THURSDAY, DECEMBER 7, 1871

THE CHAIRS OF SCIENCE IN THE SCOTTISH UNIVERSITIES

THE biographer of a Scottish Professor says (we fear boastfully) that his friend had lectured on anatomy, chemistry, physiology, pathology, medical jurisprudence, and medicine, and that he was well qualified also to lecture on botany, mineralogy, and geology. There were giants then surely, but their day is past; for the Professor of Natural History in Glasgow University is just now trying to procure the erection of a new Chair, on the ground that geology or comparative anatomy is, either of them, as much as he can effectively teach. Perhaps no better indication of the enormous progress of Science during the last half century could be found than the facts we have mentioned. The earlier professor found his multifarious duties possible because the subjects were very limited, and, in physiology, chemistry, mineralogy, and geology, the means of investigation were few. Now geology has outgrown the dimensions of anatomy, as a teaching subject. The Chairs of Natural History in Scotland, now only two in number, those in Glasgow and Aberdeen (for Science is only provided for temporarily in St. Andrews at present at the cost of Civil History), are remarkable foundations. There is no clear notion what the Professors may not teach. Custom has settled that geology and zoology shall be expected of them, and the Ordinances of the University Commissioners act upon this tradition. But it is doubtful if successful restraint could be put upon an eccentric Professor who selected ethnology and meteorology as his topics. He would lose class fees; but as he holds from the Crown, and the Crown has not defined his duties, he would be legally safe. Fortunately there has been no attempt hitherto to act independently of University needs; on the contrary, there have been from time to time voluntary modifications of the class work, both as regards the length of the courses and the subjects, so as to meet the needs of students. But this very complaisance has been injurious; for, to take the case of Glasgow, the Universities (Scotland) Act made zoology a compulsory subject for medical students, and the Court and Senate at a later date resolved to grant a degree in Engineering Science (modestly calling it a certificate), requiring geology as one of the subjects of examination. Complete systematic courses were therefore indispensable, and the attempt to provide these has demonstrated their impossibility; hence the present attempt to procure a change.

While sympathising with the Glasgow Professor, and with his colleagues in Aberdeen and in Queen's College, Ireland, we decline to discuss the question as one of individual hardship, or even as detracting from the efficiency of one or several Universities. The existence of lectureships which profess to be scientific, but which can only be popular if the work is equally divided between the different subjects, is an evil which demands a remedy, and Scotland cannot be indulged in her fancy for multiple Chairs, as anatomy and botany, logic and rhetoric, moral philosophy and political economy, civil and Scots law. If the teacher has a strong bias in favour of either subject he will throw himself into that and neglect the other, even though it forms part of that curriculum for which a degree is granted. Now, apart from the degradation of a scientific honour, the lowering of the standard of scientific teaching is especially to be guarded against at the present time. There are too few inducements for young men to devote themselves to Science as a life profession, still less encouragement do they receive to devote their energies to one branch exclusively. If our Universities continue to sanction average teaching, it will be a substantial injury to education throughout the country, and will put an end to that scientific work upon which the progress of science and the reputation of the country ought to rest: for it cannot be expected that a man whose ideas are frittered away by desultory work can have either the inclination or the time for patient continuous research. It is to be regretted that the Scottish Universities are too poor to help themselves in this matter. Private liberality has placed Edinburgh in a right position; geology and zoology being respectively the entire occupation of Geikie and Wyville Thomson. In Newcastle the new college has started wisely with one subject, geology; but it is to be hoped that zoology will ere long be added as a separate professorship. In the London colleges separate provision, such as it is, is made for these two branches of Science, and even in the Universities which flippant so-called Radicals are wont to denounce as effete, and to contrast unfavourably with their Scottish sisters, there is provision for teaching as well as for the teacher.

It is in the interest of these and other bodies that we urge the necessity of reforming Scottish Universities in the matter of Science teaching. If they are permitted to continue as at present, the good done by their better equipped rivals will be diminished. It is a mistake to suppose that one college is better off if the teaching in another is defective; that may happen for a year or two, but in the end all suffer for the fault of one, all are lowered in tone though they may not be brought equally low. To maintain English teaching, Scottish teaching must be raised. But as no funds exist on which a just claim may be established for this purpose, private generosity or the State purse are the only appeals. Cabinet Ministers have been known to talk of Science as having condemned itself if it is not self-supporting, and in London there is a current opinion that Science is too largely subsidised, comparatively speaking, north of the Tweed. But it must be remembered that in Glasgow and Aberdeen, even in Edinburgh, it is impossible, save in the exceptional case of the director of the Scottish Survey, to find a man qualified for the post, and at the same time deriving an adequate income from other sources; for the time is past when Science was the pursuit only of the wealthy. It may not be sound in principle, but it is a practical necessity for the State to endow Science in the provinces; failing that and failing local effort, it would be best, in the interests of sound education, to suppress the starved chair altogether. But in the particular cases at present under consideration there is a strong claim on the State; the chairs of Natural History are creations of the Crown, and as circumstances have altered greatly since their creation, it behoves the Crown to secure that its intentions are fulfilled by making corresponding alterations.

Of course this is the final resort after it is clear that Scotsmen decline to supply the money needed; but in Glasgow at least it is not to be believed that the examples of Manchester, Birmingham, and Durham will be without effect. All that has been said is equally true of Ireland; but the practical treatment of the difficulty involves other considerations upon which we cannot at present enter.

JUKES'S LETTERS

Letters and Extracts from the Addresses and Occasional Writings of J. Beete Jukes, M.A., F.R.S., F.G.S. Edited, with connecting Memorial Notes, by his Sister, with a Portrait. (London: Chapman and Hall, 1871.)

HOW few among us—when his glass is run—would care to have the story of his life from year to year, even from his boyish days, writ down and published to the world—indeed, how very few would be found worthy of more record than "born, lived, died." Now and again, however, one meets with a man whose career in life is not only lifted above the monotonous hum-drum existence of ordinary mortals, but who, both by his life and writings, attracts our admiration and regard.

Such a man was Joseph Beete Jukes, a sketch of whose life and writings, together with some two hundred letters, edited by his sister, Mrs. A. H. Browne, form the substance of this volume.

Blest not only with a goodly person and stature but with a noble and generous nature, which won to his side both the ignorant and the educated, Mr. Jukes was also a man of high mental endowments, and both as a speaker and a writer had the knack to command attention. But in his leisure hours no one entered more keenly than he into all the enjoyments of the country, being fond of hard riding, and a keen sportsman and good shot. Nor was he less fond of a good joke, as his letters often testify.

Educated at Cambridge during Sedgwick's palmy days,* no wonder that he caught some of the fire from "Old Adam," as his students lovingly nicknamed him, and instead of entering the Church, as his mother fondly hoped, inaugurated a career for himself by walking through Derbyshire, Staffordshire, Cheshire, Shropshire, Yorkshire, and many other parts of England, geologising and lecturing wherever he could get a class to attend. And very successful Jukes seems to have been. Writing from Nottingham in June 1838, he says, "I have had a very good class here, never less than two or three hundred, and frequently four or five hundred" (p. 26).

Having about 1838 made himself acquainted with practical surveying, he was in 1839 offered the appointment of Geological Surveyor of Newfoundland, a post he gladly accepted, and which occupied his time until the close of 1840. Into all the hardships of this work he entered with his accustomed good-will and spirits. Mr. Jukes contrasts his own easier lot with that of the hardy naturalist Prof. Stüwitz, who "set off at the beginning of December in a boat with a little cuddy, to which (he says) my cabin is a palace, to see the winter fishing in Fortune Bay, with the chance of being frozen up on his return, and having to get ashore and come through the woods and snow," and he adds, "don't talk of my hardships and privations and courage" (p. 91). But the Newfoundland survey ended in October 1840,* and early in 1842 Mr. Jukes had the satisfaction to find himself appointed to the office of Naturalist to the Expedition for surveying Torres Straits, New Guinea, &c., on board H.M. ship *Fly*, commanded by Captain E. P. Blackwood, R.N. This task, so congenial to him who loved no occupation so well as one requiring constant out-door exercise in the saddle, on foot, or on the water, occupied him until June, 1846, and during his four years' absence his letters and journals furnish abundant materials of interest to the reader; much of which, however, will necessarily also be found in Mr. Jukes's book entitled "Narrative of the Surveying Voyage of H.M.S. *Fly* (2 vols.), published in 1847.

* He matriculated at St. John's in 1830, being then nineteen years of age.

His description of scenery in the interior of Java is very interesting:—"Rich plains covered with all kinds of tropical productions, watered in every direction by clear rocky brooks, surrounded by mountains, either in single cones or serrated ranges, from 5,000 to 11,000 feet in height; abundance of game whenever we choose to stop and shoot, jungle-fowl, peacocks, deer, wild pigs, tigers. We crossed one great range of mountains by a path that led us through the extinct crater of a volcano, five miles across and 7,000 feet above the sea, and in the centre of which was a small cone and crater still in action, though when we looked down into it it was only blowing out steam, with a roar as of a thousand blast-furnaces. Take a scene on the slope of these mountains, as they dip into the plain of Malang. Scene:—An open mountain valley, full of coffee plantations, with small scattered villages, into which opens a deep mountain glen, crowded with the rankest luxuriance of tropical vegetation, groups of tree ferns and great broad-leaved plants, so as to arch over and frequently hide altogether the full brook that comes flashing and roaring down the rocks in a succession of rapids, varied by waterfalls; the road, narrow, steep, and slippery, as it winds down the sides of the glen, expands into a broad green lane, with an exquisite carpet of turf as it opens on the more level lands" (pp. 238, 239).

Like every other man who is fond of the sea, we find him exclaiming, "I confess I am getting more and more enamoured of a sailor's life, and regret I did not know the navy early enough to enter it. I see it would have suited me exactly" (p. 251).

But Mr. Jukes was destined to be a geologist. On the return of the good ship *Fly*, in June 1846, he only allowed himself a few weeks at home before he had again "signed articles" to Sir H. T. de la Beche, then Director-General of the Geological Survey, and in October joined Profs. Ramsay and Forbes at Bala. These appear to have been his most intimate friends, as his letters to Ramsay abundantly attest. His letters to Forbes have, unfortunately, not been preserved. To those not connected with the Survey, this is the section of the book which it seems to us will be the least interesting, although here and there one comes upon a funny bit or a matter of public interest.

His fagging away at the geology of the rocks south of Conway forms the subject of many letters, and the solution of their puzzling structure is well given at p. 306. For

* For an account of his Newfoundland experiences and travels, see also "Excursions in and about Newfoundland during the years 1839 and 1840," 2 vols. 8vo, London, 1842. See also "Report on the Geology of Newfoundland," folio, 1840.

comical bits, the story of a new fossil discovered (p. 314); the boundary of the Caradoc Sandstone at Pentre Voelas (p. 318); and "a strange and marvellous history of a temptation and what befel thereon" (p. 323), must be read and laughed over, as also must the account of Miss Moggore and Miss Bood, natives of Murray and Darnley Islands, who *would* walk arm-in-arm with Mr. Jukes (p. 252).

Besides a vast number of letters to Prof. Ramsay, all more or less relating to geology, there are letters to Dr. Ingleby and other relatives; one on Versification (p. 377), in which two of Mr. Jukes's own verses appear. The annexed is a sample, probably intended for the Old Annual Survey Dinner:*—

> Free o'er the hills our feet shall roam,
> We'll breathe the mountain air, sir;
> Care shall not ever dare to come,
> Nor grief pursue us there, sir.
> Joyous in Nature's wildest scene,
> Where rocks lie topsy-turvy,
> And falling waters flash between,
> We'll prosecute the Survey.
> Oh, the Survey, the Geological Survey!
> Health and good humour shall be queen
> Of the Geological Survey!

We have religious beliefs considered (p. 375); views on Providence (p. 386); creeds (p. 409); political opinions (p. 405), and many other matters discussed.

But we have said sufficient to recommend the book to all who are likely to be interested in it. We would especially direct geologists to it, as being the record of the life of a man who did very much for their science—indeed, who died in its service. To his friends, who are to be found scattered far and wide, the title of the book is sufficient to recommend it to them. To his relatives and intimate companions his memory will always be dear.

It seems strange that Prof. Jukes's life should be dedicated to Prof. Sedgwick, his early teacher; but so it is—the old oak, though decayed and feeble, still puts out its green leaves; but the younger man, whom he bid God speed thirty years ago, has already rested from his labours. H. W.

* Alas! that this time-honoured institution of meeting "all hands" once a year should have fallen into disuse. It was a very bond of union.

OUR BOOK SHELF

The Science of Arithmetic. By James Cornwell, Ph.D., and Joshua G. Fitch, M.A. Thirteenth Edition. (Simpkin, Marshall, and Co., 1870.)

The School Arithmetic. By the same authors. Eleventh Edition. (Simpkin, Marshall, and Co., 1871.)

THESE books are too well known to mathematical teachers to need detailed notice from us. Both are very good, and stand in the first rank among the scores of arithmetics published in England. The explanations, arrangement and examples, especially in the former book, are generally very good. We will venture, however, to suggest two or three changes to the authors, which we think would render the book better still, and which our experience would make us wish to see universally adopted. The rule for multiplication of decimals given in these books is the old one of counting the decimal places. We think this becomes a rule of thumb. The method ought to be the same as that in multiplication of integers; and it is at once seen by the pupil that as in multiplying by tens and hundreds, the figures are shifted to the left; so in multiplying by tenths and hundredths, they are shifted to the right. The decimal point is brought down straight, and each line in the working has its meaning; as in the example, multiply 712·35 by 15·807:—

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  712·35
   15·807
 ---------
 3561·75
7123·5
  569·880
    4·98645
 ---------
11260·11645
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This is more certain to be understood *every time it is done* than the old counting rule, and each line means something. Again, in that schoolmaster's *crux*, the division of decimals, we have in the books before us, the old Case 1, Case 2, and Case 3; and everybody knows the result in an examination. A better method is this, which we indicate briefly. Explain first that you cannot divide until the quantities are of the same kind, and of the same denomination. You cannot divide 2*l.* by 3 pence, till you have reduced the pounds to pence. Nor can you divide tenths by thousandths, till you have reduced the tenths to thousandths. Hence, to divide 1·375 by ·0025, the dividend must first be expressed in the same denomination as the divisor, namely as ten thousandths; this amounts to marking off as many decimal places in the dividend as there are in the divisor, which is best done by drawing a line after the figure, and then dividing. It is plain that the result is integral until the figures on the right of the line are brought down. It is worth while, perhaps, to give examples of the different cases; the explanation is obvious from what has been already said—

Divide 7·9 by 4·308—

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4·308) 7·900|00 (1·83 . .
       4·308
       -----
       35920
       34464
       -----
        14560
```

Divide 34·79628 by 2·5—

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2·5) 34·7|9628 (13·91 . . . .
     25
     --
      97
      75
      --
      229
      225
      ---
        46
```

Lastly, the methods of summation by differences and interpolation are essentially arithmetical, and of considerable interest, and we think might be introduced with advantage in the larger work.

The miscellaneous questions at the end of the larger book are not particularly good. They are often tedious, and not sufficiently varied, suggestive, or difficult. Nevertheless, the books are very good, and will teach teachers as well as learners. J. M. W.

Skandinaviens Coleoptera, synoptiskt bearbetade af G. C. Thomson. Tom. X. 8vo. (Lund, 1868. London: Williams and Norgate.)

THERE are few investigations of more interest to the student of British Natural History than the comparison of our native productions with those of the Scandinavian peninsula, and no descriptive works published on the Continent, a knowledge of which is of greater importance to him, than those of the acute and laborious naturalists of Scandinavia and Denmark. The work done by these men is usually of the highest quality, both for carefulness of investigation and clearness of statement; and the great similarity which exists between the faunas and floras of our islands and of the Scandinavian region, enables their work to be used to a certain extent as handbooks by British Naturalists. May their study lead the latter to imitate the Scandinavian mode of work! We are led to these remarks by the receipt of the tenth and concluding volume of Prof. Thomson's descriptive work on the Scandinavian Coleoptera, although this consists almost entirely of corrections, emendations, and additions to the contents of the nine previous volumes, in which the systematic description of those insects was completed. Prof. Thomson's work will be found of the highest value to the British entomologist, inasmuch as a very large proportion of the insects described in it are inhabitants of these islands, and many of the others will probably be discovered hereafter in the north of Scotland. The whole descriptive portion of the book is written in Latin, the characters, although often brief, are admirably drawn up, and the determination of the species is greatly facilitated by the excellent tables both of genera and species given throughout the work. Amended tables, introducing all new forms discovered during the progress of the book, are given in the second part of the ninth and in the tenth volumes. Although it appears under a Swedish title, the only portions of the work written in that language are the notices of localities of occurrence and critical remarks on genera and species, the former, at any rate, requiring little knowledge of Swedish for their comprehension. W. S. D.

