers, thinks it desirable that investigation on this subject ought to be made, and quotes what is being done at Takashima. Mr. Galloway, writing in NATURE of February 5, if I read him correctly, does not encourage Mr. Brown's suggestions, and enters into an argument about the possibility of an earth-tremor forming a fissure. Earthquakes often form fissures on the surface, but these effects in mines are usually nothing. I make this statement on the authority of personal inquiry in many mining districts.

With the exception of the disturbances near an epicentrum, the movements due to ordinary earthquakes are so superficial that the range of motion at the depth of 10 feet is sometimes only one-fortieth of what it is at the surface. Earth-tremors are phenomena usually lasting many hours, and they certainly occur with low barometers. That they could by any possibility form fissures it is difficult to imagine.

As to what may be the cause of earth-tremors I am not prepared to offer a definite opinion; but, inasmuch as their association with barometric fluctuations renders it possible that in their occurrence they may also be associated with the escape of fire-damp, about which we have so little knowledge of practical value, it seems impossible that their study should be neglected.

Whether the results of such a study would be of practical value to the miner is not known, but that results of scientific value would be obtained is indisputable.

As the making of such observations are neither a matter of trouble or serious expense, I sincerely trust that they may be undertaken. On some future occasion I hope to describe the experiments which I made with one of these instruments on the summit of Fujiyama (13,365 feet), where movements were of a very marked and decided character.

Tokio, Japan — JOHN MILNE

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—"The Removal of Micro-organisms from Water." By Percy F. Frankland, Ph.D., B.Sc., F.C.S., Associate of the Royal School of Mines.

The author has investigated the efficiency, as regards the removal of micro-organisms, of methods of water-purification depending upon

(*a*) Filtration
(*b*) Agitation with solid particles
(*c*) Precipitation.

The method of investigation consisted in determining the number of organisms present in a given volume of the water before and after treatment, the determinations being made by Koch's process of gelatine-culture on glass-plates.

Treatment of Water by Filtration,—The filtering materials examined were greensand, silver sand, powdered glass, brick-dust, coke, animal charcoal, and spongy iron. These materials were all used in the same state of division, being made to pass through a sieve of 40 meshes to the inch, and in columns of 6 inches in depth. The following results were obtained:—

	No. of organisms in 1 c.c. of water before filtration	Ditto after filtration
Greensand	80	0
ditto (after 13 days)	8,193	1,071
ditto (after 1 month)	1,281	779
Silver Sand	11,232	1,012
Powdered Glass	11,232	792
Brickdust	3,112	732
ditto (after 5 weeks)	5,937	406
Coke	3,112	0
ditto (after 5 weeks)	5,932	86
Animal Charcoal	very numerous	0
ditto (after 12 days)	2,792	0
ditto (after 1 month)	1,281	6,958
Spongy Iron	80	0
ditto (after 12 days)	2,792	0
ditto (after 1 month)	1,281	2

Thus greensand, coke, animal charcoal, and spongy iron wer at first successful in removing all organisms from the water pass ing through them, but after 1 month's continuous action this power was in every case lost, the improvement still effected, however, by spongy iron and coke was very great indeed, whilst the greensand and brickdust were much less efficient, and the number of organisms in the water that had been filtered through animal charcoal was greater than in the unfiltered water.

Treatment of Water by Agitation with Solid Particles.—Water was agitated with various substances (in the same state of division as above) and after the subsidence of the suspended particles, the number of organisms in the water before and after treatment was determined. 1 grm. of substance was in nearly each case shaken up with 50 c.c. of water. The agitation was in nearly all cases continued for 15 minutes, but the duration of subsidence was varied according to the length of time which it required for the water to become clear. The following results were obtained:—

	No. of organisms in 1 c.c. of water before treatment	Ditto after treatment
Spongy Iron (1 minute agitation, ½ hour subsidence; 5 grms. used)	609	28
Spongy Iron (15 minutes' agitation, ½ hour subsidence; 5 grms. used)	609	63
Chalk (15 minutes' agitation, 5 hours' subsidence)	8,325	274
Animal Charcoal (15 minutes' agitation, 5 hours' subsidence)	8,325	60
Coke (15 minutes' agitation, 48 hours' subsidence)	Too numerous to be counted	0
China Clay (15 minutes' agitation, 5 days' subsidence)	—	Too numerous to be counted

