THURSDAY, NOVEMBER 22, 1883

THE GERMAN FISHERIES COMMISSION

Vierter Bericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere für Jahre 1877-1881. II. Abtheilung. (Berlin: Paul Parez, 1883)

THIS portion of the Fourth Report of what might perhaps be called the German Fisheries Commission is a folio volume of considerable thickness, consisting exclusively of three elaborate scientific memoirs, each of which is stamped with the thoroughness so characteristic of German work. The first, by Dr. Adolf Engler, deals with the marine fungi of Kiel Bay, the second, by Dr. R. Möbius and Fr. Heincke, with the fish fauna of the Baltic, and the last contains an account of the properties and history of the eggs of certain fishes, by Dr. von Hensen.

The second, which we shall first consider, is the most important and the largest—extending to nearly 100 pages—and consists of an elegant and concise description of all the species of fish hitherto found in the Baltic. As the work is founded on observations extending over twenty years, made with the advantages of constant residence on the Baltic shore and of control over the collections in the Kiel Museum, the list is as valuable as it is complete. This makes the absence of some forms we should naturally have expected all the more remarkable: we have especially noticed the absence of Myxine, but perhaps to those better acquainted with the distribution of this interesting form its absence will not be a matter of surprise.

The descriptions are preceded by an introduction which explains in a very lucid manner the principal points of fish organisation and their relative importance in identification. This is followed by a simple classificatory catalogue of the fishes described. In this catalogue all Teleostei are divided into Physostomi and Physoclisti. It is satisfactory to find the great fundamental characters which divide the Teleostei insisted upon, but there seems no objection to retaining the criterion of the fin rays for the Physoclisti, especially as this criterion brings out the affinity between Gadidæ and Pleuronectidæ.

The concise and elegant descriptions are supplemented by a useful fin formula which makes comparison easy. The food and habits of the fish are mentioned, the spawning habits being especially described, and each account is accompanied by a simple but extremely well executed woodcut, in which all the characteristic features are definitely indicated in outline. The object stated in the preface, to make identification practicable to laymen, has been certainly attained.

In the account of the herring considerable space is given to the discussion of the differences between the two races which the labours of the Commission have shown to exist in the Baltic. Perhaps before long it will be ascertained whether the same differences exist between the spring and autumn herring of the North Sea.

The last portion of this memoir consists of general considerations on the fish fauna of the Baltic. The authors find that this sea may be divided into three regions, each characterised by a distinct fish fauna, of which the Western receives the greatest number of occasional visitors from the North Sea. They conclude that the Baltic was once in open communication with the Arctic Ocean, and that some of the species of fish which entered at that time remain now as inhabitants of the Gulfs of Bothnia and Finland. This portion of the work is illustrated by an interesting map. Appended to the whole is a table of the spawning periods of the fishes constantly inhabiting the Bay of Kiel, and also an index of the Latin names of the fishes described, and another of their German, Danish, and Swedish synomyms.

Dr. von Hensen reports at length on the researches made by him during four years on the eggs of the plaice, flounder, and cod.

Agassiz described the eggs of the plaice as floating at the surface, while the Swedish naturalist, Malm, affirmed that they slowly and gradually sink. The first eggs that Dr. Hensen obtained from a ripe female plaice gradually sank. This being a question of the relation between the specific gravity of the eggs and of the salt water, Hensen carried out a series of investigations into the specific gravity of the different eggs and their natural condition when deposited by the fish. By an elaborate process of measurement and calculation he arrived at the specific gravity of the ripe eggs before extrusion, and ascertained the limit of specific gravity and the salt percentage in the water which determines whether the eggs of the cod and plaice shall float or sink. He found that cod's eggs floated in water which contained more than 1·85 per cent. of salt; and plaice eggs, when the percentage was above 1·78. These correspond to a specific gravity of 10145 and 10136 respectively, at 17°·5 C. He found from the observations of the Commission that the water in the Bay of Kiel has very often a specific gravity less than these. Thus there is an exception even to the statemen that cod's eggs float. As will be seen, they always float in the open ocean. It was found that the specific gravity of the eggs before extrusion was somewhat greater, and their volume somewhat less than in the fertilised eggs which had been in sea water, and further that the eggs swell somewhat by the absorption of water without salt.

The author next calculated, from the number of female fish taken on a given fishing-ground and the average number of eggs contained in each, the average number of eggs in the sea corresponding to a square metre of surface, and then made careful continuous nettings of the eggs to find if the actual number coincided. He fished the bottom, and the surface, and vertically. Eggs of the plaice and flounder were frequently taken at the bottom. He found the eggs pretty evenly scattered, and often obtained them in the proportion of 30-80 per square metre of surface. He then discusses what proportion of eggs are likely to be destroyed by their various enemies. This is the first attempt which has been made to estimate the actual number of eggs of fishes hatched in a particular area. The whole paper bears evidence of the most profound and careful work.

The memoir which stands first in the book gives an interesting account of the areas of sea-bottom in the Bay of Kiel known as "weisser" or "todter Grund." They are called "dead" by the fishermen because no fish are found on them, a fact probably due to the presence of sulphuretted hydrogen. The white felting which gives the name "white" is formed by threads of different species of Beggiatoa, a thread-like fungus classed with the Schizomycetes by Zopf and others who have stated that bacteria forms constitute a stage of their life-cycle. Thus *Monas Okenii*, *Bacterium sulphuratum*, *Clathrocystis rosea-persicina*, and *Beggiatoa rosea-persicina* have all been described as stages of a single life-history. Dr. Engler is extremely cautious on this point, and limits himself to what he has seen. He does not agree with Warming that *Monas Mülleri*, which occurs with the Beggiatoæ, is the young stage of one of them; although he has observed one species sending off motile spherical spores. Two new genera of thread-shaped fungi are described which were found on a *Gammarus locusta* living on the white bottom. The paper is illustrated by a number of admirably executed drawings.