Ichneumonologia Suecica, auctore Aug. Emil Holmgren. Tom. II. (Stockholm, 1871. London: Williams and Norgate.)

THIS is a second most important Swedish work, which illustrates in a striking manner the remarks which we made in noticing M. Thomson's "Skandinaviens Coleoptera." In this the author has commenced a monographic revision of the Swedish members of one of the most difficult families of insects, the Ichneumonidæ, which he here treats in an almost exhaustive fashion. We cannot venture to say how far he is correct in his synonymies, or in the reference of supposed species to others as varieties; but he has spared no pains in the preparation of his descriptions, and the student of his book will find no difficulty in understanding precisely what he means. This work, when completed, will be an invaluable aid to the few entomologists who venture upon the study of the Ichneumonidæ. W. S. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Planet Venus

THIS beautiful planet being now very favourably situated for examination, it may interest many of your astronomical readers if I give a brief description of the markings which have recently been seen on her surface. That these markings are exceedingly difficult objects to detect, even with a powerful telescope and under favourable atmospheric conditions, there is no doubt, and many observers have consequently failed to see them. The late Rev. W. R. Dawes, although possessed of very excellent vision, could never make them out, and it seems that the fact of their existence is doubted at the present time by some observers. At the meeting of the Royal Astronomical Society on November 10 last, "the Astronomer Royal mentioned that Venus was very favourably situated for observation, especially for noticing spots if any existed on her surface, his own experience being that there were no certain markings thereon, which the President corroborated." The opinions of such eminent astronomers should always be carefully considered, and the matter in dispute thoroughly investigated, before a contrary opinion is entertained. In the present case, however, I think that there is a sufficicy of evidence to prove that markings of various forms exist on the surface of the planet. I am the more particularly induced to say this by having before me upwards of sixty sketches of their appearance, made by experienced observers, who in the making of observations employ telescopes of great power and excellent definition. No doubt the faint cloudlike markings can only be made out after attentive gazing, and then are scarcely visible, though they have been distinctly seen by many observers. It is difficult to account for the fact that Mr. Dawes could not distinguish them, but perhaps the reason may be apparent, if we consider that an observer who is the most successful in the observation of faint companions to double stars, cannot satisfactorily observe the faint markings with which the planet's disc is diversified. Many observations of the spots were made at Rome in 1839—1841, and of six observers those were the most successful who experienced the greatest difficulty in detecting minute companions to large stars.*

With respect to the spots and markings which have recently been examined, it may be said that they are of various forms and degrees of visibility. Some of them are only just perceptible after a long and careful scrutiny of the planet's di c, while others are much more apparent, and distinguishable with less difficulty. Whether or not they are permanent in their form remains to be determined from a comparison of the whole of the observations. Some of the representations of the cloudy spots taken at different dates seem to be somewhat similar in their principal features. Several times that position of the planet's surface immediately adjacent to the terminator has been seen to be interspersed with small bright circular spots, which seem to be analogous to lunar formations. These bright spots have been seen by several of those who have critically examined the planet's appearance. They were seen by Mr. T. H. Buffham on May 4 and May 6, 1868, and Dr. Huggins at the last meeting of the R.A.S. said that "he had occasionally seen dusky spots, but he considers them as very uncertain or illusive. When, however, the crescent was thin and the planet near the earth, he had seen minute points of light on the terminator, which by most observers was described as irregularly indented. He had also noticed that when definition was very good, appearances analogous to those of lunar craters had been seen. Dr. De la Rue had often seen markings on Venus similar in character to those observed on Mars." An observation made by Mr. F. Worthington, with a 13-inch reflector, on June 11 last, confirms the statement made by Dr. Huggins in reference to the bright markings on Venus being similar to objects on the surface of our satellite. He writes, "Definition extremely good. The markings were very clearly seen, and bore a very remarkable resemblance to the craters and inequalities of the moon as seen with a low power, say an opera glass." From the foregoing it would appear to be beyond a doubt that, when the planet is in a crescent form, small bright markings, resembling lunar craters, are perceptible. These objects should be persistently looked for, and when observed the details of their appearance and position duly registered.

That the dark, cloud-like markings are similar to those on the surface of Mars, as stated by Dr. De la Rue, seems also an established fact. Mr. Henry Ormesher saw several irregular spots on Venus on May 10 last, and he says they were "clear and well-defined, and reminded me very much of those on the planet Mars, as they had much the same appearance." Of course the markings on Mars are much more conspicuous than those visible on Venus, but in their appearance there is no doubt that they are not altogether unlike.

In many of the drawings which I have before me the outlines of the cloudy patches do not terminate abruptly as in the case of the penumbræ to solar spots (*maculæ*) but seem to fade away into the general brilliancy of the disc. In some of the sketches, however, the boundary of the spots appears to have a well-marked outline. In regard to the terminator, it seems to have a very serrated edge, but in some of the drawings this is not depicted.

Referring again to the coincidence in the appearance of the bright spots of Venus and the craters of the moon, I would draw the attention of your readers to the Rev. T. W. Webb's "Celestial Objects," second edition, p. 51, in which there is an observation of interest recorded. WILLIAM F. DENNING

Hollywood Lodge, Cotham Park, Bristol, Nov. 28

* See Webb's "Celestial Objects," p. 50. It is there stated that "a very sensitive eye which would detect the spots more readily would be easily overpowered by the light of a brilliant star, so as to miss a very minute one in its neighbourhood."

The Flight of Butterflies

In the 103rd number of NATURE there are two notices of remarkable butterfly flights in America, and it is asked "Where the yellow butterflies are going?" Mr. R. Spruce, in "Notes on some Insect and other Migrations observed in Equatorial America" (published in the Journal of the Linnean Society, vol. ix. No. 38, read June 6, 1867), has the following curious account of similar flights, which, he says, have also been described by Messrs. Edwards, Wallace, and Bates: "The first time that I fell in with such a migration was in November 1849, near the mouth of the Xingú, when I was travelling up the Amazon from Parà to Sautareon. . . . We saw a vast multitude of butterflies flying across the Amazon from the northern to the southern side in a direction from about N.N.W. to S.S.E. They were evidently in the last stage of fatigue. They were all of common white and orange yellow species, such as are bred in cultivated and waste grounds, and having found no matrix whereon to deposit their eggs to the northward of the river (the leaves proper for their purpose having probably been already destroyed or at least occupied by caterpillars) were going in quest of it elsewhere. The very little wind there was, blew from between E. and N.E., therefore the butterflies steered their course at right angles to it; and this was the case in subsequent flights I saw across the Amazon. . . . But the most notable circumstance is that the movement is always southward. . . . Since my return to England I have read Mr. Bates's graphic description of a flight of butterflies across the Amazon, below Obidos, lasting for two days without intermission during daylight. These also all crossed in one direction, from north to south. Nearly all were species of Callidryas, the males of which species are wont to resort to beaches, while the females hover on the borders of the forest and deposit their eggs on low-growing, shade-loving Mimosas. He adds, 'the migrating hordes, so far as I could ascertain, are composed only of males.' It is possible, therefore, that in the flights witnessed by myself the individuals were all males in which case the flights should probably be looked upon, not as migrations, but dispersions, analogous to those of male ants and bees when their occupation is done, and they are doomed by the workers to banishment, which means death. In the case I am about to describe, however, the swarms certainly comprised both sexes, *although I know not in what proportion*; and their movements were more evidently dependent on the failure of their food.

"In the year 1862 I spent some months at Chandsey, a small village on the desert coast of the Pacific northward of Guayaquil, where one or two smart showers are usually all the rain that falls in a year; but that was an exceptional year, such as there had not been for seventeen years before—with heavy rains all through the month of March, which brought out a vigorous herbaceous vegetation where almost unbroken sterility had previously prevailed. In April swarms of butterflies and moths appeared coming from the East, sucking the sweets of the newly-opened flowers, and depositing their eggs on the leaves, especially of a Boerhaavia and of a curious Amaranth, until the caterpillars swarmed on every plant. New legions continued to pour in from the East, and finding the field already occupied, launched boldly out over the Pacific Ocean, as Magalhaens had done before them, there to find a fate not unlike that of the adventurous navigator. No better luck attended most of the offspring of their predecessors, especially those who fed on the Boerhaavia. The shoal of caterpillars advanced, continually westward, eating up whatever to them was eatable, until, on nearing the sea shore and the limit of vegetation, I used to see them writhing over the burning sand in convulsive haste to reach the food and shelter of some Boerhaavia which had haply escaped the jaws of preceding emigrants. The explanation of this continual westward movement is not difficult. A few leagues inland, instead of the sandy coast-desert with here and there a tree, we find woods, not very dense or lofty, but where there is sufficient moisture to keep alive a few remnants of the above-mentioned herbs all the year round, and doubtless also of the insects that feed on them. There are also cattle farms. When the rains come on, therefore, they cause as it were a unilateral development of the vegetation from the forest across the open ground, and a corresponding expansion of the insect-life which breeds and feeds upon it."

The whole paper is very interesting, but I have copied only such portions as bear on the question "Where are the yellow butterflies going?"

T. S-M.

The Origin of Insects

In an article by Dr. Beale, in your number for Nov. 23, on "One of the Greatest Difficulties of Darwinism," a most extraordinary misconception is stated to be a difficulty. That the pupa state is a modification of the ordinary process of skin-shedding in the Insecta is proved by so many facts, that one cannot understand for a moment how it can possibly be denied, much less how its denial can be made use of as an argument against the doctrine of evolution. Sir John Lubbock pointed out long ago that, in the development of the Insecta, every grade of modification exists between those insects which are gradually developed, each successive ecdysis producing only the slightest possible modifications, and those which undergo a change so complete that it may be likened to the process of metagenesis, as it has been called, which takes place in the Echinodermata.

It is an utter mistake to suppose that any insect is redeveloped during the pupa state. The most perfect instance of metamorphosis is that of the flies (some Diptera). In these the materials out of which the perfect insect is developed are supplied by the breaking up of the muscular system and fat bodies of the larva; but the cellular structures known as the Imaginal discs of Weismann are formed in the egg, and persist all through the life of the larva. These, it is true, only form a skin or case in which the fly is developed; but they are really nothing more than a larva skin, formed on the inside of the larva skin in the egg, and detached from it by the subsequent modifications of the larva.

The nervous system undergoes extensive modification in the development of the fly, but it never undergoes degeneration. The mouth organs of the imago, it is true, are not the mouth organs of the larva, nor are they formed by their modification, but they are foreshadowed in the egg before the mouth organs of the larva are formed. It is the mouth organs of the larva which are new formations, not those of the imago. In this most extreme case, the pupa skin is derived directly from the inner layers of the first larval skin, about twelve hours before the creature emerges from the egg. The imaginal skin is likewise derived from cells laid down in contact with the imaginal discs. There is absolutely only a difference in the time at which the successive skins are formed in this and in ordinary ecdysis.

A cimex which undergoes no change of form develops each successive skins from cells laid down within the last integument, and the same process is followed in the development of the fly.

The alimentary canal is likewise undoubtedly formed in a similar manner around that of the larva, and the sexual organs are gradually developed, even from the time when the embryo is enclosed in the egg.

Fritz Müller in his "Facts for Darwin," has shown very conclusively that the larval forms of insects are probably derived from imaginal forms; such seems, without doubt, to be the case with the flies (*Musca*). Every day the difficulties presented by the development of the Insecta to the doctrine of evolution are vanishing. It is extremely probable that insects first emerged from the water with fully formed wings. We have still relics of an aquatic winged insect fauna in the hymenopterous genus discovered by Sir J. Lubbock. We may readily believe the larval forms now existing on the earth are modified forms of originally perfect insects; we know that the larvæ are subject to far greater changes of life and far greater struggle for existence than the perfect insects. They are all probably embryonic forms, brought from the egg in a modified state before their perfect development is attained. The same thing is seen in several crustaceans, which are hatched as *Nauplius* forms, whilst all their allies attain the *Zœa* stage in the egg. The existence of mandibulate larvæ in insects which in the perfect state have suctorial mouths, is an additional argument in favour of this view. It appears to be either a reversion in the larva to an anterior type, for the earlier types of the Insecta were undoubtedly mandibulate, or it may by an embryonic character, which has never been lost in the egg, modified by reversion or circumstances. This view may appear fanciful, but the aortic arches of a fish undoubtedly exist in the mammalian embryo, and no one can say what changes might take place by reversion in those arches under altered conditions. Teratological embryology goes far to show that the embryo may revert to long anterior types in its development.

I should, however, transgress too far on your valuable space in giving proofs of all that has been put forward. I trust, however, that even this little may do some good, for it does seem hard, when the labours of men like Fritz Müller, Weismann, and Lubbock, are throwing light on this intricate subject, that darkness should return in the form of manifest misconceptions of well-known phenomena. B. T. LOWNE

99, Guilford Street, W.C.

Aspect

MR. LAUGHTON'S *aspect* is not only a felicitous word in relation to a plane, but it is susceptible of a wider application than that which he proposes for it, since it expresses a fundamental idea in the theory of surfaces. Every *surface* has at every point an *aspect*, which is the direction of a normal at that point. This may be regarded as the first property of surfaces, for if we define a surface as that form of extension which has at every part two and only two dimensions, we virtually say that, among all the directions in space that radiate from any point of the surface, there is one and only one perpendicular to all those (infinite in number) that lie within the surface at that point; in other words, that the surface has a normal at every point. A plane is then a continuous surface which has *the same aspect throughout*, the angle of two planes is the measure of *their difference in respect of aspect;* parallel planes (as Mr. Wilson points out) are those which have *the same aspect*, a plane tangent to a surface is one which contains a point of the surface, and has *the aspect of the surface at that point*, and a line tangent to a surface is one that contains a point of the surface, and has *a direction which lies within the surface* (or is perpendicular to the normal) *at that point.* Then *a straight line tangent to a plane lies wholly in the plane*, and if such a line, passing through any assumed point of a plane—rotate about that point—always remaining tangent to the plane, it must sweep *every point of the plane*, for it will generate a continuous and infinite surface coincident throughout its extent with the plane, and the plane, being continuous, can have no points without this surface. Therefore, *a straight line which joins two points of a plane lies wholly in the plane*, whence the propositions that *a plane is determined by three points*, and that *the intersection of two planes is a straight line*, together with the other elementary theorems of the geometry of space, are readily derived.

The use of *aspect* in the sense now proposed is not absolutely new, as Mr. Proctor (NATURE for October 26) seems to argue. It has the high authority of Sir W. R. Hamilton in his "Lectures on Quaternions" (1853). Thus we read on page 92 (the italics and capitals of the original are preserved):—"A biradial has also a PLANE and an ASPECT, depending on the *star* or *region* of infinite space, towards which its plane may be conceived to FACE. . . . When two bi-radials have, in the sense just now explained, the *same aspect*, their planes both facing at the same moment the *same star*, they may be said to be CONDIRECTIONAL BIRADIALS. When, on the other hand, they face in exactly *contrary* ways, and, therefore, have OPPOSITE ASPECTS, they may be called CONTRADIRECTIONAL. . . . Both these two latter classes may be included under the common name of PARALLEL BIRADIALS, so that the PLANES of any two *parallel biradials* are either coincident or parallel."

Vaguely, indeed, *aspect of a plane* may be used in the sense Mr. Proctor would assign it, as well as in several other senses. But if we could give it an exact and technical signification, that which is proposed by Mr. Laughton seems to issue directly from the proper meaning of the word; and it is a signification which no other word yet suggested will so easily bear. At present, therefore, it ought to be accepted as the very word that is needed in the re-construction of geometry.

As for *position*, it is pertinent to ask whether anyone would say that parallel planes have *the same position.* The attribute of planes, for which a word is demanded, is precisely that *element* of position in which parallel planes agree; and the *position* of a plane requires for its determination not that element only, but also some other element whereby the plane shall be distinguished from its parallels.

Permit me, by way of appendix to my too long note, to call the attention of those who are interested in the *early* teaching of Geometry, which has lately been discussed in your columns, to Dr. Thomas Hill's "First Lessons in Geometry. Facts before Reasoning." (Boston, 1856.)