In order to ascertain whether subsidence alone would diminish the number of organisms contained in the upper strata of water, bottles containing infected water were allowed to remain at perfect rest, and then the upper layers in the several bottles were tested for organisms at different intervals of time. Thus:—

Hours of rest	No. of organisms found in 1 c.c. of water
0	1,073
6	6,028
24	7,262
48	48,100

Thus, without agitation with solid particles and subsequent subsidence of the latter, there is no diminution, but on the contrary an increase in the number of organisms in the upper strata of water.

Treatment of Water by Chemical Precipitation.—The effect of "Clark's process" in removing organisms from water was investigated both in the laboratory and on the large scale. In the laboratory experiments the following results were obtained:—

	Organisms in 1 c.c.
Untreated water	85
ditto (after 18 hours' rest)	1,922
Water after Clark's process and 18 hours' subsidence	42

In a second series of experiments the following results were obtained:—

	Organisms in 1 c.c.
Untreated water	37
ditto (after 21 hours' rest)	42
ditto (after 48 hours' rest)	298
Water after Clark's process and 21 hours' subsidence	22
ditto (after 48 hours' subsidence)	166

On the large scale the efficiency of the process was examined at the Colne Valley Waterworks, Bushey:—

	Organisms in 1 c.c.
Hard water	322
Water after softening and 2 days' subsidence	4

A recent modification of Clark's process devised by Gaillet and Huet was also examined:—

	Organisms in 1 c.c.
Hard water	182
Soft water	4

Thus a very great reduction in the number of organisms present in a water may be effected by submitting it to Clark's process. It appears also that the clear water should be removed as rapidly as possible from the precipitated carbonate of lime, as otherwise the organisms may become again distributed through the water.

Micro-organisms in Potable Water.—The number of organisms in natural waters of various origin has been determined by the author, who appends the results of a monthly examination, in this respect, of the various waters supplied to London during the first three months of the present year:—

	1885 No. of organisms in 1 c.c. of water Jan.	Feb.	March
Chelsea	8	23	10
West Middlesex	2	16	7
Southwark	13	26	246
Grand Junction	382	57	28
Lambeth	10	5	69
New River	7	7	95
East London	25	39	17
Kent	10	41	9

General Conclusions.—Of the substances experimented with only greensand, coke, animal charcoal, and spongy iron were found to wholly remove the micro-organisms from water filtering through them, and this power was in every case lost after the filters had been in operation for one month. With the exception of the animal charcoal, however, all these substances, even after being in action for one month, continued to remove a very considerable proportion of the organisms present in the unfiltered water, and in this respect coke and spongy iron occupy the first place.

The results obtained by agitating water with various solid materials show that a very great reduction in the number of suspended organisms may be accomplished by this mode of treatment, and the complete removal of all organisms by agitation with coke is especially worthy of notice.

Again, the results obtained with Clark's process show that we possess in this simple and useful mode of treating water a means of greatly reducing the number of suspended organisms.

Thus, although the production in large quantities of sterilised potable water is a matter of great difficulty, involving the continual renewal of filtering materials, there are numerous and simple methods of treatment which secure a large reduction in the number of organisms present in water.