Thus the volume forms a very considerable contribution to the accurate scientific knowledge of the Baltic, for the attainment of which the Commission was instituted. Like all the other work published by the Commission, it exemplifies in the most convincing manner the truth that, to obtain light on marine problems, what is required is not a mass of evidence from people all equally without knowledge on the subject, but continued and elaborate research.

MASCART AND JOUBERT'S "ELECTRICITY AND MAGNETISM"

Electricity and Magnetism. By E. Mascart and J. Joubert. Translated by E. Atkinson. Vol. I. (London: Thos. de la Rue and Co., 1883.)

WE took occasion some time ago to draw the attention of the readers of NATURE to the "Leçons sur l'Électricité et le Magnétisme," by Professors Mascart and Joubert; we have now to thank Prof. Atkinson for an English translation of this valuable work. This is not the place to inquire into the necessity for an English translation of *any French* scientific work, not to speak of one which makes such demands on the culture of its readers as this does. It is enough for us to know that the publishers and translator consider the number of semi-educated Englishmen sufficiently great to justify their venture; it is our part to speak to the merits of the work and the manner of the translation.

The alterations in the matter of the book are so slight as to call for no remark. Our first duty therefore reduces itself to a simple iteration of our high opinion of its value as a scientific manual. At the present time the public is well supplied with scientific instructors. The good intentions of all of them need not be doubted; but the inactivity or modesty of some and the incompetency of others have brought it about that there are large gaps in our repertory of science text-books either not filled at all or filled very unworthily. It would not be accurate to say that vol. i. of the treatise of MM. Mascart and Joubert fills the greatest of these gaps in the department of electricity and magnetism; nevertheless it fills a place not at present wholly occupied by any English text-book of merit. It has the misfortune, no doubt, of overlapping to a large extent the great work of Maxwell; but we believe that the tyro in the mathematical theories of electricity and magnetism will find it of the greatest advantage to use Mascart and Joubert as companion and commentary to Maxwell's volumes. In all that relates to fundamental points and general theory Maxwell should be studied, even where he is hardest to follow, because his work was written, not to evade, but to meet, difficulties. On the other hand, Mascart and Joubert will be found invaluable in matters of detail. We know of no text-book in any language that contains such an abundance of elementary illustrations of electrical and magnetic theory, all arranged with an elegance peculiarly French.

The English version now before us is neatly printed and solidly got up. The translation on the whole is very well done. It would be easy to pick out small inaccuracies here and there, particularly in the early chapter. For some of these the translator is not altogether to blame; for the introductory part of the work seems to us to be less clear and carefully written than the following chapters, where the authors enter more into detail; and in that part of the book the translation leaves little to be desired. We noticed very few misprints, but one calls for correction: the name of van Troostwyk's collaborateur in the decomposition of water by the voltaic current was Deimann and not Diemann. No doubt this mistake occurs in the original; but the individual in question, though perhaps not widely known, yet deserved better than to be made quite unrecognisable. This brings to mind the only complaint of any gravity we have to bring against the editor of the English translation. Why did he not do something to remedy the one serious defect of MM. Mascart and Joubert's text-book, viz. the want of sufficient references to original sources of information? It must be remembered that the scientific student who goes the length of MM. Mascart and Joubert's leading strings is expected one day to walk alone; and some indication should be given him of the paths that lead to farther knowledge. A defect of the kind might be overlooked in a school primer, written to enable the oppressed schoolmaster to screw a Government grant on the minimum qualification from some reluctant inspector, but is to be deplored in a work of the present pretensions.

Instead however of complaining farther of what MM. Mascart, Joubert, and Atkinson *have not* done (perhaps had not the leisure to do) for us, it will be more fitting to conclude by thanking them heartily for what they *have* done, and done so well. G. C.

OUR BOOK SHELF

Energy in Nature. By William Lant Carpenter, B.A. B.Sc. (London, Paris, and New York: Cassell and Co.)

THIS book is, with some additions, the substance of a course of six lectures on the Forces of Nature, and their mutual relations, delivered under the auspices of the Gilchrist Educational Trust.

It is of the greatest importance that the general body of the people, and more especially the intelligent artisan class, should become acquainted with the leading principles of the science of energy. The series of lectures delivered with this object represents one of the best sustained efforts to bring this great subject before the minds of this class of the people, and in collecting together and publishing these lectures the author has done a work which must be regarded as a scientific boon to the artisan.

In one respect this task has presented difficulties of a peculiar nature, due to the fact that our country has taken a leading part in developing the principles of energy—this science has in fact grown here, and the terminology has grown with it. At the present moment there is no man of science who speaks of the forces when he means the energies of nature, but there is a lagging behind in this respect amongst the body of the people, to whom the word force is a familiar one, and the word energy, in a scientific sense, very much the reverse. Accordingly one of the first duties of the author has been to define the exact relations between force and energy in a way suitable to his audience—a task which he has successfully achieved.