J. M. PEIRCE

Cambridge, Massachusetts, Nov. 15

Cause of Low Barometric Pressure

IN the number of NATURE for July 20, 1871, I find a paper by Ferrel, "On the Cause of Low Barometer in the Polar Regions," &c. The author says that the law which deflects a body to the right in the northern hemisphere and to the left in the southern is not understood by meteorologists, and that it is admitted only when the movement is north and south.

I believe this law is now admitted by almost all meteorologists. The proof of it is the general acceptance of Buys Ballot's law of winds, which states that the wind will always blow towards a barometrical depression, and be deflected to the right in the northern hemisphere.

The most important meteorological works of the last years are based on this principle, as, for example, Buchan's "Mean Pressure and Prevailing Winds," and Mohn's "Storm Atlas." Mr. Mohn states the error which was committed in former times, and gives the expression of the deflecting force (page 17).—15°. sin L. (latitude) per hour. As to Mr. Ferrel's explanation of the low barometer at the poles, I must first state that it is not lowest near the poles. In the northern hemisphere, the lowest pressures are near Iceland and near the Aleutian islands, but northwards they are higher, as the observations of Greenland have shown, as is seen also in the prevalence of N.E. winds in winter at Stykkisshohn (Northern Iceland); this would indicate that the pressure to the north and north-west of the last place is higher.

The great barometric depressions which so often visit Iceland cannot exist at temperatures of some degrees below freezing point. This explains why the barometer cannot be lower at the Arctic Pole than near Iceland in winter; the temperature there must be certainly much lower, even if the pole be surrounded by open water.

It is the low temperature also that explains the course of the Atlantic storms across European Russia (from N.W. to S.E.), as the winter temperature of Siberia is too low to admit the storms. This was already stated by Mr. Mohn, and I can but confirm his opinion.* In southern latitudes the barometrical depression seems to increase towards the pole, but do we know enough of these regions to say that the lowest barometer will be at the pole? In the highest southern latitudes attained by Sir James Ross the barometer was a little higher than northward. All that we know about the origin and propagation of barometrical depressions gives us the right to say that pressure cannot be lowest at the south pole, but that, as in the northern latitude, the greatest depression will be found at some distance from the pole, perhaps as far as the Antarctic Circle.

St. Petersburg, November 28 A. WOJEIKOFER

Symbols of Acceleration

I WISH to direct the attention of the reviewer of the "New Works on Mechanics," in No. 107 of NATURE, to the following statements which he makes while speaking of Wernicke's book:—"The symbol j is here and throughout the work used to denote an acceleration; for example j x (*sic*) is the acceleration parallel to the axis of x. This notation (unfamiliar to English readers) has obvious advantages when the more appropriate language of the differential calculus cannot be employed."

Now I cannot see how the notation is "unfamiliar to English readers," when we have in common use α to denote an acceleration, and α_x an acceleration parallel to the axis of x. Again, though I agree with the reviewer that j_x (or the English α_x) "has obvious advantages when the more appropriate language of the Differential Calculus cannot be employed," yet it should be remembered that there is a more appropriate notation still, viz., that of Newton's Fluxions, recalled to its proper position in mixed mathematics by Sir W. Thomson (see Thomson's and Tate's "Nat. Phil.") and beginning to spread, in which $\frac{d^2 x}{d t^2}$ or an acceleration parallel to the axis of x is denoted by $\ddot{x}$. This notation can be employed at all stages of the student's progress, for it is as easy for him to learn that acceleration parallel to the axis of z, actual acceleration in the path, &c., are denoted by $\ddot{z}$, $\ddot{s}$, &c., as to make himself acquainted with Wernicke's symbols. Afterwards, when studying the Differential Calculus, he may be told the name of the notation, and have his knowledge of it enlarged, but he will never need to unlearn it; on the contrary, he will

* See also my paper "On Barometrical Amplitudes," in the *Journal of the Austrian Meteorological Society*, 1871, No. 10.

find its service increase in importance as he makes his way into the highest parts of the subject.

Of course no attempt is here made to attack D-ism, but to state that it and Dot-ism have their proper spheres, the latter generally, with more or less appropriateness, throughout the whole realm of functions, the former in the realm of motion, where the functions are functions of *t*—the sway over which realm was originally given to it by Newton, and acknowledged, as I have been told, by the D-ist Lagrange.

Glasgow College THOMAS MUIR

Occurrence of the Eagle Ray

A DOUBLE-SPINED specimen of the eagle ray (*Myliobatis aquila*), taken in Torbay on the 1st Nov., has been presented to this museum by Mr. Frank Gosden, fish dealer, High Street, Exeter. Its dimensions are as follows:—Breadth across the fins, 2ft. 3½in.; length from snout to the base of the spines, 1ft. 7¾in.; total length from snout to extremity of the tail, 3ft. 6½in. W. S. M. D'URBAN, Curator

Albert Memorial Museum, Exeter

Deep Sea Dredging

WHILE winter allows of time for complete arrangements to be made in anticipation of dredging weather, will you permit me to raise the question of the conditions under which our knowledge of the natural history of the sea may be most readily extended?

As a rule, yacht owners object to the fatigue and dirt of dredging, but as we have the successful example of the *Norna*, may we not hope that other yachts may further the cause of science, if assistance in the way of instruction or apparatus be afforded to them by those having the necessary experience and means?

The idea of now urging the question is not mine alone, but is entertained by many ardent naturalists who are much in favour of a skilful search of our seas at home, as well as of the Mediterranean and other distant and almost untried seas.

Your pages have often borne witness to the interest and importance attaching to marine zoology, and if men of practical experience, such as Carpenter, W. Thomson, Marshall Hall, &c., will indicate the best localities for search and the best measures to adopt, we may hope that others may follow in their steps, and that the large aquaria now built and building will be supplied, as only private zeal and enterprise can compass, with new and rare specimens from deep waters.

T. H. HENNAH

Milton House, Clarence Street, Brighton, Dec. 5

The Solar Halo

THE solar halo of the morning of the 13th ult. described in your last number as seen near, and at about thirty miles from, Durham, and which Prof. A. S. Herschel conjectures may have been seen from more distant stations, was visible here.

I first saw it at about 8 A.M., when it appeared as the arc of a circle, with a very short portion of an inverted arc touching it at the vertex—the sun itself being hidden by a bank of cloud, from behind which issued several radiating spikes. Shortly after half-past nine this halo had disappeared, except a small portion at the point of contact of the two arcs, vertically over the sun, which appeared like a bright elongated patch, forked at each end, and projected not on mist, but on blue sky, and tinged with dull prismatic colours, which were most strongly marked in the inverted arc, in which the red or orange was downwards, or on the outside of the circle. I then suddenly caught sight of a second halo, of much greater radius than the first—visible through perhaps 130° or 140° of arc, above, and to the right of, the sun, projected on the clear blue sky, but so faintly that it might easily have been missed. This outer circle exhibited the prismatic colours with a purity and delicacy that I have never before seen in halos, and which was quite different to the ordinary dull, muddy colours. In fact, it had just the appearance of a very faint and *narrow* rainbow, the red being inside, and the blue outside the circle. I was shortly after able to borrow a sextant, and measured the distance from the sun to the bright patch and the outer circle, which appeared respectively 21° 40′ and 43° 20′; but they were already growing so faint that I was unable to do this with much precision. Except the bright patch before named, I did not observe any appearance of "mock-sun."

Cardiff, Dec. 4 GEO. C. THOMPSON

ON THE ZIPHIOID WHALES

THE peculiar division of Cetaceans to which the term "Ziphioid" is now commonly applied, from one of the earliest known forms, *Ziphius* of Cuvier,* is in many respects one of the most interesting of the order. They form a very compact group, united closely together by the common possession of very definite structural characters, and as distinctly separated from all other groups by equally definite characters.

With the singular exception of *Hyperoodon rostratus* (the structure and habits of which species are as well known, perhaps, as those of any other cetacean), no specimen of the group had ever come under the notice of any naturalist up to the commencement of the present century. Since that time, however, at irregular intervals, in various and most distant parts of the world, solitary individuals have been caught or stranded, now amounting to nearly thirty, these being by some naturalists referred to upwards of a dozen distinct species and to very nearly as many genera. No case is recorded of more than one of these animals having been observed at one place at a time, and their habits are almost absolutely unknown. Their very presence in the ocean seems to pass unnoticed and unsuspected by voyagers, and even by those whose special occupation is the pursuit and capture of various better known and more abundant cetaceans, until one of the accidental occurrences just alluded to reveals the existence of forms of animal life of considerable magnitude, and at least sufficiently numerous to maintain the continuity of the race.

This comparative rarity at the present epoch contrasts greatly with what at one time obtained on the earth, especially in the period of the crag formations, and leads to the belief that the existing ziphioids are the survivors of an ancient family which once played a far more important part than now among the cetacean inhabitants of the ocean, but which have been gradually replaced by other forms, and are themselves probably destined ere long to share the fate of their once numerous allies or progenitors.

The Ziphioid whales belong to the great primary division or sub-order of the Odontocetes or Toothed whales, as distinguished from the Whalebone whales. They are allied on the one hand to the Cachalots or Sperm whales, and on the other to the true Dolphins and Porpoises, but more nearly to the former than the latter. They are animals varying between fifteen and thirty feet in length, and in external characters very closely resemble each other, all having small pointed snouts or "beaks," small rounded or oval pectoral fins or "flippers," a comparatively small triangular dorsal fin, situated considerably behind the middle of the back, and a single "blowhole" of concentric form, situated in the middle of the top of the head One of their most obvious characteristics, distinguishing them from the true dolphin, is the complete absence of teeth (except occasionally a few mere rudiments concealed in the gum) in the upper jaw, while in the lower jaw there is usually but a single pair, which in some species may be greatly developed and project like tusks from the mouth, though sometimes even these are rudimentary and covered up by the gum, so that the animal is practically toothless. In addition to these external and easily-recognised characters, there are others connected with the skeleton and internal organs which separate them still more trenchantly from the other members of the order. Their food appears

* "J'appliquerai au genre dont elle (a skull found on the shore of the Mediterranean) devient le premier type, le nom de Ziphius, employé par quelques auteurs du moyen age (Voyez Gesner I., p 209) pour un cétacé qu'ils n ont point déterminé" (Cuvier, "Ossemens fossiles"). According to strict rules of priority "Hyperodontoid" would be the more correct term, as Hyperoodon was the first genus of the group distinctly characterised; but as the name is erroneous in its signification, it will be better to keep to the more generally adopted and less objectionable term of "Ziphioid," first applied by Gervais. The group is equivalent to Eschricht's "Rhynchoceti."

to consist almost exclusively of cephalopods, or cuttlefish-like animals.

One of the greatest obstacles to acquiring a more accurate knowledge of this group is the excessively confused state of the nomenclature of the different animals of which it is composed. Nearly every single specimen that has been met with has been described under a different name, and before their characters and affinities were understood they were bandied about from one genus to another, even different individuals of the same species having been placed by systematists in different genera, until it has become almost impossible to write or speak of any of them, without the fear of inadvertently adding to the perplexity of those that come after, by adopting and perpetuating some ill-chosen or incorrect term.

In a valuable recent memoir on the subject by Prof. Owen,* the difficulty is disposed of in a very summary manner by uniting all the known forms, both recent and extinct (with the exception of *Hyperoodon*), under the generic name of *Ziphius*. This proceeding, at all events, has the merit of running no risk of adding to the confusion of nomenclature, caused by hasty or ill-defined generic subdivisions, founded on imperfect or fragmentary knowledge of the animal described. But, however great our admiration may be for this strong-handed resistance to the passion for name-coining, which is fast rendering the study of zoology almost an impossibility, it must not lead us to overlook well-marked structural characteristics by which certain small groups of species are allied together, and differentiated from others, whether we call them genera or by any other term.

In a paper recently presented to the Zoological Society (read Nov. 7), I have given reasons for my belief that the species of ziphioids at present known (I refer only to those now existing, not to the extinct forms), may be naturally arranged by certain structural characters, especially the conformation of the skull and teeth, into four groups; and as, so far as is yet known, these are not united by intermediate forms, they may, I think, be considered as generic, though of course this is a subject upon which the judgment of different zoologists may differ. This arrangement does not differ from that adopted by several other zoologists, who have specially studied the animals of this group, but the characteristics of each section or genus have not hitherto been clearly defined.

It is not my present purpose to enter into the details of these characteristics, for which I must refer to the above-mentioned communication, but to give a short summary of the known zoological facts relating to the different animals of which each is composed, so that a general idea may be gained of our present state of knowledge of the whole group.

I. Genus *Hyperoodon*, Lacépède.—This genus differs from the rest in having a very prominent convex "forehead" as it appears externally, though really corresponding to the lower part of the face of other animals, supported by strong bony crests on the maxilla, and below which the small pointed snout projects, something like the neck of a bottle from its shoulder, hence the name "Bottle-nose" often applied to these animals, in common with various other cetaceans. The common Hyperoodon (*H. rostratus*) is, as before mentioned, one of the best known of cetaceans, being a regular visitor to our coasts, and having been frequently described and figured by naturalists who have had opportunities of observing it in a fresh state. Skeletons, moreover, are to be seen in nearly every considerable osteological museum. The first really good description and figure is that of John Hunter, founded on an individual which was caught in the Thames near London Bridge, in the year 1783, and the skeleton of which still hangs in the great hall of the Museum of the Royal College of Surgeons. The figure of the animal appears in the Philosophical Transactions for 1787. Among the numerous subsequent contributions to the knowledge of the structure and natural history of this species, the monographs of Vrolik and of Eschricht are of especial importance.

The common Hyperoodon attains the length of twenty to twenty-five feet. It has no functional teeth, the only two which it possesses are quite small and buried in the gum at the front end of the lower jaw, but the palate is beset with numerous minute horny points. As in many other whales in which the teeth are either absent or very rudimentary when adult, it possesses a complete set at a very early period of its growth, but the majority of these disappear even before birth. Judging by the contents of the stomach of the captured specimens, their food consists of several kinds of squid and cuttlefish, and not of true fish; they are, therefore, not the enemies to fishermen that some have supposed them, but rather the reverse, for the cuttles, of which they destroy great quantities, are themselves voracious fish-eaters. In geographical range this species is limited to the North Atlantic, having been found both on the American and European coasts, extending as far north as Greenland, but its southern limit has not been accurately determined; it has, however, never been known to enter the Mediterranean. Within this range it is migratory, spending the summer in the Polar seas and the winter in the Atlantic, and it is chiefly on its passage northwards in the spring and southwards in the autumn that it visits our shores. It happens almost every year that in the last-named season one or more are stranded on some part of the extensive coast-line of the British Isles; usually a female accompanied by a young one, seeking probably for food in too shallow water, are cut off by the retreating tide from their chance of regaining the open sea. In these cases it appears that it is the less experienced younger animal which gets into danger, and is then rarely abandoned by the old one, who thus falls a victim to the strength of the maternal instinct so largely developed in the cetacea. The old males are apparently more wary, and rarely approach the shore near enough to be taken. They are never seen in herds or "schools" like so many of their congeners, but always either singly or in pairs.

Another animal, allied to *Hyperoodon rostratus* but of larger size, being fully thirty feet in length, and of heavier proportions, has been occasionally met with in the North Seas, and is generally supposed to be another species of the same genus (*H. latifrons*), though some naturalists have maintained that it is nothing more than the old male of the former.

II. Genus *Ziphius*.—The type of this genus is *Z. cavirostris* of Cuvier, founded on an imperfect skull picked up in 1804 on the Mediterranean coast of France, near Fos, Bouches-du-Rhône, and described and figured in the "Ossemens Fossiles." It was at first supposed to be a fossil, but has since been proved to belong to a species still living in the Mediterranean, and there is no evidence that the skull is of ancient date.

2. An animal of the same species was afterwards taken on the coast of Corsica; its external characters are described and figured by Doumet in the *Revue Zoologique*, v. 1842, p. 208, and its skeleton is preserved at Cette. 3. A third specimen was stranded near Aresquiers, Hérault, South France, in 1850; the skull, which is now in the Museum at Paris, has been described by Gervais and Duvernoy (*Annales des Sciences Naturelles*, 3 series, 1850 and 1851). 4 In the Museum of Arcachon is a skull found on the beach at Lanton, Gironde, West France, in 1864, and described and figured by Fischer, in the *Nouvelles Archives du Muséum*, tome 3, 1867. 5. A complete skeleton of an adult animal is mounted in the Anatomical Museum of the University of Jena. This was obtained at Villa Franca in 1867 by Prof. Haeckel, but has not yet been described. 6. In the Museum of

* British Fossil Cetacea from the Crag. Palæontological Society, vol. xxiii., 1870.

the University of Louvain is a skull of an animal of this genus, brought from the Cape of Good Hope, of which a description has been published by Prof. Van Beneden, under the name of *Ziphius indicus* (Mem. de l'Acad. Roy. de Belgique, coll. in 8vo, 1863). 7. A very similar skull in the British Museum, also from the Cape of Good Hope, has been described by Gray (Proc. Zool. Soc. 1865, p. 524) by the name of *Petrorhyncus capensis*. 8. A complete specimen of a young male, thirteen feet long, was taken near Buenos Ayres in 1865, and is the subject of an elaborate memoir by Burmeister (Annales de Museo Publico de Buenos Aires, Vol. i. p. 312, 1869), accompanied by detailed figures of external characters, skeleton, and some of the viscera. The specimen was first named in a preliminary notice *Ziphiorhynchus cryptodon*, but subsequently described as *Epiodon australis*.