Physical Society, June 27.—Prof. Guthrie, President, in the chair.—Dr. Ramsay, Messrs. T. Hands, F. W. Sanderson, W. A. Shenstone, and T. H. Nalder were elected Members of the Society.—The following communications were read:—On the specific refraction and dispersion of the alums, by Dr. J. H. Gladstone. The refraction, dispersion, and specific gravity of nineteen different alums in the crystalline form were published by M. Charles Soret, of Geneva, in the *Comptes rendus* for last November. These, together with some additional data from Soret, Topsöe, and Christiansen, were employed by the author for comparison with certain experimental results of his own and of Kannonikof. In this way additional proof was obtained that a salt has the same specific refraction, whether it be crystallised or dissolved, and that the refraction equivalent of a compound body is the sum of the refraction equivalents of its components. The refraction equivalents of the alkalies in these alums are in the following ascending order—sodium, potassium, ammonium, rubidium, methylamine, calcium, and thallium; and of the other metals—aluminium, chromium, and iron. This is in accordance with what was previously known, but Soret's observations do not afford the means of determining the equivalents more accurately than before. The refraction equivalents of iridium and gallium were determined for the first time, giving respectively 17·4 and 14·8. The specific dispersion of the same compounds, measured by the difference between the specific refractions for the lines A and C, was also examined. The differences of dispersion are much greater comparatively than the differences of refraction. The order was also determined, but not the actual dispersion equivalents of the different elements.—On a form of standard Daniell cell, and its application for measuring large currents, by Dr. J. A. Fleming. The author first referred to the careful and thorough investigation of the circumstances affecting the electromotive force of Daniell's and allied cells by Dr. Alder Wright. He then described a form of all that had been found most convenient and reliable in practice. It consists of a U-tube in the two limbs of which are the two solutions of sulphate of copper and sulphate of zinc of the same specific gravity. Electrodes consisting of freshly electro-deposited copper and pure zinc that has been twice distilled dip into the two limbs. The E.M.F. of this cell is 1·102, and the variation of E.M.F. with temperature is practically *nil*.—On the phenomenon of molecular radiation in incandescent lamps, by Dr. J. A. Fleming. Some years ago Dr. Fleming had called attention to a phenomenon in incandescent lamps very analogous to that of discharge in high vacua observed by Mr. Crookes. The inner surface of the lamp-glass was sometimes found to be coated with a deposit of carbon, with the exception of a clear line marking the intersection of the glass with the plane of the loop, and being in fact a shadow of the loop apparently caused by an emission of matter from the terminals. Dr. Fleming has since found how to produce this appearance at pleasure by passing a very strong current momentarily through a lamp, and has succeeded in obtaining similar deposits of various metals that had been used as terminals. These deposits show colours by transmitted light, and as a general result the author concludes that red metals such as gold and copper appear green by transmitted light, whereas white metals like silver and platinum appear brown, a conclusion which, however, was challenged by Capt. Abney in the discussion ensuing.—On problems in networks of conductors, by Dr. J. A. Fleming.—Lecture experiments on colour mixtures, by Capt. Abney. The apparatus employed by Capt. Abney is a modification of Maxwell's colour-box: the spectrum, instead of being formed upon a screen, is received upon a convex lens which forms an image of the face of the prism upon a screen. If all the light from the prism falls upon the lens this image is colourless, but by interposing a screen with a slit in the spectrum close to the lens, so as only to allow light of a given colour to fall on the lens, the image appears coloured with that light. By using two or more slits different lights may be mixed in any required proportions.—On stream-lines of moving vortex-rings, by Prof. O. J. Lodge. The communication described a method of drawing vortex stream-lines, consisting in superposing uniform motion represented by a series of parallel lines upon the lines of a stationary vortex as given by Sir W. Thomson in his memoir on vortex motion, and joining up the corners of the quadrangles so formed. This operation is very simple, and by its application a number of the more remarkable properties of vortex-rings may be obtained, the general analytical investigation of which involves mathematical methods of the highest order. Drawings were exhibited showing the nature and behaviour of a single vortex-ring moving with different velocities, a vortex-ring approaching a large distant obstacle, the chase of two unequal rings, and many other cases.—On the thermo-electric position of carbon, by Mr. J. Buchanan. It having been observed that the carbon filaments of incandescent lamps usually gave way at the negative end, experiments were instituted to find if the destruction could be due to the "Peltier effect" causing a local generation of heat. Observations on a platinum-carbon thermo-couple showed that a generation of heat would result from a current passing from carbon to platinum, but the effect was too small to account for the observed phenomenon. It was found that a couple of carbon-iron rose considerably in E.M.F. by maintaining the hot joint for some time at 250° C.—On some further experiments with sulphur cells, by Mr. Shelford Bidwell. The paper contains (1) a description of a class of cells which give a constant voltaic current, the electrolyte consisting of a solid metallic sulphide; (2) an explanation of the unilateral conductivity exhibited by selenium and by sulphur cells; and (3) a description of a cell which gives, as the result of passing a current through it, a current in the same direction as the primary current.