While in respect of importance the science of energy holds a paramount place, it is also a subject which lends itself admirably to the mode of treatment adopted by the author of this volume. Probably no subject is more difficult of conception on general principles merely, and without reference to the actualities of life. The philosopher in his study may have but a vague conception of these general laws, and his assent to the definition of work may be purely intellectual. Perhaps he may never have witnessed a well marked case of the transmutation of energy, nor may he have the consciousness that he himself is frequently the subject of such transmutations. The artisan is, however, in a totally different position. After a day's hard toil he is well able to realise in a very vivid manner the meaning of the word *work*. To spend his personal physical energy, and to recruit it by food, are operations in which he is constantly and consciously engaged. Hence it follows that a theory which borrows all these facts as illustrations of its truth appeals to the artisan in a much more emphatic way than it does to the mere student of science. To use the scientific terminology, the latter may have more *kinetic* intellectuality than the former, but the artisan is in a *position of advantage* which enables him to grasp the truths of the science. A book, therefore, which, like the present, abounds in good illustrations and in clear and simple statements, carrying practical applications, is one peculiarly fitted to a class better qualified by education and experience to perceive the concrete than to appreciate abstract general principles. B. S.

Journal of the Royal Agricultural Society. Second Series, Part II. Vol. XIX. October, 1883. Price 6*s.* (London: John Murray.)

THE current number of the *Journal of the Royal Agricultural Society* has just reached us. It fully maintains the reputation so justly earned by previous numbers, and contains papers on many topics of present interest to agriculturists. Among the principal of these may be mentioned "The Progress of Fruit-Farming," by Mr. Whitehead, of Barming House, Kent, himself largely interested in this business. The continued reports upon Prize Farms are worthy of attention as showing what is being done on the best farms in various districts. A report on sheep-feeding experiments conducted at Woburn by Dr. Voelcker in his capacity of chemist to the Society, and a report on wheat mildew, by Mr. W. C. Little, of Stag's Holl, form the chief attractions to practical farmers. Among the more purely scientific or speculative contents may be mentioned a contribution from Rothamsted, by Sir John Lawes and his able coadjutor, Dr. Gilbert, upon the composition of drainage water collected at Rothamsted, and a valuable paper upon nitrogen as nitric acid in the soils and subsoils of certain fields on the same estate. The remainder of the volume is chiefly occupied with useful official matter, such as the Weather Report; the Botanical Report, by Mr. Carruthers; and Reports on Live Stock, Implements, &c., exhibited at York. A touching tribute is paid to the memory of a late president of the Society, the late Lord Vernon, by Mr. Wells, himself an ex-president. Perhaps the most striking and instructive paper is that by Mr. Thomas Bell upon the Yorkshire Prize Competition, containing a full report of the Tuyers Wood and East Park Farms, occupied by Mr. Turnbull. In these days, when dairying is justly attracting very special attention, it is highly interesting to receive sound information as to the methods used on thoroughly well-managed farms. A daily record of the milk yielded by each cow in a dairy containing 100 animals in milk is in itself highly useful, and worthy of imitation. It is impossible in a short notice like the present to open up the various topics dealt with. It has ever been the wise policy of the "Royal Agriculturist" to fill its pages with contributions from specialists upon their own specialities. There is no padding or superfluous discursiveness, and sometimes to the uninitiated there may appear to be a want of that introductory and explanatory matter which entices on the general reader. As a record of agricultural research and progress, the journal holds a high position, which the number just issued fully maintains. J. W.

LETTERS TO THE EDITOR

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

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

On Chepstow Railway Bridge, with General Remarks suggested by that Structure

IN a letter to NATURE of some months past, suggested by a special subject of engineering, I pointed out the necessity of clearly understanding the effects of endwise pressure on metallic columns, in respect of its tendency to cause springing or buckling of the columns. I remarked that there is a total want of experiments on the subject (Mr. Hodgkinson's observations, made on a very small scale, being excepted), and I gave some details of a theory by which the effective arrangement of such experiments might perhaps be facilitated. I have lately observed in an engineering work a failure of a different class arising from endwise pressure, of a kind which I had not anticipated, and which appears to be perhaps more dangerous than even the buckling to which I had called attention.

In the neighbourhood of Chepstow, the River Wye is crossed by a railway bridge of a single span. The four corners of the bridge are supported by iron tubular vertical, columns of considerable length. One of these columns (on the Monmouthshire side of the river, and on the lower side of the bridge as regards the course of the river) is split, with several important longitudinal fissures. To avert the present destruction of the bridge, strong iron hoops have been placed surrounding this tube, drawn tight by screws and nuts, exhibiting a somewhat unsightly appearance.

For clear understanding of this state, the reader may figure to himself a cask or barrel, set on its end, and loaded on the top till its staves burst outwards; then he must conceive a hoop to be placed round the body of the cask, and drawn till the edges of the staves are wholly or nearly in contact.

I do not doubt that this column is now safe. But there are other columns supporting the bridge which are exposed to the same dangers: the bridge is heavy, the loads from the Taff and the Tawe are not light, and the jar of ponderous locomotives may try every original weak point or may create new ones; and I think it would be well provisionally to encircle the other supporting columns in the same way as the one which has failed.

A symmetrical system of rings, with some attention to simple elegance, would remove the offensive effect produced by the bent bars of mere blacksmith's work which now surround a single column.

But it is not specially to the state of the Chepstow Bridge that I wish to call the attention of the public. It is to the total want of practical knowledge as to the enduring power of metals, with which this bridge was built, and with which other such bridges must at present be built. We are totally without experiment on the danger of springing or buckling, and on the danger of bursting (now, I believe, for the first time brought forward). And we might perhaps consider such experiments as well falling within the province of those organised bodies whose union is based on the promotion of the most important determinations in civil engineering.