Such are the materials upon which our knowledge of the genus *Ziphius* is based. For the present it is impossible to determine whether the differences that have been noticed in the above-mentioned specimens are the result of age, sex, or individual peculiarity, or whether they denote specific distinctions. The remains that are preserved indicate in every case an animal of rather smaller size than the Hyperoodon.

III.—Genus *Mesoplodon*, Gervais. It is not without some hesitation that I assign this designation to the present well-marked section, as it is extremely difficult to determine which of the numerous names which have been given to it by various authors should have the preference. The type-species of the group, Sowerby's whale, has had no less than eleven generic appellations given to it since its discovery in 1804, viz., *Physeter*, *Delphinus*, *Heterodon*, *Diodon*, *Aodon*, *Nodus*, *Delphinorhynchus*, *Micropteron*, *Mesoplodon*, *Mesodiodon*, and *Ziphius!* Many of these names had to be abandoned almost as soon as they were bestowed, as their authors had overlooked the fact that they had been previously appropriated to other members of the animal kingdom. To give a full account of the entangled literary history of the genus would occupy too much space for the present communication, so I will content myself with enumerating the specimens which are referable to it, as far as they are known to me, existing in various museums, from which some idea of the frequency of occurrence and of the geographical distribution of the animals will be obtained. They are rather more numerous than those of *Ziphius*.

1. An imperfect skull in the University Museum, Oxford, from an animal (a male) sixteen feet long, obtained on the coast of Elginshire, figured and described by Sowerby (*British Miscellany*, p. 1, 1804) under the name of *Physeter bidens*, but to which the specific name of *Sowerbyi* has since been generally attached. (This is *Delphinus* (*Heterodon*) *Sowerbensis* of De Blainville, Nouv. Dict. d'Hist. Nat., t. ix., 1817, Second edition; *D. Sowerbyi* Desmarest, Mammalogie, 1822.) 2. A skull in the Paris Museum from a female specimen fifteen feet long, stranded at Havre, Sept. 9, 1825, described by De Blainville (Nouv. Bulletin. Sc. t. iv., 1825) as the "Dauphin du Dale," by Cuvier as *Delphinus* (*Delphinorhynchus*) *micropterus*, and afterwards by a variety of other names, but now generally considered to be specifically identical with the first mentioned. 3. A complete skeleton in the Brussels Museum from a young specimen stranded at Ostend, August 31, 1835. 4. A skull and part of skeleton in the Museum at Caen from Sallenelles, Calvados, North France, 1825. 5. Mutilated skull in the Museum of the Royal Dublin Society, from an animal fifteen feet long, stranded in 1864 in Bandon Bay, Kerry, Ireland. 6. Another skull and some bones in the same museum from a second specimen from the same locality, in 1770. 7. A lower jaw in the Christiana Museum, from the Coast of Norway. 8. A skull in the University Museum, Edinburgh, of unknown origin. (I am indebted to Prof. Van Beneden for information about this specimen, which has not hitherto been recorded.) All these appear to belong to one species. The adult males have a single triangular compressed tooth on each side, rather in front of the middle of the lower jaw, which projects beyond the lip like a tusk, working against a hard callous pad in the upper jaw. In the specimen from Calvados, a group of barnacles had attached themselves to the outer surface of the tooth. 9. In the British Museum is a skull received from the Cape of Good Hope, with teeth in a similar situation, but developed to such an extent as to pass (curving upwards, backwards, and finally inwards) all round the upper jaw, and actually to meet above, preventing the mouth from opening beyond a very few inches at most. It is very difficult to imagine how the animal could have lived and obtained food in this condition, and it might well be supposed to be an individual deformity, but Mr. E. Layard has shown me a tooth of another individual having exactly the same conformation, and being upwards of a foot in length. To this species the name of *Layardii* has been applied by Dr. Gray. 10. An animal probably of the same species, but with the tooth much less developed (? a female), was very lately stranded at Little Bay, about six miles from Sydney, and its skeleton is now in the Australian Museum. 10. In the Museum at Caen there is another skull, from an animal caught in the entrance of the Channel about 1840, which appears to belong to a different species from those ordinarily found on our coasts, as the compressed tooth is placed nearer the apex of the jaw. 12. A skull in the Museum at Paris, remarkable for the peculiar form of the lower jaw, and of the heavy massive tooth which it supports, obtained from the Seychelle Islands, has received the specific name of *densirostris*, and very recently a complete skeleton of the same (13), obtained by Mr. Krefft from Lord Howe's Island, has been added to the Sydney Museum, already rich in skeletons of rare Cetaceans. Lastly (14), in the Museum at Wellington, New Zealand, is a skull and some bones of an animal, nine feet long, which was killed in Titai Bay, Cook's Strait, January 1866, and figured by Dr. Hector in the "Transactions of the New Zealand Institute," vol. iii., part XV., of which the conformation of the skull shows that it is a member of this group; but the single compressed tooth in the lower jaw is situated farther forwards than in any other known species, thus completing the series of different positions in the side of the ramus occupied by the developed teeth, and proving its small value as a generic character.

IV.—*Berardius*, Duvernoy. This genus was founded by Duvernoy upon a skull received at the Museum of Paris in 1846, having been obtained from an animal stranded in Akaroa Harbour, New Zealand. In the name of *Berardius Arnuxii* conferred upon it by Duvernoy, the captain of the French corvette, *Le Rhin*, Bérard, and the surgeon, Arnoux, who jointly presented the specimen, with some others of considerable interest to the Museum, are commemorated in zoological literature.

Only three other specimens of this animal have since been seen, and all on the coasts of New Zealand:—One in 1862, embayed in Porirua Harbour, was converted into oil, and can only be conjectured to have been a Berardius by its dimensions, and a slight description published by Mr. Knox. In January 1870 another was taken in Worser's Bay near the entrance to Port Nicholson, and its skull and some bones were preserved for the Wellington Museum; and, lastly, a specimen of this fine animal, which is thirty feet long, and, after *Hyperoodon latifrons*, the largest of the group, ran aground on the beach near New Brighton, Canterbury, on the 16th of December, 1868, where it fortunately came under the notice of Dr. Julius Haast, F.R.S., the energetic and able geologist, and Curator of the Museum at Christ Church. The details of its capture are given by Dr. Haast in the Proceedings of the Philosophical Institute of Canterbury, New Zealand, May 5, 1869, and also in the "Annals and Mag. Nat. Hist." October 1870.

The skeleton of this animal has been lately placed among the fine series of Cetaceans in the Museum of the Royal College of Surgeons, thanks to the extremely liberal desire of Dr. Haast that it should be made as available as possible for scientific examination, comparison, and description, and to the generosity of Mr. Erasmus Wilson, F.R.S, a member of the Council of the College, in providing the means of adding it to the collection without expense to the Institution. A detailed and fully illustrated description of this skeleton formed part of the communication to the Zoological Society alluded to above, and will appear shortly in the "Transactions." All the characters of the skeleton agree generally with those of the other Ziphioids, but it appears in some respects to be a less specialised form, approaching somewhat nearer to the true dolphins, while *Hyperoodon* is at the other extremity of the series, being modified in the direction of the sperm whales. It has two teeth on each side of the lower jaw, situated near the front end or symphysis, which show nearly the same characteristic and peculiar structure as that described by Mr. Ray Lankester in the teeth of *Mesoplodon Sowerbyi.* The skull is far more symmetrical than in any other member of the group, and wants the great maxillary crests of *Hyperoodon*, and the dense ossification of the rostrum found in so many of the others. The cervical region is comparatively long, with the majority of its vertebræ free, the dorsals and ribs are ten in number, the lumber and caudals thirty-one, making forty-eight in all Viewing the skeleton as a whole, the most striking feature is the small size of the head compared with the great length of the vertebral column, and the massiveness of the individual bones, especially of the lumbar and anterior caudal vertebræ. It presents in this respect a remarkable contrast to the sperm whale, which hangs near it in the museum, though agreeing generally with the other Ziphioids. As before mentioned, it is thirty feet in length, and, as Dr. Haast was able to observe, it agrees with its congeners in the nature of its food, for its stomach was found to contain about half a bushel of the horny beaks of cephalopods. The colour of the whole animal when fresh was of a deep velvety black, with the exception of the lower portion of the belly, which was greyish.

Extinct Ziphioids.—To the circumstance of the extreme density of the rostral portion of the skull of certain Ziphioids, owing to the firm ossification of the mesethmoid cartilage and its coalescence with the surrounding bones (the maxilla, premaxilla, and vomer) our knowledge of many of the ancient members of this group of whales is due. When all other portions of the skeleton have yielded to the destructive influence of time, these rostra, generally in the form of elongated and somewhat flattened cylinders, worn and eroded by the action of water, gravel, and sand, occasionally come to light to attest the presence of a former world of oceanic life. A few teeth also have been found which would appear to be referable to these same animals. The localities in which these occur in England are the Red Crag deposits of Suffolk. They are still more abundant, and in a much more perfect condition in the beds of corresponding age in the neighbourhood of Antwerp, which have fortunately been laid bare by the excavations made in the defensive works of that city. A magnificent series of these fossils containing many new forms has recently been added to the Brussels Museum, but until M. le Vicomte Du Bus, the accomplished late Director of the Museum, has completed the great task he has undertaken of determining and describing them, they are as little available for zoological science as if they still lay

In the bottom of the deep
Where fathom line could never touch the ground.

W. H. FLOWER

CONTINUITY OF THE FLUID AND GASEOUS STATES OF MATTER *

WHEN we find a substance capable of existing in two fluid states different in density and other properties, while the temperature and pressure are the same in both; and when we find also that an introduction or abstraction of heat without change of temperature or of pressure will effect the change from the one state to the other; and also find that the change either way is perfectly reversible, we speak of the one state as being an ordinary gaseous and the other as being an ordinary liquid state of the same matter; and the ordinary transition from the one to the other we would designate by the terms boiling, or condensing; or occasionally by other terms nearly equivalent, such as evaporation, gasification, liquefaction from the gaseous state, &c. Cases of gasification from liquids, or of condensation from gases, when any chemical alteration accompanies the abrupt change of density, are not among the subjects proposed to be brought under consideration in the present paper. In such cases I presume there would be no perfect reversibility in the process; and if so, this would of itself be a criterion sufficing to separate them from the proper cases of boiling or condensing at present intended to be considered. If now the fluid substance, in the rarer of the two states—that is, in what is commonly called the gaseous state—be still further rarefied, by increase of temperature or diminution of pressure, or be changed considerably in other ways by alterations of temperature and pressure jointly, without its receiving any abrupt collapse in volume, it will still, in ordinary language and ordinary mode of thought, be regarded as being in a gaseous state. Remarks of quite a corresponding kind may be made in describing various conditions of the fluid (as to temperature, pressure, and volume), which would in ordinary language be regarded as belonging to the liquid state.

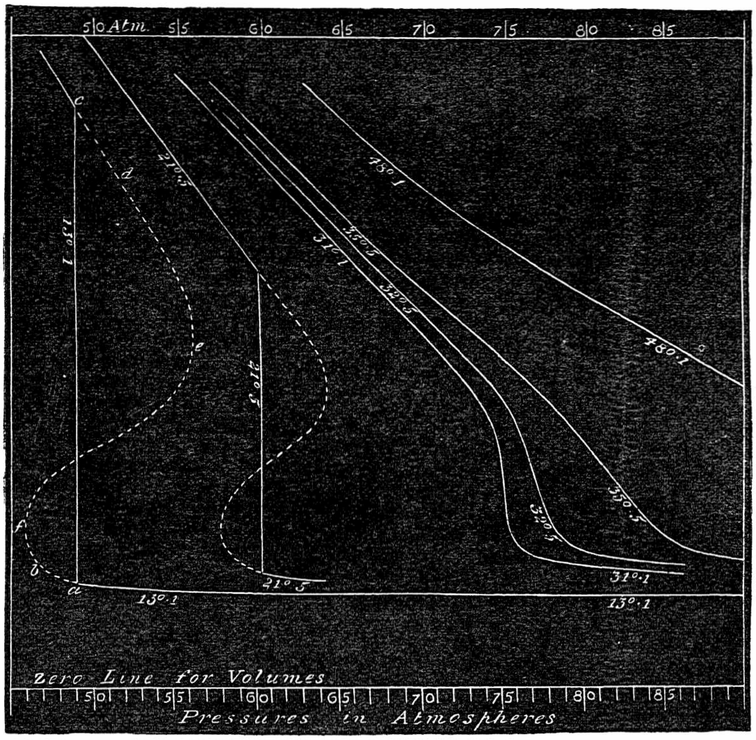
Dr. Andrews (Phil. Trans. 1869) has shown that the ordinary gaseous and ordinary liquid states are only widely separated forms of the same condition of matter, and may be made to pass into one another by a course of continuous physical changes presenting nowhere any interruption or breach of continuity. If we denote geometrically all possible points of pressure and temperature jointly by points spread continuously in a plane surface, each point in the plane being referred to two axes of rectangular coordinates, so that one of its ordinates shall represent the temperature, and the other the pressure denoted by that point; and if we mark all the successive boiling- or condensing-points of temperature and pressure as a continuous line on this plane; this line, which may be called the boiling line, will be a separating boundary between the regions of the plane corresponding to the ordinary liquid state and those corresponding to the ordinary gaseous state. But, by consideration of Dr. Andrews's experimental results, we may see that this separating boundary comes to an end at a point of pressure and temperature, which, in conformity with his language, may be called the critical point of pressure and temperature jointly; and we may see that, from any ordinary liquid state to any ordinary gaseous state, the transition may be effected gradually by an infinite variety of courses passing round outside the extreme end of the boiling line.

Now it will be my chief object in the present paper to state and support a view which has occurred to me, according to which it appears probable that, although there be a practical breach of continuity in crossing the line of boiling-points from liquid to gas or from gas to liquid, there may exist in the nature of things a theoretical continuity across this breach, having some real and true significance. This theoretical continuity, from the ordinary liquid state to the ordinary gaseous state, must be supposed to be such as to have its various courses passing through conditions of pressure, temperature, and volume in unstable equilibrium for any fluid matter theoretically conceived as homogeneously distributed while passing through the intermediate conditions. Such courses of transition, passing through unstable conditions, must be regarded as being impossible to be brought about throughout entire masses of fluids dealt with in any physical operations. Whether in an extremely thin lamina of gradual transition from a liquid to its own gas, in which it is to be noticed the substance would not be homogeneously distributed, conditions may exist in a stable state, having some kind of correspondence with the unstable conditions here theoretically conceived,

* "Considerations on the abrupt change at boiling or condensing in reference to the Continuity of the Fluid State of Matter," by Professor James Thomson, LL.D., Queen's College, Belfast, read before the Royal Society, Nov. 16, 1871.

will be a question suggested at the close of this paper in connection with some allied considerations.