Edinburgh

Mathematical Society, July 10.—Mr. A. J. G. Barclay, president, in the chair.—Mr. R. E. Allardice gave an account of a paper by Mr. Charles Chree on physical applications of polar co-ordinates to the displacement of elastic solid and fluid bodies, and contributed some notes of his own on solid geometry.—Mr. J. S. Mackay submitted a paper by Mr. Robert J. Dallas on the method of orthogonal projection.—Mr. A. Y. Fraser, the hon. secretary, and Dr. Rennet, of Aberdeen, were appointed by the Society to represent it at the ensuing meeting of the British Association.—The president, in his closing remarks, stated that the membership of the Society at the end of its first session was 58, at the end of its second 92, and now, at the end of its third, 147.

Paris

Academy of Sciences, July 6.—M. Bouley, president, in the chair.—New methods for determining the absolute co-ordinates of the polar stars without the necessity of ascertaining the instrumental constants, by M. Lœwy.—On the movement of a heavy revolving body fixed at a point in its axis, by M. G. Darboux.—On some new properties of the differential parameter of the second order for the functions of any number of independent variables, by M. Haton de la Goupillière.—A reply to

M. Mascart's recent note on the great movements of the atmosphere, by M. Faye.—Researches on vegetation: on the carbonates in living plants, by MM. Berthelot and André. In this paper the authors explain the methods followed by them in determining the quantity of the simple organic salts now known to be largely, if not universally, diffused throughout the vegetable kingdom.—Anatomy and physiology of Phœnicurus, a remarkable parasite found largely associated with certain mollusks, by M. de Lacaze-Duthiers.—On the homography of two solid bodies, by M. Sylvester.—Report on the experiments made in Holland and Belgium on an application of the large movable tubes of the hydraulic system constructed at the sluices of the Aubois; further modifications of that system, by M. A. de Caligny.—Spectrum of ammonia obtained by reversal of the induced current, by M. Lecoq de Boisbaudran.—A process of prophylactic inoculation against splenetic or charbon fever, by M. A. Chauveau. The peculiarity of this process consists in the method adopted for attenuating the cultivated virus, which is effected by means of compressed oxygen. Three points are established: (1) that it suffices to inoculate animals a single time in order efficiently to protect them both from experimental inoculations with strong, unattenuated virus and from the effects of spontaneous contagion; (2) that the virus attenuated by means of compressed oxygen is as harmless as that obtained by other methods constituting what is known as the first charbon vaccine; (3) that the most attenuated virus continues still active and serviceable long after its preparation.—Remarkable solar protuberances observed at diametrically opposite points of the disk on June 26, in Paris, by M. E. L. Trouvelot.—On some formulas in the theory of left curves, by M. Ph. Gilbert.—On the reductive properties of pyrogallol; its action on the salts of iron and copper, by MM. P. Cazeneuve and G. Linossier. The authors' experiments establish a complete parallelism between the reactions of ferric and cupric salts.—On the action of acetic acid in decomposing the hyposulphites of sodium and potassium, by M. E. Mathieu-Plessy.—Description of a new method of quantitative analysis for cadmium, by MM. Ad. Carnot and P. M. Proromant.—A new process for detecting and rapidly analysing small quantities of nitric acid in the air, water, earth, &c., by MM. Al. Grandval and H. Lajoux.—On the formation of large deposits of nitrates in Venezuela, the Andes, the Orinoco Basin, and other intertropical regions, by MM. A. Muntz and V. Marcano. From their observations the authors conclude that these nitrates have a purely animal origin, developed without the intervention of atmospheric electricity. Their position, the constant presence of large quantities of sulphates and of the nitrifying organism, combined with the study of the phenomena observed in deposits now in process of formation, all tends to exclude the recently advanced hypothesis of electric influences.—On the composition and fermentation of interverted sugar; a reply to M. Maumené, by M. Em. Bourquelot.—On the fermentation of the jéquirity plant, by MM. J. Béchamp and A. Dujardin.—On the production of the hydrate of crystallised magnesium (artificial brucite) and of the hydrate of crystallised cadmium, by M. A. de Schulten.—On the determination of the mineral group of zeolites in the absence of determinable crystalline forms, by M. A. Lacroix.—On a new group of felspar rocks in the district of Four-la-Brougue, Puy-de-Dôme, by M. F. Gounard.—On the position of some serpentine rocks on the road between Granada and Jaen in the north of the province of Granada, Spain, by M. W. Kilian.—On the augite and hornblende eruptive formations (diorites and serpentines) in the Sierra de Peñaflor, Andalusia, and on the genesis and dissemination of gold throughout these rocks, by M. A. F. Nogués.—Contributions to the study of the oolitic flora of West France, by M. L. Crié.—On the structure and growth of whalebone in the Balenopteræ, by M. Y. Delage.—On the structure and action of the stylets in the sting of the bee, by M. G. Carlet.—On the respective toxic properties of the organic and saline matters present in the urine, by MM. R. Lépine and P. Aubert.—Epilepsy of auricular origin: a contribution to the study of otopiesis (auricular compression), by M. Boucheron.—New metalloscopic processes applicable especially to cases of lethargy, catalepsy, and somnambulism, by M. Moricourt. The author shows that patients subject to these morbid affections are peculiarly sensitive to the action of metals, many cases having been successively treated by his new metallotherapic processes.—Clinical studies on the leprosy still surviving in the rural districts of Norway, by M. Paul Bert.—On the passage of pathogenic microbes from the mother to the fœtus, by M. Koubassoff.—M. Grandidier was elected a member of the Section for Geography and Navigation in place of the late M. Dupuy de Lôme.