The Institution of Civil Engineers (with which body I have a much-valued honorary connection) has lately departed in some measure from the strict subject of engineering to which its attention had been successfully given for so many years. I venture to suggest that this body might well take up the conduct of experiments bearing on engineering. The examination of the effects of force in mere crushing of external surfaces has been admirably prosecuted by American engineers. But the examination of bending and bursting, as the effects of end-pressure, is still open to the engineers of Britain. The funds of the Institution appear to be amply sufficient for such purposes, and the undertaking of them would undoubtedly be considered as honourable to the body. G. B. AIRY

The White House, Greenwich, November 17

Physiology in Oxford

A PARAGRAPH appeared in the *Spectator* of Saturday, the 10th inst., on the Oxford memorial concerning the University Physiological Laboratory. That part of it which affects Magdalen College appears to me to rest upon erroneous information, and is certainly calculated to spread an entirely false and misleading impression of the attitude of this College in the matter, and of the University in general.

If you will allow me to quote the paragraph, and at the same time give you the actual facts, I think you will easily form an opinion on the real state of the case.

The paragraph states that the signatures were received "from members in Oxford and its suburbs, and the rest from a circle of about fifteen miles round."

The fact is that the signatures are not drawn exclusively from either the smaller or even the larger area, one of the so-called Magdalen signatures being that of a member of the Hereford Cathedral choir.

The paragraph goes on to say:—"We are told that Magdalen men have signed it more numerously than any other College but one, and, in proportion to the size of the College, more numerously than any. Now, as Prof. Burdon Sanderson is *ex officio* a Fellow of Magdalen, and as Magdalen has for years past had a physiological laboratory of its own, this popularity of the memorial among Magdalen men is highly significant."

On this I have to remark that the signatures are representative neither of the governing body of the College, nor of its resident members.

The governing body of the College consists of the President and twenty-four Fellows; of these twenty-five *three alone have signed the memorial.* The resident members, as shown by the list of congregation, number twenty-two; of these twenty-two *only six* have signed.

Finally, as regards the last paragraph, it is true that Magdalen College has for years past had a physiological laboratory of its own, and it is further true that the University teaching of physiology has been carried on there, previous to the advent of Dr. Burdon Sanderson, for years past under a Government licence with the full and express consent of the whole governing body of the College, a fact which is indeed significant, but hardly in the way in which the *Spectator* appears to have been informed. EDWARD CHAPMAN

Magdalen College, Oxford, November 15

Green Sunlight

MR. G. H. HOPKINS' observation that the parting ray at sunset is sometimes brilliant emerald-green brings to my memory a somewhat similar experience. On September 13, 1865, watching on the summit of the Rigi for sunrise, I caught the very first possible glimpse of the sun's disk as, on a very clear morning, he emerged from behind the sharply-defined outline of a distant mountain. The very first rays, although necessarily proceeding from the comparatively obscure limb of the sun, were dazzlingly brilliant, and of a superb emerald green colour. But almost instantly, as more of the sun appeared and his light grew sensibly more intense, the green passed away or was merged in the yellowish white of ordinary sunlight.

In my case I do not doubt the phenomenon was purely subjective, for before sunrise the sky was all lit up of a magnificent crimson hue. Every one must have noted how the moon when surrounded with bright crimson clouds looks more or less decidedly green.

A very striking effect of this sort, like the others an example of the well-known visual phenomenon of "accidental colours," may be artificially obtained, any time the moon shines, by burning an ordinary "blue" signal light. After my eye had been intensely excited by such a light close at hand, I have seen the moon, near or at its full, of a deep plum colour, by which I mean the colour of the bloom on a black plum or on a well coloured Hamburg grape. Or, in place of these, the *violet* of my friend Prof. Piazzi Smyth's exquisite chart of colours in his "Madeira Spectroscopic," or the *bleu violet* of Chevreul's chromatic circle. I recommend the experiment as easy of performance and exceedingly beautiful in its effects. Possibly a small blue light would suffice. But, on the occasion to which I have referred, certainly not less than thirty ounces of nitre, ten of sulphur, and five of black antimony sulphide were employed. These, mixed in fine powder, may be burned in a case about six inches high and four in diameter; of course in the open air, and where no mischief may accrue from an intensely hot and voluminous flame.

In a communication made to the Royal Society of Edinburgh in 1852 (*Trans.* vol. xx. pp. 445–471), I adduced evidence to prove that a continuous thin layer surrounds the sun's photosphere, of which upturned portions form the red protuberances seen at total solar eclipses; and I then showed that if the well known darkening of the sun's limb be due to absorption in his atmosphere, it can only be caused by such a *thin* envelope. The existence of this envelope, the sun's chromosphere, is now fully established. If, from the red colour of its upper portions, we may infer the resultant tint emitted by the whole to be red, then, by a well known law, the discolouration of the sun's limb due to its absorption should be of a greenish hue. But such an effect would necessarily be but slight, and could not explain the brilliant green witnessed on the Rigi. Nor do I recollect any instance where the first emerging rays of the photosphere at the end of a total eclipse have been observed to be green. WILLIAM SWAN

Ardchapel, Dumbartonshire, November 8

A LETTER from Barinas, Venezuela, states that on September 2, from daylight until noon, and from 3 p.m. to sundown, the sun appeared like a globe of burnished silver. Between noon and three o'clock it was of a bluish-green colour. This appearance in the western hemisphere seems to dispose of the suggestion of the Java eruptions as the cause of green suns in India. HYDE CLARKE

Mangrove as a Destructive Agent

As I have never seen the mangrove mentioned but as a conservative or productive agent as regards geological change, it may be interesting to readers of NATURE to hear of its acting in a contrary direction.