It is first to be observed that the ordinary liquid state does not necessarily cease abruptly at the line of boiling-points, as it is well known that liquids may with due precautions be heated considerably beyond the boiling temperature for the pressure to which they are exposed. This condition is commonly manifested in the boiling of water in a glass vessel by a lamp placed below, when the temperature of the internal parts of the water, or, in other words, of the parts not exposed to contact with gaseous matter, rises considerably above the boiling-point for the pressure, and the water boils with bumping.* At this stage it becomes desirable to refer to Dr. Andrews's diagram of curves, showing his principal results for carbonic acid, and to consider carefully some of the remarkable features presented by those curves. In doing so, we have first, in the case of the two curves for 13°·1 and 21°·5 which pass through the boiling interruption of continuity, to guard against being led by the gradually bending transition from the curve representing obviously the liquid state into the line seen rapidly ascending towards the curve representing obviously the gaseous state, to suppose that this curved transition is in any way indicative of a gradual transition from the liquid towards the gaseous state. Dr. Andrews has clearly pointed out, in describing those experimental curves, that the slight bend at about the commencement of the rapid ascent from the liquid state is to be ascribed to a trace of air unavoidably present in the carbonic acid; and that if the carbonic acid had been absolutely pure, the ascent from the liquid to the gaseous state would doubtless have been quite abrupt, and would have shown itself in his diagram by a vertical straight line, when we regard the co-ordinate axes for pressures and volumes as being horizontal and vertical respectively. Now in the diagram here submitted, the continuous curves (that is to say, those which are not dotted) are obtained from Dr. Andrews's diagram with the slight alteration of substituting, in accordance with the explanations just given, an abrupt meeting instead of the curved transition between the curve for the liquid state and the upright line which shows the boiling stage. Looking to either of the given curves which pass through boiling, and, for instance, selecting the curve for 13°·1, we perceive, from what has been said as to



the conditions to which boiling by bumping is due, that for the temperature pertaining to this curve the liquid state does not necessarily end at the boiling pressure for this temperature; and that thus in the diagram the curve showing volumes for the liquid state must not cease at the foot of the upright line which marks the boiling stage of pressure, but must extend continuously, for some distance at least, into lower pressures in some such way as is shown by the dotted continuation from *a* to *b*. But now the question arises, Does this curve necessarily end at any particular point *b*? We know that the extent of this curve in the direction from *a* towards or past *b*, along which the liquid volume will continue to be represented before the explosive or bumping change to gas occurs, is very variable under different circumstances, being much affected by the presence of other fluids, even in small quantities, as impurities in the fluid experimented on, and by the nature of the surface of the containing vessels, &c.

The consideration of the subject may be facilitated, and aid towards the attainment of clear views of the mutual relations of temperature, pressure, and volume in a given mass of a fluid may be gained, by actually making, or conceiving there to be made, for carbonic acid, from the data supplied in Dr. Andrews' experimental results, a solid model consisting of a curved surface referred to three axes of rectangular co-ordinates, and formed so that the three co-ordinates of each point in the curved surface shall represent, for any given mass of carbonic acid, a temperature, a pressure, and a volume which can co-exist in that mass. It is to be noticed here that in his diagram of curves the results for each of the several temperatures experimented on are combined in the form of a plane-curved line referred to two axes of rectangular co-ordinates, one of each pair of co-ordinates representing a pressure, and the other representing the volume corresponding to that pressure at the temperature to which the curve belongs. Now to form a model such as I am here recommending, and have myself made, Dr. Andrews' curved lines are to be placed with their planes parallel to one another, and separated by intervals proportional to the differences of the temperatures to

* It has even been found by Dufour (Bibliothèque Universelle, Archives, year 1861, vol. xii. "Recherches sur l'Ebullition des Liquides") that globules of water floating immersed in oil, so as neither to be in contact with any solid nor with any gaseous body, may, under atmospheric pressure, be raised to various temperatures far above the ordinary boiling-point, and occasionally to so high a temperature as 178° C. without boiling. On this subject reference may also be made to the important researches of Donny, "Sur la Cohésion des Liquides et sur leur Adhérence aux Corps solides," Ann. de Chimie, year 1846, 3rd ser. vol xvi. p. 167,—July 28, 1871.

which the curves severally belong, and with the origins of co-ordinates of the curves situated in a straight line perpendicular to their planes, and with the axes of co-ordinates of all of them parallel in pairs to one another, and then the curved surface is to be formed so as to pass through those curved lines smoothly or evenly.* The curved surface so obtained exhibits in a very obvious way the remarkable phenomena of the voluminal conditions at and near the critical point of temperature and pressure, in comparison with the voluminal conditions throughout other parts of the range of gradually varying temperatures and pressures to which it extends, and even throughout a far wider range into which it can in imagination be conceived to be extended. It helps to afford a clear view of the nature and meaning of the continuity of the liquid and gaseous states of matter. It does so by its own obvious continuity throughout its expanse round the end of the range of points of pressure and temperature where an abrupt change of volume can occur by boiling or condensing. On the curved surface in the model Dr. Andrews' curves for the temperatures 13°·1, 21°·5, 31°·1, 32°·5, 35°·5 and 48°·1 Centigrade, which afford the data for its construction, may with advantage be all shown drawn in their proper places. The model admits of easily exhibiting in due relation to one another a second set of curves, in which each would be for a constant pressure, and in each of which the co-ordinates would represent temperatures and corresponding volumes. It may be used in various ways for affording quantitative relations interpolated among those more immediately given by the experiments.

We may now, aided by the conception of this model, return to the consideration of continuity or discontinuity in the curves in crossing the boiling stage. Let us suppose an indefinite number of curves, each for one constant temperature, to be drawn on the model, the several temperatures differing in succession by very small intervals, and the curves consequently being sections of the curved surface by numerous planes closely spaced parallel to one another and to the plane containing the pair of co-ordinate axes for pressure and volume. Now we can see that, as we pass from curve to curve in approaching towards the critical point from the higher temperatures, the tangent to the curve at the steepest point or point of inflection is rotating, so that its inclination to the plane of the co-ordinate axes for pressure and temperature, which we may regard as horizontal, increases till, at the critical point, it becomes a right angle. Then it appears very natural to suppose that in proceeding onwards past the critical point, to curves successively for lower and lower temperatures, the tangent at the point of inflection would continue its rotation, and the angle of its inclination, which before was acute, would now become obtuse. It seems much more natural to make such a supposition as this than to suppose that in passing the critical point from higher into lower temperatures the curved line, or the curved surface to which it belongs, should break itself asunder, and should come to have a part of its conceivable continuous course absolutely deficient. It thus seems natural to suppose that in some sense there is continuity in each of the successive curves by courses such as those drawn in the accompanying diagram as dotted curves uniting continuously the curves for the ordinary gaseous state with those for the ordinary liquid state.

The physical conditions corresponding to the extension of the curve from *a* to some point *b* we have seen are perfectly attainable in practice. Some extension of the gaseous curve into points of temperature and pressure below what I have called the boiling, or condensing line, as for instance some extension such as from *c* to *d* in the figure, I think we need not despair of practically realising in physical operations. As a likely mode in which to bring steam continuing gaseous to points of pressure and temperature at which it would collapse to liquid water if it had any particle of liquid water present along with it, or if other circumstances were present capable of affording some apparently *requisite conditions for enabling it to make a beginning of the change of state*,† I would suggest the admitting speedily of dry steam nearly at its condensing temperature for its pressure (or, to use a common expression, *nearly saturated*) into a vessel with a piston or plunger, all kept hotter than the steam, and then allowing the steam to expand till by its expansion it would be cooled below its condensing point for its pressure; and yet I would suppose that if this were done with very careful precautions the steam might not condense, on account of the cooled steam being surrounded entirely with a thin film of superheated steam close to the superheated containing vessel. The fact of its not condensing might perhaps best be ascertained by observations on its volume and pressure. Such an experiment as that sketched out here would not be easily made, and unless it were conducted with very great precautions, there could be no reasonable expectation of success in its attempt; and perhaps it might not be possible so completely to avoid the presence of dust or other dense particles in the steam as to make it prove successful. I mention it, however, as appearing to be founded on correct principles, and as tending to suggest desirable courses for experimental researches. The overhanging part of the curve from *e* to *f* seems to represent a state in which there would be some kind of unstable equilibrium; and so, although the curve there appears to have some important theoretical significance, yet the states represented by its various points would be unattainable throughout any ordinary mass of the fluid. It seems to represent conditions of co-existent temperature, pressure, and volume, in which, if all parts of a mass of fluid were placed, it would be in equilibrium, but out of which it would be led to rush, partly into the rarer state of gas, and partly into the denser state of liquid, by the slightest inequality of temperature or of density in any part relatively to other parts. I might proceed to state, in support of these views, several considerations founded on the ordinary statical theory of capillary or superficial phenomena of liquids, which is dependent on the supposition of an attraction acting very intensely for very small distances, and causing intense pressure in liquids over and above the pressure applied by the containing vessel and measureable by any pressure-gauge. That statical theory has fitted remarkably well to many observed phenomena, and has sometimes even led to the forecasting of new results in advance of experiment. Hence, although dynamic or kinetic theories of the constitution and pressure of fluids now seem likely to supersede any statical theory, yet phenomena may still be discussed according to the principles of statical theory; and there may be considerable likelihood that conditions explained or rendered probable under the statical theory would have some corresponding explanation or confirmation under any true theory by which the statical might come to be superseded. With a view to brevity, however, and to the avoidance of putting forward speculations perhaps partly rash, though, I think, not devoid of real significance, I shall not at present enter on details of these considerations, but shall leave them with merely the slight suggestion now offered, and with the suggestion mentioned in an earlier part of the present paper, of the question whether in an extremely thin lamina of gradual transition from a liquid to its own gas, at their visible face of demarcation, conditions may not exist in a stable state having a correspondence with the unstable conditions here theoretically conceived.

* For the practical execution of this, it is well to commence with a rectangular block of wood, and then carefully to pare it down, applying, from time to time, the various curves as templets to it; and proceeding according to the general methods followed in a shipbuilder's modelling room in cutting out small models of ships according to curves laid down on paper as cross sections of the required model at various places in its length.

† The principle that "the particles of a substance, when existing all in one state only, and in continuous contact with one another, or in contact only under special circumstances with other substances, experience *a difficulty of making a beginning of their change of state*, whether from liquid to solid, or from liquid to gaseous, or probably also from solid to liquid," was proposed by me, and, so far as I am aware, was first announced in a paper by me in the Proceedings of the Royal Society for November 24, 1859, and in a paper submitted to the British Association in the same year. In the present paper, at the place to which this note is annexed, I adduce the like further supposition that *a difficulty of making a beginning of change of state* from gaseous to liquid may also probably exist.

ALTERNATION OF GENERATIONS IN FUNGI

IT has long since been shown that certain fungi pass through an alternation of generations on the same plant. The Rev. M. J. Berkeley demonstrated that in the case of the common "bunt" at least four consecutive forms of reproductive cellules were produced. In the majority of Uredines there are two forms of fruit, but these can scarcely be regarded as an alternation of generations, since there is no evidence that the spores of *Trichobasis* by germination, or otherwise, produce the bilocular spores of *Puccinia*. In *Podisoma* and *Gymnosporangium* (if the two genera are really distinct) the bilocular spores germinate freely and produce unilocular secondary spores. Prof.

Oersted contends that if these secondary unilocular spores are sown upon young plants of the *Sorbus aucuparia*, they will germinate, and that the ends of the germinating filaments penetrating the tissues of the leaf of the sorb will in turn produce the spermagonia and peridia of *Rœstelia cornuta*. This is very similar to the deductions of Prof. de Bary that the spores of the *Æcidium* which flourishes on the berberry may be employed to inoculate young plants of wheat, and will produce as a result the wheat-mildew (*Puccinia graminis*), which he contends is another generation of the berberry fungus completed upon a different host. (*See* NATURE, vol. ii. p. 318)

Such experiments as those of Professors Oersted and De Bary must always prove unsatisfactory unless performed with extraordinary care, and until confirmed by other observers. One or two strong presumptions can always be urged against them, and require to be boldly faced. Wheat is very subject to the attacks of mildew (*Puccinia*), and the results claimed for certain experiments are that they have produced by inoculation with other spores the common *Puccinia* upon wheat plants, to which the wheat is particularly addicted all the world over. Admitting that the *Æcidium* spores sown on the leaves of young wheat plants germinate, and that the germinating filaments enter the tissues of the leaf, are we therefore justified in affirming, or admitting that the inoculating spores produce the *Puccinia* which ultimately exhibits itself? Is it not more feasible to believe that the germination of the foreign spores have only served to stimulate the latent germs of the *Puccinia* already present in the tissues of the wheat plant? What guarantee is afforded by those who have already experimented, that the wheat plants experimented upon would not ultimately, without inoculation, have developed precisely the same parasite as that supposed to have been produced by inoculation? Assuming also that the experiment was pursued in the opposite direction, and that the spores of the wheat mildew were sown upon young plants of the berberry, if the *Æcidium* should soon afterwards appear on the leaves, it is easy enough to jump to the conclusion that they were produced by inoculation, but assumption is insufficient since the berberry is very subject, year after year, to bear on some of its leaves the peridia of the *Æcidium*. What evidence could be given that the *Æcidium* would never have appeared but for the inoculation? It is manifest that no amount of care in cultivation under bell glasses or other exclusion from foreign influences is sufficient against a contingency which dates back to the seed of the nurse-plant.

If the sowing of the spores of *Æcidium* upon the leaves of wheat resulted in the production of an *Æcidium* identical with it, or if the inoculation of berberry with wheat mildew was succeeded by the development of a *Puccinia* of a very similar character, it would not be so difficult to believe in both cases that the resulting forms might have been caused by inoculation. When the fungi assumed to be produced by inoculation are those to which the nurse-plants are particularly and specially subject, the evidence should be very strong before it is affirmed that a very natural phenomenon had an unnatural* cause.

The evolution of *Rœstelia* on the leaves of the "mountain ash" by inoculation with *Podisoma* spores is quite analogous to the berberry and wheat fungi. It is common enough to find the *Podisoma* on junipers, and the *Rœstelia* on "mountain ash," and the presumption would be, if young plants of "mountain ash" were covered up ever so carefully with bell glasses, notwithstanding that the leaves had been sprinkled with the spores of a dozen other species of fungi, if *Rœstelia* made its appearance, that it bore no relation whatever to any of the foreign spores which had been sown upon it, but would have been there independent of inoculation, or bell glasses, or a dozen like contingencies.

* The term "unnatural" is employed here in the sense that the presumed cause is one of which we have no experience, and which is contrary to the ordinary course of nature.

In both cases to which allusion has been made above, there is need of the strongest evidence to show that the ultimate parasite would not have made its appearance but for the inoculation, or that the whole chain was completed which connected the inoculating spore with the parasite produced. It would be folly to contend against facts for the sake of theory, and absurd to combat conclusions fairly deduced from ascertained facts; but in this instance we are bound to contend, in honesty to our convictions, that in neither case has Oersted or De Bary shown to our satisfaction that they were justified in declaring for an alternation of generations of fungi in which the stages were passed on different nurse plants. When the facts are confirmed and established will be time enough to inquire whether both stages are essential the one to the other, and, if so, how it is that mildewed wheat in such great profusion can be found in districts where berberry bushes are unknown, or why the *Rœstelia* on the leaves of pear trees should be so common in counties where scarcely a savin can be found.

I have been led to these observations partly because some writers have accepted the conclusions at once as if they were incontrovertible facts, and partly because I have personally been charged with ignoring (by silence, it is presumed) the results of De Bary and Oersted's experiments, whereas I only claim the privilege of doubting where I would not dare to deny.

M. C. COOKE

THE SCIENCE AND ART DEPARTMENT

THE following important Minute on the subject of Science instruction has recently been issued by the Committee of the Privy Council on Education:—

It appears desirable that the instruction of students in Science, after they have completed the course of the ordinary elementary school, should be carried on more methodically than is at present the case, and that they should not attempt to grapple with the more advanced forms of Science until they have received sound and practical instruction in those subjects which constitute the groundwork of all the physical sciences.

To this end the course of instruction specified below has been prepared as adapted both to secondary day schools and to night classes.

It will depend on circumstances, especially if the student can only attend night classes, how many subjects he can take up in one year. It must therefore be understood that the course should not only comprise the subjects named below, but also that they should be taken in the order in which they are stated.

The terminology used is that of the Science and Art Directories. The syllabus of subjects there given states precisely what is included under each head. And it is assumed that before commencing the following course, the student will have been made acquainted, in the elementary school, with the elements of arithmetic, and the primary conceptions of physical science.

COURSE OF INSTRUCTION.—*First Year.*—Mathematics (Subject V., First Stage); Freehand Drawing (2nd Grade Art); Practical Plane Geometry (2nd Grade Art); Elementary Mechanics, including the physical properties of liquids and gases (Subject VI., First Stage); Physics: Acoustics, Light and Heat (Subject VIII., First Stage). *Second Year.*—Chemistry, Inorganic (Subject X., First Stage), with practical work; Physics: Magnetism and Electricity, frictional and voltaic (Subject IX., First Stage); Mathematics (Second Stage and, if possible, Fourth Stage, Subject V.); Practical Geometry, Plane and Solid (Subject I., First Stage); Animal Physiology, if possible (Subject XIV., First Stage). The student should also, during the first and second year, work at mechanical drawing as provided for in the Art Directory, Stage 23*a*. *Third Year*.—The work of this year must depend so much on the student's aptitude, and the progress he has made in the preceding course, that it is impossible to lay down the subjects for the third year's course with any definiteness. It is essential that before continuing his course, or commencing new subjects, he should have a sound knowledge of the first stage of Mathematics, Elementary Mechanics, Physics, and Chemistry; that he should have such a knowledge of practical Geometry and Mechanical Drawing as to be able to draw and read simple plans, elevations, and sections with readiness, and that he should have sufficient facility in Freehand Drawing to make clear and neat explanatory diagrams.