SYDNEY

Royal Society of New South Wales, May 6.—Annual Meeting.—H. C. Russell, B.A., F.R.A.S., President, in the chair.—The report of the Council stated that 34 new members had been elected during the year, making the total on the roll 494. Sir G. B. Airy, K.C.B., F.R.S., and Prof. John Tyndall, F.R.S., had been elected Honorary Members in the room of Sir F. B. Barlee, K.C.M.G., and George Bentham, C.M.G., F.R.S., deceased. The sum of 380*l.* had been expended on books and periodicals during the year. The Clarke Memorial Medal for 1885 had been awarded to Sir J. D. Hooker, K.C.S.I., C.B., and the Society's Medal and a prize of 25*l.* to Mr. W. E. Abbott for his paper on the water-supply in the interior of New South Wales. The Society had presented its *Journal* to 313 kindred societies and institutions, and received 1147 volumes and pamphlets in return. The following papers had been read at its monthly meetings:—Presidential Address, by Hon. Prof. Smith, C.M.G.; the removal of bars from the entrances to our rivers, by W. Shellshear, A.M.I.C.E.; notes on gold, by Dr. Leibius, M.A.; some minerals new to New South Wales, by Prof. Liversidge, F.R.S.; the oven-mounds of aborigines in Victoria, by Rev. P. MacPherson, M.A.; notes on the trochoided plane, by L. Hargrave; a new form of actinometer, by H. C. Russell, B.A.; notes on some mineral localities in the northern districts of New South Wales, by D. A. Porter; notes on Doryanthus, by C. Moore, F.L.S.; water-supply in the interior of New South Wales, by W. E. Abbott; notes on a new self-registering anemometer, by H. C. Russell, B.A.; researches upon the embryology and development of the Marsupials, Monotremes, and Ceratodus, by W. H. Caldwell, M.A. —A *conversazione* was held on October 8 in the Great Hall of the University, attended by about 900 members and their friends. The Council had issued the following list of subjects with the offer of the Society's Bronze Medal and a prize of 25*l.* for each of the best researches, if of sufficient merit (to be sent in not later than May 1, 1886):—On the chemistry of the Australian gums and resins; on the tin deposits of New South Wales; on the iron ore deposits of New South Wales; list of the marine fauna of Port Jackson, with descriptive notes as to habits, distribution, &c. (to be sent in not later than May 1, 1887); on the silver ore deposits of New South Wales; origin and mode of occurrence of gold-bearing veins and of the associated minerals; influence of the Australian climate in producing modifications of diseases; on the Infusoria peculiar to Australia.—The Chairman delivered the Presidential Address, and the officers were elected for the ensuing year.

CONTENTS