In several parts of eastern tropical Africa, where the shores are mostly of upraised coral limestone, I have noticed the effect of mangrove in eating away this rock, but nowhere have I seen it so well marked as in the Island of Aldabra, some two hundred miles to the north-west of Madagascar, and which I surveyed in 1878.

Aldabra is an upraised atoll about twenty-two miles long, and presents low cliffs of about fifteen to twenty feet of solid coral rock to the sea and also to the lagoon, which is, at low water, nearly dry

The mangrove has established itself on the edges of the lagoon, doubtless from seed transported by the currents, and, in all places where it has done so, tortuous creeks or little gorges run back into the coral, filled with mangrove trees (standing in deep mud of the adhesive and fœtid nature so characteristic of mangrove swamps), which stretch out their roots to the coral walls around them, and, as it seemed indubitably to me, in some way decompose the softer parts and eat their way in. The island is riddled with these creeks, always filled with mangrove, and opening into the lagoon.

The outer face of the island is of course being slowly undermined by the sea at high water, presenting overhanging cliffs impossible to scale, and the island is wearing away from that cause also, but the destruction from the mangrove is much more important, and at no very distant period, as it seemed to me, the upraised island will be again reduced to its original level as an ordinary atoll.

It would be interesting to know how long the mangrove has been there, for as Aldabra is one of the two oceanic groups in which the giant tortoises still exist indigenous, it must have been in its present condition of upraised atoll, I imagine, for a long period. It could never have been much larger in diameter, from the soundings round it, but the mangrove may have greatly increased the size of the lagoon by steady working at the inner rim of the islands, the actual area of which is now but small, from their narrowness.

I may mention that the island is covered with low, tangled scrub, which has managed to find foothold and sustenance on the rock, for there is but little or no soil, and the top of the rock is everywhere cut up by sub-aërial action into the sharp, honeycombed, and jagged surface which upraised coral in the tropics, uncovered by grasses, soil, &c., always wears into, and which, by the way, makes it extremely difficult to walk over, a difficulty much increased in this instance by these mangrove channels, as well as the tough nature of the matted, thorny bushes. A walk in Aldabra is the most aggravating and slowest piece of locomotion I have ever engaged in: and nothing short of the patience, perseverance, and general disregard of time of the tortoise tribe can make it an agreeable residence. Some of my negro sailors were sent into the bush to hunt for tortoises, and after three days' search brought back one, which is now in the Gardens of the Zoological Society; but they returned nearly as guiltless of artificial clothing as their captive.

W. J. L. WHARTON

H.M.S. *Sylvia*, Monte Video, October 10

The "Cloud-Glow" of November 9

THE beautiful after-glow of Friday, the 9th instant, was most striking as seen from the west side of Hampstead Hill, where its first development was made more effective by a frame of dark cumulus, with a fringe of dusky green tint, carried up from the sunset quarter by a westerly breeze, rather rolled up like a curtain, exhibiting the richly-coloured scene behind as it was withdrawn. I estimated the altitude of the upper edge of the glow at about 30°; but at Freshwater, Isle of Wight, it has been described as extending nearly to the zenith. There would be no difficulty in calculating approximately the height of the cirrus—as desired by Mr. Russell—if it could be assumed that the reflection was from the same matter in both cases, which is improbable.

J. J. WALKER

Waking Impressions

A CURIOUS case I have just read in a recent number of NATURE recalls a somewhat similar experience of my own, rather earlier in date. I awoke in the middle of a story told by an internal voice—a voice felt, not heard. I listened with curiosity and interest, as totally unprepared for what was coming as if the narrator had been Gladstone or Ruskin. I believe when I awoke I had a dim recollection of what had gone before, but I strove afterwards in vain to recall it. All I know of the history of the mysterious lady is the following fragment: "She had many admirers, but she gave the preference to Tom, because he promised to marry her in the West Indian fashion. He drew her three times through a hoop, once standing, once sitting, once lying, which signified that he would never desert her in youth, maturity, or old age."

I have not the least idea who "she" was. I know no one I call Tom except an old schoolfellow long married, and, to the best of my belief, I never heard of such a custom in the West Indies or elsewhere. Once since I have waked in the middle of a dream which went on, but it was a dream of a very commonplace character.

WILLIAM RADFORD

Sidmouth

Barytes from Chirbury

I AM indebted to Mr. Yelland of Wotherton for sending me some fine examples of the crystals described by Mr. Miers in NATURE, vol. xxix. p. 29, and am collecting several particulars respecting their occurrence. Some time ago I commenced a determination of the faces, but my work has been interrupted.

The characteristic plane E is mentioned by Carl Urba (Groth, *Zeitschrift für Crystallographie*, v. 433, 1881) as occurring on barytes crystals from Swoszawice in Galizien. In a measurement I made last year to determine this plane on one of the Wotherton specimens I obtained E E' as 39° 59', and, using Miller's distance for *b d* leads to the symbol 412, and by calculation the distance *a* E as 26° 2'. Carl Urba gives its calculated distance as 26° 4', and measured distance as 25° 58'.