When these subjects have been mastered, the student should, while continuing his studies in mathematics, take up the first stage of Animal Physiology, if he has not already done so. He will then be in a position to specialise his studies with advantage in one of the following groups, according to his requirements, taking up, for instance—1. Physics and Chemistry and Metallurgy; 2. Theoretical and Applied Mechanics, Steam, and Machine Construction and Drawing; 3. Theoretical and Applied Mechanics, and Building Construction and Drawing; 4. Biology; 5. Geology, Physical Geography, Mineralogy, and Mining. The student may also with advantage continue his freehand drawing and practical geometry.

The foregoing course is framed to lay the foundation of a thorough and systematic scientific training. It must, however, be understood that this course, though strongly recommended for all those who can devote sufficient time to go through it, in no way supersedes or does away with the power of holding special classes in different subjects for those who have not these opportunities, or diminishes the aid at present offered to such classes.

The fact of the course being intended as a systematic training will also explain the omission of certain subjects which are not to be considered unimportant because they find no place in the course. Thus systematic Botany will be found of very great use as a preliminary to the study of natural science. As such it may be taught in elementary schools before this course is commenced. But, further than that, it cannot be considered a step in a systematic course till the student takes it up as a portion of Biology in his third year. In the same way Physical Geography is a subject which may with great advantage be studied in all schools, and is especially adapted for students who cannot go through a systematic course. The first elements of Physical Geography, treating broadly the outlines of physical science and describing its objects, should, as stated above, be taught as an introduction to its systematic study. But Physical Geography in its general sense covers so wide a field, embracing to a greater or less degree so many branches of Science, that it does not fall into a systematic course of training in science, though as a means of imparting highly valuable general information, as distinct from a systematic training, it may be strongly recommended.

ARCTIC EXPLORATIONS

AN excellent paper on the above subject appears in NATURE of Nov. 30, and it is to be hoped that it may have the desired effect of reanimating in our Government and among scientific men a fresh interest in the prosecution of a further survey of the unknown seas round the Pole.

Agreeing as I do with the writer as to the great importance of such an exploration as he recommends, I cannot so readily acknowledge the correctness of his opinion as to the advantages of the route by Smith Sound over that along the west shore and to the north of Spitzbergen, from which point Parry (the greatest and noblest of arctic explorers) attempted to reach the Pole with boat sledges in 1827.

Parry had, I think, on this occasion chosen the right route, but the wrong season of the year; for he attempted the journey in the month of July, instead of in March, April, May, and June.

At Spitzbergen a vessel can always get as far as 80° north, probably higher; for Mr. Lamont has, during the last two summers, on his pleasure cruises, readily reached the latitude named.

I had it from the great navigator Parry himself, that the ice he saw to the north of Spitzbergen would not have been difficult to travel over at the proper season of the year.

The farthest north point reached with much difficulty by ships in Smith Sound has been 78°40′, and we have not the least warrant or certainty that any future expedition may be able to winter its ship or ships nearer the Pole by this route.

From lat. 78°40′ the distance to the Pole is 680 geographical miles, making the journey there and back 1,360 miles in a straight line.

But surely no experienced Arctic traveller would be sanguine enough to believe that he could take a "bee line" in a sledge journey to the Pole; in fact, he would require to make an allowance of about one-fifth for obstructions by rough ice, probable contour of coast line, &c., so that the actual distance to be made would be $1,360 + 270 = 1,630$ geographical miles, a journey 200 or 300 miles longer than any that has yet been accomplished, even by that admirable Arctic traveller, the late Lieut. Mecham. Yet Mecham, in his two longest journeys of 1,200 or 1,300 miles each (I forget whether these are geographical or statute miles, but I think they are the latter), had advantages not likely to be found in a journey to the Pole. On the one occasion deer, musk-cattle, and other game were so abundant and so tame that he could and did easily kill as many as the party required, and could have killed many more. On the other occasion he was travelling along a known route, at several points of which depots of provisions had been placed by ships wintering there, or by other means, from which he was enabled to obtain supplies both on the outward and homeward march.

Mr. Markham says that a ship can always get so far north in Smith Sound that the Pole can be reached by a journey from it with sledges of 968 miles there and back.

By what powers of reasoning or rule of arithmetic this conclusion has been arrived at I am at a loss to know, unless there is always a certainty of ships getting into winter quarters in Smith Sound as far up as 82° latitude, yet Kane was stopped 200 miles south of this, and Hayes even at a greater distance.

The Spitzbergen route has never had a fair trial with sledges over ice either with or without the aid of dogs, and I believe that if the Pole is ever to be reached, it will be by it, and not by Smith Sound. The distance to be travelled will not probably be less than 1,400 geographical miles, possibly more, a journey practicable enough under favourable circumstances, but by no means easy of accomplishment.

JOHN RAE

NOTES

AT the Anniversary Meeting of the Fellows of the Royal Society on Thursday last, Lieut.-General Sir Edward Sabine, R.A., K.C.B., resigned the office of president, which he has filled since 1861, and the Astronomer Royal was elected to fill the presidential chair. The following gentlemen were appointed officers and council for the ensuing year:—President: George Biddell Airy, M.A., D.C.L., LL.D., Astronomer Royal. Treasurer: William Spottiswoode, M.A. Secretaries: William Sharpey, M.D., LL.D.; Prof. George Gabriel Stokes, M.A., D.C.L., LL.D. Foreign Secretary: Prof. William Miller, M.A., LL.D. Other Members of the Council: George J. Allman, M.D.; John Ball, M.A.; George Burrowes, M.D.; George Busk, P.R.C.S.; Prof. Robert B. Clifton, M.A.; H. Debus, Ph.D.; Prof. P. M. Duncan, M.B.; Prof. G. Carey Foster, B.A.; Francis Galton; Thos. A. Hirst, Ph.D.; Sir John Lubbock, Bart.; Sir James Paget, Bart., D.C.L.; The Earl of Rosse, D.C.L.; General Sir E. Sabine, R.A., K.C.B.; Isaac Todhunter, M.A.; Sir Charles Wheatstone, D.C.L. The President's annual address was occupied by a *résumé* of the most important advances in science, mainly physical, during the year. After alluding to the loss sustained by the Society in the deaths of Sir John Herschel, Mr. Babbage, and Sir R. Murchison, General Sabine referred particularly to the munificence of Mr. J. P. Gassiot, by which the Kew Observatory has been transferred to the Royal Society in trust, with an income of 500*l.* per annum towards the cost of carrying on and continuing magnetical and meteorological observations with self-recording instruments, and any other physical investigations that may from time to time be found practicable and desirable in the present building at Kew belonging to the Government; or, in the event of the Government at any time declining to continue to place that building at the disposal of the Royal Society, then in any other suitable building which the Council of the Royal Society may determine. The following papers and investigations were also specially named by the president:—"On the Dependence of the Earth's Magnetism on the Rotation of the Sun," by Prof. Hornstein, of Prague; the Pendulum Experiments in India, by the late Captain Basevi, R.N.; Mr. Ellery's report on the Great Melbourne Telescope; the Investigations of the Lunar Atmospheric Tide, by M. Bergsma, of Batavia; and the Memoir by Prof. Heer, of Zürich, on the Fossil Plants brought from Greenland by Prof. Nordenskiöld. The Copley and Royal medals were then awarded, as already noted.

WITH regard to the Australian arrangements for observing the Total Eclipse of Tuesday next, we learn that the Royal Society of Victoria (not of New South Wales, as had been previously reported) were up to the end of September making vigorous preparations for an Expedition, but that at that time they were afraid that their plans would be seriously frustrated by the failure of Government aid, which they had been led to expect would be liberally granted. Mr. Ellery, the president, and Mr. Rusden, the secretary of the Royal Society of Victoria, were exerting themselves to the utmost to secure the success of the Expedition, which was to start not later than November 22nd. By the most recent Melbourne papers of October 9 and 10, we learn that, notwithstanding the supineness displayed in the matter by the other Australian colonies, it was still hoped that the Government of Victoria would render such pecuniary assistance as would make it possible for the Expedition to set out with some chance of success in obtaining results of scientific value. The number of persons who had already agreed to join the expedition up to that date was twenty, of whom four or five were of Adelaide, three of Sydney, and one or two of Tasmania. No very certain information had been procured about the prevailing weather in the latitude where the eclipse will be visible. The destination of the steamer will be Cape Sidmouth, about midway between Cardwell and Cape York, where there is some risk of the weather being unfavourable, inasmuch as during December the N.W. winds frequently bring heavy rain. Probably the Expedition will be broken up into several observing parties, and two or more stationed at different points of the mainland, and one on a neighbouring island.

THE elevation of Mr. W. R. Grove, Q.C., to the judicial bench is a noteworthy event in the history of the *personnel* of Science. It is well known that the author of the "Correlation of Forces," and *quondam* President of the British Association, is an authority of no mean rank on some of the most abstruse questions of law.

THE Exhibition of Stone Implements (Neolithic and Savage) at the Apartments of the Society of Antiquaries in Somerset House will be open at the meeting of the Society this evening, and from the 8th to the 14th inclusive from eleven to four. Cards of admission may be obtained from the secretary.

WE learn from Prof. H. A. Newton, of New Haven, Conn., that between 11·20 P.M. on November 13, and 1·45 A.M. November 14, ninety-eight meteors were seen, though the sky was cloudy. Not more than one-tenth of them were, however, regarded as belonging to the meteor stream of November. Prof. Newton thinks that if the earth met the stream this year, it was either before or after the interval of observation.

AN application has been received by the Kew Committee of the Royal Society from Dr. Jelinek, Director of the "Central Anstalt für Meteorologie and Erdmagnetismus," to procure for that establishment a set of self-recording magnetographs similar to those at Kew. The request has been complied with; and it is hoped that the apparatus will be ready for transmission to Vienna in March next, being the time named by Dr. Jelinek as that at which the new building in course of erection in that city is expected to be completed. The Committee has also been apprised by a letter from Mr. Stone, Astronomer Royal at the Cape of Good Hope, that he had at that date applied to the Admiralty for a set of magnetographs, similar to those at Kew, to be employed at the Cape. The Kew Committee hold themselves in readiness to supply the desired apparatus when they may receive directions to that effect from the Admiralty; such directions, however, have not yet been received. If Mr. Stone's request is granted, the Cape Observatory will be the third in the British Colonial Dominions employing such instruments, the other two being the Colaba Observatory under Mr. Chambers at Bombay, and the Mauritius Observatory under Mr. Meldrum.

IT is reported that the French Government intends to establish two schools, one at Lyons and the other at Nancy, in place of the Strasburg medical school. The Strasburg professors are to go to Lyons; and it is expected that that school will assume an important position in consequence of the large amount of hospital accommodation in the city. At Nancy, physics, chemistry and physiology will be more especially taught.

Harper's Weekly announces the death, in Boston, of the Rev. J. A. Swan, on October 31, at the age of forty-eight. Mr. Swan has been long known among his New England friends for his love of natural history and his skill in the use of the microscope; and during his residence at Kennebunk, although a devoted pastor in that village, he found time to make numerous important explorations and observations in the natural history of the vicinity. Failing in health a few years ago, he visited Europe, and on his return was appointed to the responsible post of secretary of the Boston Society of Natural History, in connection with Prof. A. Hyatt, succeeding Mr. Scudder in charge of the business of the society. Apart from his scientific accomplishments, Mr. Swan was endeared to all his friends by personal qualifications of the rarest merit.

THE Society of the Friends of Science, in Posen, propose, on February 19, 1873, to celebrate the 400th birthday of the eminent astronomer, Nicholas Copernicus, at his birth-place, in the village of Thorn. In addition to the festivities of the occasion, they intend to publish an accurate biography of their countryman, and to prepare a monumental album, as also to strike an appropriate medal. A prize of 500 thalers is offered for the best biography that can be prepared before January 1, 1872, to be based only upon authentic documents.

WE have received the first number of "The German Quarterly Magazine; a Series of Popular Essays on Science, History and Art." The plan of the publication is to give in English such essays, selected from the "Sammlung gemeinverständlicher wissenschaftlicher Vorträge," edited by Profs. Virchow and Franz von Holtzendorff, as are likely to interest the English reading public, and also original contributions; the numbers presenting alternately selections from the departments of Science, History, and Art. The present number contains three papers:—"The Cranial Affinities of Man and the Ape," by R. Virchow; "Sight and the Visual Organs," by A. von Graefe; and "The Circulation of the Waters on the Surface of the Earth," by H. W. Dove; all papers of great interest and importance, but losing something to the English reader from the German phraseology in which the translations are clothed. They are illustrated by good woodcuts, and the subscription to the magazine is 10*s.* per annum.

MESSRS. LONGMAN & Co. are about to publish a volume by Mr. Serjeant Cox, entitled "Spiritualism answered by Science," in which he will detail the arguments that satisfied himself and the other scientific investigators that the phenomena of alleged "Spiritualism" are purely physical, and in no manner associated with spirits of the dead.

DR. BESSELS, the director of the scientific corps of Captain Hall's steamer *Polaris*, in a letter addressed to the president of the American National Academy of Sciences, dated Godaven, August 16, states that he had already made some important observations in regard to the physics of the northern seas, such as a peculiar coloration of the water and an unexpectedly high specific gravity, the maximum density noticed being 1 028. His experiences with his colleagues, Mr. Bryan, the astronomer, and Mr. Meyer, the meteorologist, have been very satisfactory; the former gentleman having made a number of successful azimuth observations, and the latter approving himself an excellent mathematician and an accomplished observer, and an honour to the Signal Service, from which he was detailed for duty with Captain Hall.

THE recently published report of Commissioner R. W. Raymond upon statistics of mines and mining in the states and territories west of the Rocky Mountains for the year 1870, forms a stout volume of nearly 600 pages, illustrated by a number of plates and sections, embodying the result of a laborious personal examination, and that of several assistants. The report contains a detailed account of the present condition of the mining in dustry in California, Nevada, Oregon, Idaho, Montana, Utah, Arizona, New Mexico, Colorado, and Wyoming, together with interesting statements in regard to improved metallurgical processes, such as especially relate to the treatment of auriferous ores, the chlorination and smelting of silver ores, &c. There are also chapters on narrow-guage railways and their adaptation to mining regions, the mining law, the geographical distribution of mining districts, the origin of gold ingots and gold-dust, and the bullion product. The Commisioner congratulates the country upon an increased prosperity in the mining industry, as seen not only in an augmented bullion product, but an improved tone in the business itself, and relief from more or less of the irritating and burdensome questions that have hitherto been connected with the mining interest. Although the excitements which so frequently carry off the miners and settlers of one region into a new locality have been comparatively rare, yet there have been a few of special note. Among these mentioned by Mr. Raymond are those caused by the discovery of gold in Southern California, near San Diego; the discovery of silver in the Burro Mountains, and the rumours of rich placers on Peace River, far into the interior of British Columbia; the bars of Snake River; several localities in Nevada, and others in Utah; the silver mines in the Caribou district of Colorado, &c.

COLDING ON THE LAWS OF CURRENTS IN ORDINARY CONDUITS AND IN THE SEA

III.

LET us now direct our attention to the polar currents, and especially to that one which from Spitzbergen proceeds to the south-west along the coast of Greenland as far as Cape Farewell. It will be seen that this current has received an impulse from the force of rotation, and rises about one foot towards the west coast of Greenland, an effect which however ceases as soon as it has passed the southern point of that country. As soon as the resistance which compelled the current to follow the line of the coast in proceeding to the south-west disappears, it can no longer continue in the same course, but takes a westerly direction towards Labrador, partly in consequence of the rotation of the earth, partly because the level of the current is then higher than that of the waters of Davis Strait. After having advanced a little into the strait, the polar current encounters the currents coming from the north by Baffin's Bay, and joins them in their progress to the south-east along the coast of Labrador, towards which it slopes in virtue of the rotation of the earth. During this passage, aud until its arrival in the neighbourhood of Newfoundland, this current is stemmed by the force of rotation, and ought, consequently, to present a slope all along Davis Strait and the east coast of Newfoundland as far as the Gulf Stream. During its course southwards along this course, the polar current is elevated towards the land by the earth's rotation; but as soon as it has passed Cape Race, this resistance suddenly disappears, and the same phenomenon is reproduced as at Cape Farewell. The current bends suddenly to the south-west, and follows the coast as far as Florida, while its breadth and the volume of its water continue to diminish.