C. J. WOODWARD

Birmingham and Midland Institute, Birmingham, Nov. 10

"Salt Rain and Dew"

LOOKING over the "School Geography" of Dr. Clyde (Edinburgh, 1870), I find, on page 32, in the paragraph headed "Russian Lakes," the following remarkable statement:—"In the south-east region, not only the lakes, *but the very rain and dew likewise are salt*, a phenomenon common to all the shores of the Caspian and Sea of Aral" (the italics are mine). Will some one of your readers kindly refer me to the traveller's tale in which this myth originated.

HARRY N. DRAPER

Esterel, Temple Road, Dublin, November 17

AN INDIAN WEATHER FORECAST

THE period of drought in Upper India, which happily came to an end in the latter part of August, was not entirely unforeseen, as will be shown by the following extracts from the Government *Gazette*; and the facts will probably be not without interest to meteorologists in Europe and elsewhere.

Extract from the "Gazette of India" of June 2, 1883

"That the unusually dry weather now prevailing over the North-Western Himalaya, and that which, though less abnormal, characterises the whole of North-Western India at the present time, is an effect of the unusual accumulation of snow, is a conclusion justified by the experience of the last few years; and were it not that the snow is rapidly decreasing under the unobstructed radiation of the sun, there might be some reason, judging from the present limited experience, to anticipate some retardation of the rains of the Upper Provinces, and possibly even in Western India generally. But, on the other hand, the fact that, during the months of April and May, the atmospheric pressure over the greater part of the country has been below the normal average of the season, is one which, arguing from the same experience, portends favourably for the timely influx of the monsoon. In Bengal it may be said that the present prospects are wholly favourable.

(Signed) "HENRY F. BLANFORD,
Meteorological Reporter to the
Government of India

"Simla, May 18, 1883"

"Since the above was written, there has been heavy rain for many days on the outer hills, and more or less on the plains of the Punjab, and apparently a very heavy fall of snow on the higher ranges. At the present time, as seen from Simla, the latter are white with snow, down to a level of about 11,000 or 12,000 feet. And some 500 feet of the top of the Chor (11,982 feet) is also covered with a snow-cap. If, therefore, the mountains of Lalwul, Spiti, and other more distant ranges have shared this fall, if it is as extensive as it is apparently heavy on the visible ranges, and if the views which the experience of recent years seems to justify, viz. that an unusual extent and thickness of snow on the Himalaya is productive of dry north-west and west winds in North-Western India, are valid, we must be prepared for a long spell of dry weather and a retarded rainfall in the Upper Provinces. The present season will serve as a test of the validity of the above view.

(Signed) "HENRY F. BLANFORD,
Meteorological Reporter to the
Government of India

"Simla, May 31, 1883"

Information was subsequently received to the effect that the heavy snow of the winter months as well as that which fell at the end of May was restricted to the outer range. In the interior of Lalwul and Spiti and in the Pangi valley the snowfall was very deficient. Nevertheless the May fall on the outer range seems to have sufficed to produce the effect predicted.

Extracts from a Memorandum on the Chief Weather Characteristics of the Month of June, 1883, *in India, in the "Gazette of India"*

"In Bengal, after some weeks of close cloudy weather, with occasional showers, the monsoon rains were ushered in on June 13, with a little cyclonic storm, formed apparently on the coast of the Sunderbuns. From the coast on the three following days this storm passed inland, on a north-west course, bringing heavy rain in its track, as far west as Behar, and a moderate fall up to Allahabad; beyond which, for a time, the rains did not advance. . . . At Bombay it blew strongly on the 11th, 12th, and 13th, but not from the monsoon quarter; and afterwards the wind fell light, and so continued till the 24th, when the monsoon set in steadily. But the rainfall has been light throughout the month, and, at its close, was six inches short of the normal average. On the 26th or 27th a second cyclone was formed at the head of the Bay of Bengal, causing heavy rain around the coasts, and especially those of Orissa and Ganjam; then, travelling westward, the centre reached Cuttack on June 30; Seoni on July 1; Indore on the 2nd; and lay between Kurrachee and Rajkot on the 3rd. It caused very heavy rain in Gujerat, flooding the rivers, and interrupting railway communication between Bombay and Baroda.

"In the North-Western Provinces, with the exception already mentioned, the rains did not set in before the 26th, but throughout the month the wind was, in general, easterly, and occasional thunderstorms occurred. In the Punjab also, the first rain fell between the 26th and 29th, but in the eastern half of the province the prevailing high temperature was mitigated by an occasional dust-storm. . . .

"In Lower Bengal rain of importance fell on twenty-two days. The total fall of the month was five inches in excess. . . .

"In Rajputana, Sind, &c., the number of days on which rain fell was only four, and the average total was less by three-quarters of an inch than even the small amount which generally falls in this region in the month of June. . . .

"From the above it appears that, over a large tract of country, the monsoon so far has been weak. On May 28 it was reported to have burst at Cochin; and between that date and June 5 it appears to have spread along that coast as far north as Goa. In Bombay itself the weather has been showery, but there have been no very heavy falls of rain. On the Bengal side, on the contrary, the south and south-west winds have brought up even more than the normal amount of rain, and the weather at the head of the Bay has been somewhat exceptionally rough In Northern India the monsoon current has been much delayed, and in parts of the North-Western Provinces and the Punjab continuous rain has hardly yet set in.

(Signed) "W. L. DALLAS,
Assistant Meteorological Reporter
to the Government of India"

Extracts from a Memorandum on the Chief Weather Characteristics of July, 1883, *in India, in the "Gazette of India"*

"Except in the North-Western and at a few Central stations, the rainfall of the month shows on the whole comparatively little departure from the average.

"After the disappearance of the storm noticed in the June summary, which passed from the Bay of Bengal across India, &c., . . . there occurred a general rise of the barometer, a corresponding decrease in the humidity of the atmosphere, and a cessation of the rainfall, over a large tract of country for two or three days. On the 5th or 6th, however, rain recommenced generally and continued for some time. In the eastern half of the North-Western Provinces, Assam, Bengal, Burmah, and the south of the peninsula, it fell more or less on every day, till the close of the month, but over Western and North-Western India the fall ceased about the 19th, and from that date till the end of the month a decided break in the rains occurred, and fine weather set in.

"On the plains of the Punjab there were only eleven wet days; the break in the rains, which commenced on the 19th, being very decided in this province. In consequence the amount of rain for the month, and, except in the Indus valley, the total since June 1, was several inches below the average. . . .

"The weather in the western half of the North-Western Provinces was similar to that experienced in the Punjab, but in the eastern half it was wetter, the number of rainy days being nineteen. In the Meerut division five inches less than the average amount fell during the month; while at Lucknow eight inches and at Allahabad one and a half inches more than the average was registered. . . .

"In Lower Bengal and parts of Behar the rainfall was several inches above the July average; while in Purneah, Patna, and Orissa it was deficient. The average number of wet days was twenty-six, and no break in the rains of any consequence occurred within these provinces. . . .

"In Rajputana the rainfall was about the average amount, and occurred on thirteen days; scarcely any fell after the 17th. . . .

(Signed) "W. L. DALLAS,
Assistant Meteorological Reporter
to the Government of India"

Extract from a Memorandum of the Chief Weather Characteristics of August, 1883, *in the "Gazette of India"*

"The month just elapsed was one of very deficient rainfall throughout India, except in the provinces of Madras, Berar, and Assam. The break in the rains, which during the latter half of July was very general in North-Western and parts of Central India, became even more pronounced throughout that region during the first three weeks of the month under review; and extended, though in a modified degree, to Behar and a large part of Bombay. The drought was apparently at its height, both as regards extent and intensity, during the second week in August. . . . On the 19th, however, a change commenced. The air became slowly damper over the Central and North-Western Provinces, and the sky more cloudy; and very gradually these changes spread, till at the close of the month rain had extended to the Punjab, Rajputana, and Gujerat; in Rajputana and a large part of the Punjab and the North-Western Provinces it was only on the last two days of the month that rain began to fall, and even then in small amounts. . . .

(Signed) "W. L. DALLAS,
Assistant Meteorological Reporter
to the Government of India"

The above extracts speak for themselves. The results do not accord precisely with the terms of the prediction, inasmuch as the rains, instead of being simply retarded, penetrated for about a fortnight to the Upper Provinces, and then gave place to the dry north-west winds, which are characteristic of periods of drought. But there is no reason to regard the snows as inactive during this rainy interval. At Simla this rainy period was one of frequent thunderstorms and on more than one occasion of hail,[1] and in fine intervals the existence overhead of the ominous north-west wind was established by the steady drift of the higher clouds (*cirro-cumulus*, &c.). The outflow of dense air from the snow-fields was therefore active, although it was only at a later period that it descended to the level of the lower hills; and then, chiefly as the result of diurnal convection, to the plains of North-Western India.

The full discussion of the evidence for the dependence of dry winds on the snowfall will be undertaken elsewhere. It must not, however, be supposed that the Himalayan snows are to be regarded as the *sole* cause of drought. Causes of wider incidence are sometimes in operation. Thus, in 1876 and 1877, an unusually high atmospheric pressure prevailed over nearly the whole of Asia and Australia. Whether there was any unusual accumulation of snow on the vast mountain tracts of Central Asia or over the northern plains in those years would be an interesting subject of inquiry were the means of information forthcoming. H. F. B.

NORDENSKJÖLD'S GREENLAND EXPEDITION[2]

III.

WE give a few extracts from Baron Nordenskjöld's concluding letters on his journey down the west coast of Greenland and his visit to the east coast:—

At Ivigtut a visit was made to a valley which, on account of its copious flora, has been named Grönnedal (Green valley), and another to the spot where the inland ice falls into the Arsukfjord. In the former place Dr. Nathorst found, in a kind of syenite, a blue mineral which seems to be sodalite. This discovery is chiefly remarkable from the circumstance that this mineral is also found in the vicinity of the small kryolite deposit at the Ilmen mountain in the Ural, which seems to indicate that a kind of relation exists between these two minerals, both strong in natron, which circumstance may be of service to the geologist in search of kryolite. From the excursion to Grönnedal Herr Kolthoff brought with him some rare butterflies and other insects, while of the botanical finds there were splendid specimens in bloom of *Linnæa borealis*, which is quite plentiful about Ivigtut. It has not before been known to exist in Greenland. The zoologists found only three kinds of land mollusks, viz. a physa, a vitrina, and a helix, which were all few in number. The entomological harvest consisted of a few beetles, butterflies, and insects of other kinds.