From Newfoundland to Florida, a distance of about 500 miles, the Gulf Stream and the polar current flow constantly side by side, under the impulse of the earth's rotation, which raises the polar current towards the land and compels it to follow all the ins and outs of the coast. But what force is it that impels the Gulf Stream, which flows freely in the ocean, to keep by the side of the polar current in all its windings, instead of taking the more easterly direction, which the rotation of the earth tends to give it? It is, of course, gravity, to wit, the force resulting from the slope which the Gulf Stream presents from right to left perpendicular to its direction throughout its entire breadth, a slope which is 1·2 feet from the point where the current debouches into the Atlantic to New York, and about one foot from New York to the place where, after having approached the shores of Europe, it separates into two branches. And if it be asked why the Gulf Stream has this slope; the reason evidently is that the water of the polar current has a specific gravity greater than the water of the Atlantic, and ought consequently to have a lower level than that of the latter sea, since the water beneath is in equilibrium. That this is the real state of the matter is fully confirmed by the researches made in recent years in the Gulf Stream at the instigation of the American Government, and which leave no room to doubt that this current has not kept its place on account of the difference of density which exists between the waters of the polar current and those of the Atlantic. Under these circumstances it is easy to see that the Gulf Stream ought to follow all the sinuosities of the polar current as far as Newfoundland.

But while the Gulf Stream ought thus to be considered as presenting a uniform slope from the Atlantic towards the polar current, the researches undertaken by the American Government prove that the bottom of the Gulf Stream could be in equilibrium only if that current had an inclination directed away from the polar current towards the Atlantic, such that its maximum level would be nearly one-third of the distance from the polar current. Under the actual conditions, then, there is no equilibrium. The waters of the polar current exercise upon the Gulf Stream a pressure which increases with the depth, and causes a continual afflux of cold water, especially in its lower depth. In proportion as these cold waters penetrate into the Gulf Stream, it communicates to them its heat and its motion, and in proportion as it is raised under the influence of the pressure of the polar current driving away the water which it displaces, its breadth ought to go on increasing. But in order that the breadth of the Gulf Stream may increase, it is necessary that its level in the centre of the current be elevated above that which corresponds to the equilibrium of the surface, so that the force of rotation should acquire the preponderance necessary to produce an enlargement of breadth towards the east; and this elevation of the level gives birth at the same time—from the middle of the Gulf Stream to the polar current—to the surface current of warm water which has been ascertained to exist by the American Commission.

It follows then from what precedes, that on the one hand the polar current penetrates at all points into the Gulf Stream, nearly as far as its surface, which sends to the polar current a surface-current of warm water from twenty to fifty fathoms deep; and, on the other hand, that the Gulf Stream ought, throughout the whole of its depth, to exercise upon the waters of the Atlantic a pressure which forces them to give place to those which it receives from the polar current, and which it draws along with it.

The researches which have recently been made as to the Gulf Stream all appear to confirm these conclusions, so that if we suppose that the volume of the Gulf Stream is increased by all the water which the polar current loses in its course, it will follow that if we designate by Q the volume of the Gulf Stream at Bemini, and by q that of the polar current in any section between Newfoundland and Florida, the volume of the Gulf Stream, for the same section, will be equal to $Q + q$. After that, it is necessary that the polar current—which, from the east coast of Newfoundland, flows towards the Gulf Stream, and from Cape Race takes a south-westerly direction along the American coast—gives up in its passage towards Florida all its water to the Gulf Stream. If, then, we assume the speed of the polar current to the south of Newfoundland to be 1·8 feet per second, its breadth 50 miles, and its depth 900 feet, it will be found that its delivery per second is 1,600,000,000 cubic feet, which makes that of the Gulf Stream to the south of Newfoundland 3,200,000,000 cubic feet per second.

From the southern part of the North Atlantic, then, between the equator and 30° of latitude, it discharges at the rate of 1,600,000,000 cubic feet per second; but besides the loss which has been accounted for, there is another which is due to evaporation; the latter deprives the Gulf Stream of a quantity of water greater than that which falls into it in the form of rain, and which flows into it from the neighbouring lands. To calculate this difference, we can make use of the results of the researches which were made in 1860 at St. Helena by Lieut. Haughton. We thus find that the excess of evaporation in the Atlantic, between 0° and 30° of latitude, is equivalent to a mean height of water of 0·22″, which, after deducting one-tenth for the water which comes from rivers, gives a loss of 50,000,000 cubic feet per second. The total quantity of water, then, which passes from the Atlantic between 0° and 30° of N. latitude, can be stated as equal to 1,650,000,000 cubic feet per second.

If we then admit that two-thirds of all the surface of the lands situated to the north of the 30th degree of latitude send directly or indirectly their waters to the Atlantic, and if we estimate the quantity of rain which annually falls upon that surface, the north part of the Atlantic will receive per second an addition of 50,000,000 cubic feet of water, or, about the same quantity which is carried off by evaporation from the south part between 0° and 30° of N. latitude.

But it follows hence that since the southern branch of the Gulf Stream is formed by the water which flows from the south part of the North Atlantic, it ought to have a delivery of 1,650,000,000 cubic feet per second; and, as the delivery of the entire current, after having passed Newfoundland, may be stated at 3,250,000,000 cubic feet, it follows that that of the northern branch is 1,600,000,000 cubic feet, while the united polar currents ought to represent a volume of 1,650,000,000 cubic feet per second. At St. Augustine the depth of the Gulf Stream is about 300 fathoms, which goes on diminishing regularly, as far as Newfoundland, where it is 1,000 feet. From Newfoundland, where it has a breadth of eighty miles and a speed of two feet, the current proceeds E.N.E., with a decreasing speed and an increasing breadth; at the end of 300 miles it has a depth of 200 and odd fathoms, a speed of 0·6 feet, and a breadth of 200 miles. Moreover, during this part of its course it rises about 2 feet above its level at Newfoundland. Until it attains this height, the Gulf Stream forms only a single current maintained by the fall of 1 foot, which it presents from right to left; but as soon as it reaches that, its southern part presents a slope sufficient to give birth to a branch which proceeds to the south-east, towards the African coast, at a speed of 0·6 feet, and with a delivery of 1,650,000,000 cubic feet per second. When the latter current reaches the 30th degree of N. latitude, it meets the north-east trade-wind, which urges it towards the south.

But while the southern half of the Gulf Stream proceeds towards the south, its northern half, whose delivery per second is 1,600,000,000 cubic feet, pursues its course towards the north, along the shores of Great Britain, as far as the 60th degree of latitude in this passage, during which the current rises towards the land and gradually increases in breadth from 100 to 150 miles, while its speed diminishes from 0·6 to 0·3 of a foot per second, it is subjected to the impulse of the earth's rotation, and its western margin, which naturally blends with the surface of the Atlantic, is raised from $1\frac{1}{5}$ foot through a course of 140 miles, so that at the 60th degree of latitude this side is $3\frac{1}{5}$ feet above the level of the ocean at Newfoundland.

After the Gulf Stream, which throughout this course has a depth of from 200 to 300 fathoms, reaches the north coast of Scotland, about two-thirds of its waters proceed eastwards towards the Norwegian coast, while the other third runs against Iceland, and afterwards continues its course to the north-west to the polar current of Greenland. The latter branch, which the force of rotation raises towards the land, has a depth of 200 and odd fathoms, and a breadth of about 50 miles; in order to be able to advance towards the polar current with a speed of about 0·3 feet per second, a fall of nearly half a foot is necessary. If next we remark that the northern Gulf Stream, towards the north point of Scotland, presents an elevation of 1·5 foot towards the land, we shall easily see that the branch of the Gulf Stream, which proceeds to the north-west, has, along the Icelandic coast, a level which exceeds by half a foot the southern margin of the same current. From this it follows that the waters which skirt the coast of Iceland encounter the polar current on the west of that island at a level higher by $3\frac{1}{3}$ feet than the surface of the Atlantic at Newfoundland. But while these waters advance towards the polar current in virtue of the above-mentioned fall, those of the southern margin of the Gulf Stream have precisely the same level as the polar current. The waters of the western side of the north branch of the Gulf Stream, which are forced to bend towards the west after having reached the 60th degree of north latitude, cannot then continue their course towards the polar current; they spread themselves over the surface of the Atlantic and take a southerly course towards Newfoundland, on account of the difference of level. With regard to those parts of the current situated between the north and south boundaries of this branch of the Gulf Stream, they are, according to their position, drawn for a shorter or longer time still towards the polar current, before taking their course towards the south; and it is thus evident that the warm current must spread itself over the whole surface of the Atlantic between the Northern branch of the Gulf Stream and the polar current which descends from Greenland.

If next we turn our attention to the progress of the polar current from the east coast of Greenland, starting from the following data, viz., that the eastern margin of this current, about 65° north latitude, on the west of Iceland, has a level of $3\frac{1}{3}$ feet higher than that of the Atlantic at Newfoundland, and that it pursues a course to the south-west at the rate of $\frac{3}{4}$ of a foot per second—we see clearly that it is obedient to the impulse communicated by the rotation of the earth. Moreover, let us estimate, after Irminger, the breadth of the current at 40 miles, and suppose that the half of the water which the Gulf Stream carries into the icy sea, as well as the half of that which falls in the form of rain or snow, returns towards the south with the current, while the other half descends by Baffin's Bay; we then find that the force of rotation raises the polar current, whose depth may be estimated at 1,000 feet, one foot above its eastern margin, and, regarding the speed as constant as far as the south point of Greenland, we arrive at the result that, along its eastern side, which naturally blends with the Atlantic, its surface must continue to rise as far as Cape Farewell, from $3\frac{1}{3}$ to 5 feet above the level of the ocean at Newfoundland. If, after having doubled Cape Farewell, the Gulf Stream descended straight towards Newfoundland, the water in Davis Strait ought to rise to a height sufficient to hinder the current from moving in a more westerly direction. But, as the water in Davis Strait cannot have a higher level than is necessary to impel towards the south the tributary bodies of water as rapidly as they join it, and, as for this purpose, at the 63rd degree of north latitude, an inclination of only $3\frac{1}{2}$ feet above the level of the sea at Newfoundland is required, the polar current, on arriving at Cape Farewell, presents towards Davis Strait a slope of $2\frac{1}{2}$ feet along the Greenland coast, and a foot and a half along its opposite margin, and in consequence of this slope proceeds several degrees into the Strait. But as Baffin's Bay and Davis Strait, as has been said before, are traversed by a polar current descending towards the south-east, it ought to have an inclination in that direction; and it is on this account that the current from the east coast of Greenland, after advancing for some time into Davis Strait, is forced to run westwards towards the coast of Labrador, along which it then flows southwards after joining the current from Baffin's Bay. The two united polar currents, whose delivery may be estimated at 1,200,000,000 cubic feet per second, have a breadth of fifty miles, a speed of $\frac{5}{8}$ of a foot per second, and a depth of about 250 fathoms. They flow to the south-east, under the influence of the earth's rotation, which raises them towards the coasts of Labrador and Newfoundland, and continue their course along the latter towards the Gulf Stream until they have doubled Cape Race, when they bend westward and make for Florida.

If now we return to the warm current which, from the Gulf Stream, curves round the south of Iceland, and then spreads itself gradually over the cold waters of the Atlantic, we see that on its arrival at the south point of Greenland, it rises from left to right, from the Gulf Stream to Cape Farewell, about $2\frac{1}{2}$ feet, which shows clearly that its course is really to the south. Moreover, this elevation from left to right enables us to give a more satisfactory account of the conditions of currents. In short, the western margin of the warm current accompanying the polar current, ought, along the latter, to have a depth of 1,000 feet and a speed of $\frac{1}{4}$ of a foot; and as the speed of the current diminishes regularly in approaching the Gulf Stream, and as all the parts of the current follow, as far as Cape Farewell, a direction nearly parallel, it follows that the speed along the Gulf Stream ought to be at the rate of about $\frac{1}{5}$ a foot per second. But if the returning branch of the Gulf Stream proceeds to the south-west with a fall of $\frac{1}{2}$ a foot on its west border, it follows that the depth of the current ought to be 76 feet. By determining in the same way the depth for a certain number of points of a transverse section, and by calculating according to these data the total delivery of the current, we find that it is raised to 410,000,000 cubic feet per second, which perfectly accords with the result which we ought to obtain. If next we inquire how the various parts of the warm surface current move under the united action of the slope and the earth's rotation, we ascertain that this current ought to follow the course of the polar current which gradually absorbs the waters that penetrate underneath, the water of the current being more dense than that of the polar current, and we find at the same time that in thus flowing towards the polar current the water ought to spread itself all over the Atlantic as far as Newfoundland.

After having thus shown that the preceding theory accounts in a tolerably complete manner for all the movements of the ocean currents, I shall add, in conclusion, that it is very possible, considering our imperfect knowledge of the progress of currents, that many details may be very different from those which have been expounded above; but, so far as the main question is concerned, I believe I am entitled to say with confidence that the laws of ocean currents are pretty much those which I have attempted to establish.

That these laws are equally applicable to the atmospheric currents is evident, and it is scarcely necessary to repeat, that in periods when the differences of temperature on the surface of the globe were greater than at present, all these currents were much stronger, and of a nature otherwise very energetic.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for October, 1871. "The origin and distribution of Microzymes (Bacteria) in water, and the circumstances which determine their existence in the tissues and liquids of the living body," by Dr. Burdon Sanderson, F.R.S. This paper is occupied chiefly by details of experiments to determine the conditions which are fatal or favourable to the existence of microzymes in the liquid or gaseous fluids by which we are surrounded, in order to approach one degree nearer to an understanding of their influence on the processes which go on in the living body. After a definition of "microzymes" the author proceeds to their chemical composition and their relation to the media in which they grow. This portion is brief and incomplete. The remainder of the paper is occupied with the experiments, which are grouped under these three sections. (1) Experimental determination of the conditions which govern the development of microzymes in certain organic liquids to be used as tests. Having found in a number of cases that either contact with surfaces which had not been snperheated, or the admixture of water which had not been boiled, was the exclusive cause of the growth of microzymes in the experimental liquid, it was inferred that water is the primary source from whence the germinal particles of bacteria are derived whenever they seem to originate spontaneously in organic solutions. A number of experiments were made with different varieties of water in ordinary use, in order to confirm the observations already made, and to ascertain if all waters possess the properties in question in a like degree. These experiments are detailed under the second section (2) Distribution of the Germal Matter of Microzymes in ordinary Water. The results under this head were not deemed satisfactory. (3) Circumstances which determine the existence of microzymes in organic liquids and tissues, that is, whether the tissues and liquids of the living body participate in the zymotic property which exists in water and moist substances. The conclusion drawn from the facts is, that "it has appeared certain that there is no developmental connection between microzymes and torula cells, and that their apparent association is one of mere juxtaposition. Thus fungi are not developed, notwithstanding the presence of microzymes in the same liquid in which, microzymes being absent, but air having access, they appear with the greatest readiness." Finally, the writer is certain that, although air is the main source of what he calls fungus impregnation, as distinguished from impregnation with microzymes, yet the two acts may take place at the same moment, germs of torula being often contained in the same liquid media as the germ particles of microzymes.—"On the Colouring Matter of some Aphides," by H. C. Sorby, F.R.S.—"Observations and Experiments on the Red Blood Corpuscles, chiefly with regard to the Action of Gases and Vapours," by E. Ray Lankester.—"On Undulina, the type of a new group of Infusoria," by E. Ray Lankester.—"On the Circulation in the wings of *Blatta Orientalis* and other Insects, and on a new method of injecting the vessels of insects," by H. N. Moseley. After describing the method adopted for preparing and fixing the wings of insects for examination of the circulation, the writer proceeds to his experiences with the cockroach. The corpuscles in *Blatta* are so large that the circulation may readily be seen with a high power of a simple dissecting microscope. If an insect be carefully tied, the circulation may be observed in action for as long as twelve hours. Abundance of parasites were found in the blood vessels of *Blatta* and coleopterous insects. The method recommended for the injection of the circulatory system of insects is through the largest artery on the front border of the wing, and the injecting fluid is indigo carmine.—"On the production of Spores in the Radiolaria," by Prof. L. Cienkowski; translated from vol. vii., part 4, of the "Archiv. für Mikroskop. Anatomie." The observations on which this paper is based were mainly made upon Collosphæra and Collozoum. The capsule is the source of the zoospores. In the mature capsule the contents break up into a quantity of little spheroids.—"On the Peripheral Distribution of non-medullated Nerve-fibres," by E. Klein. The writer purposes treating of the nerves of the cornea, those of the nictitating membrane of the frog, of the canal in the tail of the rabbit, and of the mesentery. The present communication is confined to the nerves of the cornea, the remaining subjects are to be embodied in a second paper.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, Nov. 22.—The Rev. Thomas Wiltshire, M.A., in the chair. Mr. Samuel Baillie Coxon was elected a Fellow of the Society. The following communications were read:—1. "Notes on some Fossils from the Devonian Rocks of the Witzenberg Flats, Cape Colony." By Prof. T. Rupert Jones, F.G.S. In this paper the author noticed some Devonian fossils like those of the Bokkeveld, found on Mr. Louw's farm on the Witzenberg Flats, Tulbagh. *Orthoceras vittatum*, Sandberger, was added to the South African list of fossils. The fossils under notice were stated by the author to help to substantiate the late Dr. Rubidge's view, that the old schists termed "Silurian" by Bain are of Devonian age, and continuous across the colony. Their presence in the Witzenberg Flats was also shown to be conclusive against the idea of coal-measures being found there. Mr. Godwin-Austen remarked that the presumed Devonian species of South Africa appeared not to have been completely identified with those of European origin. Although, judging from the range of European marine mollusca, some of which were found of precisely the same species both in Europe and at the Cape, there was nothing surprising in the extension of any old deposit, yet it seemed unreasonable to suppose that the whole district over which the wide-spread Devonian rocks extend could have been submerged at the same time. He traced the original foundation of the Devonian system to the late Mr. Lonsdale, who, in the fossils found in the deposits of Devonshire, thought he traced sufficient grounds for a marked discrimination between those beds and those of Carboniferous age. Mr. Austen had, however, always regarded the Devonian system as merely an older member of the Carboniferous, holding much the same relation to it as the Neocomian to the Cretaceous; and he would be glad to see it recognised, not as an independent system, but merely as the introduction of that far more important system, the Carboniferous, during the deposit of which the globe was subject to the same physiographical conditions. Mr. Etheridge did not agree with Mr. Austen as to the suppression of the name of Devonian system, and commented on its wide-spread distribution, and on the peculiar facies of its fossils, and their importance as a group. He was rather doubtful as to specific determinations arrived at from casts. Though the species of many fossils of Queensland procured by Mr. Daintree did not correspond with those of European areas, yet some of the corals were identical with those of South and North Devon, as were also the lithological characters of the containing beds. Mr. Seeley objected to any attempt to supersede the arrangements of the South African rocks in accordance with the local phenomena, by correlating them too closely with any European series. The recognition of the correspondence in forms seemed to him more to prove a similarity of conditions of life than any absolute synchronism. As to the connection between the Devonian and Carboniferous systems, he agreed with Mr. Austen in regarding the one as merely constituting the natural base of the other. 2. "On the Geology of Fernando Noronha (S. lat. 3° 50′, W. long. 32° 50′)." By Alexander Rattray, M.D. (Edin.), Surgeon R.N. Communicated by Prof. Huxley, F.R.S. The author described the general geological structure of Fernando Noronha and the smaller islands which form a group with it. The surface-rock was described as a coarse conglomerate, composed of rounded basaltic boulders and pebbles, in a hard, dark red, clayey matrix. This overlies a hard, dark, fine-grained basalt, which forms the most striking of the bluffs, cliffs, and outlying rocks. The highest peaks in the group consist of a fine-grained, light grey granite. The author remarked upon the possible relation of the geology of these islands to that of the neighbouring continent of South America, and stated that there is evidence of the islands having been elevated to some extent at a comparatively recent period. 3. "Note on some Ichthyosaurian Remains from Kimmeridge Bay, Dorset." By Mr. J. W. Hulke, F.R.S. The author noticed some teeth found, with a portion of an Ichthyosaurian skull, in the Kimmeridge clay of Dorsetshire. The fragments of the snout were said to indicate that it was about three feet long and proportionally stout. The author indicated the character by which these teeth were distinguishable from those of various known species of *Ichthyosaurus*, and stated that they approached most closely to those of the Cretaceous *I. campylodon*. Mr. Seeley did not consider that, in the main, the teeth of Reptilia afforded any criteria for specific determination. In the Cambridge Greensand, though there were five species of *Ichthyosaurus*, possibly including a second genus, the teeth found were so closely similar that it would have been impossible, from them only, to identify more than one species. Mr. Boyd Dawkins recognised in the specimens exhibited by Mr. Hulke a form of tooth he had found in the Kimmeridge beds of Shotover, near Oxford, but which he had been hitherto unable to attribute to any recognised species. He could not fully agree with Mr. Seeley as to the absence of specific criteria in the teeth of Saurians, as, from his own experience, he was inclined to attribute some importance to their external sculpturing. 4. "Appendix to a 'Note on a New and Undescribed Wealden Vertebra,' read 9th February, 1870, and published in the Quarterly Journal for August in that year." By Mr. J. W. Hulke, F.R.S. The author generically identified this vertebra with *Ornithopsis*, Seeley, *Streptospondylus*, Owen, and *Cetiosaurus*, Owen, taking the last to be typified by the large species in the Oxford Museum. He remarked that if this be the type of *Cetiosaurus*, *C. brevis*, Owen, can hardly belong to it, as the trunk vertebræ are described as being of a totally different structure. Mr. Boyd Dawkins, who had recently visited Oxford, stated that he had there examined the remains referred to. There was, however, no tooth found with them of a character to show the nature of the food on which the animal subsisted. But one of his students had lately found in the same pit that had afforded the remains, a tooth corresponding in its principal characters with those of *Iguanodon*, with which, therefore, the *Cetiosaurus* seemed to be allied, so that it was probably a vegetable feeder. Mr. J. Parker had lately procured from the Kimmeridge clay a number of Saurian remains, and among them were some vertebræ of *Megalosaurus*, to which were articulated others presenting distinctly the characters of *Streptospondylus*. He thought that probably many of the supposed Streptospondylian vertebræ might prove to belong to the cervical region of Dinosaurians. Mr. Seeley disputed the attribution to *Cetiosaurus* of the vertebræ described, and questioned whether the remains at Oxford might not be assigned to *Streptospondylus* or *Ornithopsis*. The depressions in the vertebræ, which might be connected with the extension of the air-cells of the lungs, did not exist in *Cetiosaurus*, but were to be found in *Megalosaurus*. As to the premaxillary tooth mentioned by Mr. Dawkins, he was uncertain whether it should be referred to what he considered as *Cetiosaurus* proper, or to the Oxford reptile. Mr. Hulke replied, pointing out that, since the determination of the Oxford reptile as *Cetiosaurus*, numerous other remains of the same species had been discovered, which had added materially to the basis of classification.—The following specimens were exhibited to the meeting:—Devonian fossils from the Witzenberg; exhibited by Professor T. R. Jones, F.G.S., in illustration of his paper. Specimens of Silver Ores from South America; exhibited by Professor Tennant, F.G.S. Fragment of the Wolf Rock, near the Land's End, and section under polarised light; exhibited by Mr. Frank Clarkson, F.G.S.

Royal Geographical Society, November 27.—Major-Gen. Sir H. C. Rawlinson, K.C.B., president, in the chair.—The President read a letter from Dr. Kirk, of Zanzibar, to the late Sir Roderick Murchison, giving news of a serious outbreak in Unyanyembe, the country lying on the main route to Lake Tanganyika, which is likely to prevent communication with Dr. Livingstone for some time to come. The letter was dated September 25th, and stated that a native chief, having been attacked by a force of Arabs settled in Unyanyembe, had waited his assailants in ambush when returning with their plunder, and had killed many of the principal men. Mr. Stanley, an American gentleman, who was travelling to Lake Tanganyika, and who had charge of letters and stores for Dr. Livingstone, was in the fray, and had been deserted by the Arabs. He had also been ill of fever, and his future plans were uncertain. A report, to which Dr. Kirk attached little credence, had spread in Zanzibar, to the effect that Livingstone and the Arab Mohammed bin Gharib, with whom he had been living, were returning round the south end of Tanganyika, and out of the region of disturbances. Captain R. F. Burton, in commenting upon this letter, informed the meeting that similar affrays between Arab trading parties and the natives had occurred before, and that this unsettled state might continue for two or three years. He thought that Livingstone would find no difficulty in returning by the south of the lake, and that a fearless man like him, speaking the native languages, would be able to pass through the disturbed districts. He had not the slightest misgiving with regard to him.—Captain Burton then read a paper "On the Volcanic Region east of Damascus and the Cave of Umm Nirán." This was a narrative of a hazardous journey of fifteen days, which he had performed in May and June 1871, in company with Mr. C. F. Tyrwhitt Drake, through the Safá Region, the Oriental *Trachon* of the Greek geographers, a wide extent of ancient lava-fields, the hills of which, like little pyramids, dot the eastern horizon, as viewed from Damascus. The danger and difficulty of visiting the many interesting places in this district arose simply from certain petty tribes of Bedouin, descendants of the refractory robbers of the Trachonitis, who dwell in the highlands of the Hauran, under the patronage of the Druses. The worst are the Ghiyás and the Shtáyá, who although they have given hostages, were allowed, during the author's stay at Damascus, to ride the country within three hours of the walls, and to plunder the villages. During one of his excursions a skirmishing party of Ghiyás attacked his party, severely wounding one of his companions. During his journey 120 inscriptions were collected, including three in the Palmyrene dialect. The volcanic outbreak to which the district owes its singular character the author was inclined to attribute to the epoch when the Eastern Desert, a flat stoneless tract, extending from the Trachonitis to the Euphrates, was a mighty inlet of the Indian Ocean, having its northern limit in the range of limestones and sandstones, the furthest outliers of the Anti-Libanus, upon whose southern and eastern feet Palmyra is built, and which runs eastward to the actual valley of the great river. Mr. Drake took a continuous set of compass bearings during the journey, which had enabled him to draw an excellent map of the region. Mr. W. Giffard Palgrave spoke on the subject of the paper, stating that Captain Burton was the only European who had properly explored El Safá. He had himself explored about two-thirds of the distance, without, however, reaching the cavern of Umm Nirán. His own visit terminated at the southern part of the *El Leja*, the great volcanic district celebrated for the destruction of the Egyptian army in the time of Ibrahim Pacha, when they attacked the Druses in the basaltic labyrinth.—A second paper was read, "On the Geography of Southern Arabia," by the Baron Von Maltzan, which contained interesting elucidations of the physical configuration and tribal distribution of the region north of Aden, compiled by systematic interrogation of Arabs at Aden.

EDINBURGH

Naturalists' Field Club.—The annual business meeting of this club was held on Wednesday, the 29th ult., when Mr. Skerving was elected President and Mr. John Brown Honorary Secretary and Treasurer. A vote of thanks was accorded to Mr. Taylor, the retiring secretary. The club now numbers 87 members; and 13 excursions have been made to places of local interest during the summer months.

PARIS

Academy of Sciences, November 27.—M. Chasles presented a theorem concerning the harmonic axes of the geometrical curves, in which there are two series of points corresponding anharmonically on a unicursal curve.—M. P. A. Favre communicated the continuation of his thermic investigations upon electrolysis, in which he gave the results of experiments made especially with the voltameter with plates of copper immersed in sulphate of copper.—M. de Fonvielle presented a note on musical sounds produced at the opening of the valve in balloon ascents.—M. des Cloiseaux communicated some optical and crystallographical observations upon montebrasite and the amblygonite of Montebras, the former a new fluophosphate of alumina, soda, and lithia.—A letter was read from M. Moison describing the use of sea-water for making bread in the environs of Cancale.—M. H. Sainte-Claire Deville presented a note by M. T. Schlœsing on the separation of potash and soda. The author's process is founded upon that proposed by Serullas, in which perchloric acid is employed. He uses, instead of this acid, pure perchlorate of ammonia, treated with weak nitro-muriatic acid. The preparation of the perchlorate is described by the author.—M. Chabrier presented some further observations on the alternate predominance of nitrous and nitric acids in rain-water. The author finds that in calm weather nitrous acid is present in excess in rain-water, whilst nitric acid predominates in stormy weather.—M. Chevreul communicated a letter from M. Sacc on the properties of drying oils, with regard to which M. Thenard also made some observations.—A note by MM. Dusant and C. Bardy on the phenoles was presented by M. Cahours.—M. C. Bernard communicated a note by M. E. Faivre on the movements of the sap through the bark. The author describes a series of experiments made upon mulberry trees, and demonstrates that it is in the bark, and particularly in its liber, that the ascending and descending movements of the sap take place.—M. Joseph-Lafosse presented some observations on the germination of seeds submerged in 1870-71 during the inundation of the neighbourhood of Carenton for the defence of Cherbourg. He stated that after the retirement of the water many plants sprang up in unusual abundance and vigour, and suggested that experiments should be made upon the effects of long soaking upon the germination of the seeds of useful plants.—A letter from M. A. de la Rive on M. Marcy's recent communications relating to the electrical discharge of the torpedo was read. The author considered the action of the nerves in causing muscular contraction to be electrical, and that the electrical effect produced by the apparatus of the torpedo was caused by the accumulation in it of the energy of the immense multitude of nervous filaments with which it is supplied.—M. C. Bernard presented a note by M. L. Reverdin on epidermic grafting, describing and discussing the phenomena produced by the transfer of portions of skin from one living animal to another. The author maintains that the adherence of these grafts is produced principally by the epidermis, the dermis having only a secondary action.—M. S. Meunier, in a note on meteoric metamorphism, described the transformation of aumalite into chantonnite by exposure for a quarter of an hour to a red heat, which confirms his conclusion that the latter is the eruptive form of the former.

BOOKS RECEIVED

ENGLISH.—The Young Collector's Handybook of Botany: Rev. H. N Dunster (Reeve and Co.).—Journal of the Iron and Steel Institute. Vol. II., No. 4.—Astronomical Phenomena in 1872: W. F. Denning (Wyman and Son).

AMERICAN AND COLONIAL.—The Fossil Plants of the Devonian and Upper Silurian Formations of Canada, 21 plates: Principal Dawson.—Elements of Chemistry, Vol. II.: G. Hinrichs.

FOREIGN —Zeitschrift für Ethnologie; Supplement Band: Bastian and Hartmann. (Through Williams and Norgate.)—Die Sonne, von P. A Secchi, autorisirte Ausgabe von Dr. H. Schellen, 1te Abtheilung.—Sitzungs berichte der Gesellschaft naturforschender Freunde zu Berlin, 1870.—Die ältesten Spuren Menschen in Europa: A. Müller.

DIARY

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 8.30.—On the Fossil Mammals of Australia. Part VI. Genus Phascolomys: Prof. Owen, F.R.S.—On the Solvent Power of Liquid Cyanogen. On Fluoride of Silver. Part III.: G Gore, F.R.S.
SOCIETY OF ANTIQUARIES, at 8.30.—Exhibition of Stone Implements.
LINNEAN SOCIETY, at 8—Botany of the Grant and Speke Expedition: Lieut.-Col. Grant, C.B., C.S.I.—On a hybrid *Vaccinium* between the Bilberry and Crowberry: R. Garner, F.L.S.—On the Formation of British Pearls, and their possible improvement: R. Garner, F.L.S.
CHEMICAL SOCIETY, at 8.

FRIDAY, DECEMBER 8.

ASTRONOMICAL SOCIETY, at 8.
QUEKETT MICROSCOPICAL CLUB, at 8.

SUNDAY, DECEMBER 10.

SUNDAY LECTURE SOCIETY, at 4.—On the Optical Construction of the Eye: Dr. R. E. Dudgeon.

MONDAY, DECEMBER 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, DECEMBER 12.

PHOTOGRAPHIC SOCIETY, at 8.

WEDNESDAY, DECEMBER 13.

SOCIETY OF ATS, at 8.—Observations on the Esparto Plant: Robert Johnston
ARCHÆOLOGICAL INSTITUTE, at 8.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
MATHEMATICAL SOCIETY, at 8.—On the Celebrated Theorem that any Arithmetical Progression, two of whose Terms have no Common Factor, contains an Infinitude of Prime Numbers: J. J. Sylvester, F.R.S.

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ERRATA.—Vol. v., p. 82, col. 2, line 9, for "150°" read "15°."—Vol. v. p. 95, col. 2, line 22 from bottom, for "inverse direction" read "inverse ratio."