On their way to Julianehaab, as they steamed down the narrow fjord in pitch darkness and a perfect calm, "we saw suddenly behind the vessel on the surface of the sea a broad but clearly defined band of light. It shone with a steady, yellowish light, somewhat like that of phosphorescent elements, while, in spite of the speed maintained, viz. four to six knots, the band came nearer and nearer. When it reached the ship it seemed as if we were steaming through a sea of fire or molten metal. After a while the light travelled beyond the vessel, and we saw it at last disappear on the horizon. Unfortunately I had not an opportunity of examining it with the spectroscope. It was beyond doubt of a different nature to the bluish-white phosphorescent light, which throughout its appearance was seen distinctly in our wake, and as the light was perfectly steady it cannot have been caused by the phosphorescence from a passing shoal of fish. A shoal of fish would have occasioned some stir in the sea, but in this case the surface was calm throughout, while phosphorescence from the same would have been bluish in character, not yellow as this was. The Esquimaux stated that a glacier river in the vicinity shed a thin layer of brackish clay-water over the surface of the fjord, and fancied that this circumstance was in some way or another connected with this grand phenomenon, which they themselves had never before witnessed. There was at the time no aurora visible, the sky being covered with clouds. The cause of this remarkable phenomenon, which made the *Sophia* seem to steam through a sea of fire for fully fifteen minutes, I have been unable to ascertain; maybe it was a phenomenon such as this which made Lig-Lodin, of the Greenland Saga, relate to King Harald Sigurdson that he had once sailed over a spot where the sea was on fire."

At Fredriksdal Nordenskjöld engaged two Esquimaux to act as pilots in the sounds on the east coast, north of Cape Farewell. One of them stated that remains of buildings, which were not built by the Esquimaux, are to be found in nearly every great fjord on the east coast, particularly in the large ones of Umanak, Ekaleumiut, and Igdluluarsiut. Entire walls do not remain standing, but though low they are extensive. The largest ruin is said to exist at Igdluluarsiut. A fine kind of soft stone is to be found on an island south of Umanak, from which pots were made to three feet in diameter. This mineral deposit is of special interest in reference to the ethnography of Greenland, as the Umanak fjord is situated in lat. 63°. This name is, however, a common one for places among the natives. Ivar Baardsen, in his famous description of Greenland, states that a soft stone was found on Renö, outside the Einafjord, from which the largest vessels were made. Cannot the mineral deposit at Umanak be identical with this? These statements, as well as others received from the "Eastlanders," and the remarkable Norse characteristics possessed by the same, which the missionary Hans Egede pointed out long ago, seem to Baron Nordenskjöld to refute the theory now mostly advanced as to the Norse colonies, viz. that they were situated on the south-west coast of Greenland.

In spite of predictions of failure and even disaster before he left Europe, Nordenskjöld decided to attempt to land on the east coast, south of the Arctic circle. After some difficulty they succeeded in anchoring in the Kangerlutsiok Bay, but on account of the state of the ice they had to stand to sea again, and steamed along the ice-belt lining the coast, in order to find an opening by which the shore might be reached. The fauna of the sea here was very poor, and they only saw in two days one whale, a few seals, and a very small number of sea birds. The abundant fauna of the coasts of Spitzbergen and Novaya Zemlya is thus entirely wanting on the east coast of Greenland. The cause of this may be the great depth of the sea right up to the shore, which prevents the animals from fetching their food from the bottom; perhaps also the war of extirpation which the natives seem to have carried on for years has also contributed thereto. The auk and the *Uria grylle* are, however, said to breed in large numbers on the rocks off Cape Farewell. The Esquimaux pilot stated that he had been told by old people that they could remember the *Alka impennis* having been found here. The natives called it Isaro-

[1] These accompaniments are characteristic of the spring rainfall both on the hills and the plains, not of the monsoon rains, and indicate demonstrably in most cases the existence of a dry upper current.

[2] Continued from p. 42.

kitsok. Only a little distance out to sea they found a warm current—rising to 6° C.—coming from the south. The drift-ice was what Arctic skippers call "knatteris," *i.e.* little bits, viz. remains of large floes after the influence of the summer heat and the Gulf Stream. Very few icebergs were seen, and they appear to be far more numerous on the west coast. As it was now late in the season, and the coals were nearly done, Nordenskjöld had reluctantly to renounce the plan of reaching the fjords where the greatest ruins are said to exist, and, instead, attempt to reach the south shore by Cape Dan, a promontory which, if the Einafjord was situated at Umanak or Ekaleumiut, should be the Herjolf's Naze of the Sagas. "On the 4th, when off the Cape, we met the ice twenty miles from the coast, which was, however, passable, as it consisted mostly of large, loose floes only a few feet above water, while nearer the shore it again became heavier. Beyond this we saw an ice-free channel three to four miles wide. The sea was as smooth as a pond, and a boat could easily reach the shore. The mountains ran mostly into the sea with almost perpendicular declivities, without any grass-covered underland. Opposite us we saw a small bay, into which I steamed, in order to take the sun; but finding both the depth and the bottom unsuitable for anchoring, we only landed for a few hours, while some of the crew went on the hills above to look for a better harbour. The staff returned on board with a rich harvest from the steep slopes, the flora of which was copious beyond expectation. The sailors reporting a harbour near, I steamed thereto and cast anchor. It was a beautiful fjord, with several arms, which was only connected with the sea through a small opening, and was well sheltered. It was the first harbour on the east coast south of the Polar circle, in which a vessel had anchored for several centuries.[1] It was named 'King Oscar's Harbour.' If Cape Dan is the old Herjolf's Naze, this harbour is the "Sand" described by Ivar Baardsen, 'much frequented by the Norwegians and traders.' That the Norwegians had once been here was demonstrated by walls of loose stones erected on the mountains above the harbour, which had, no doubt, served as landmarks for finding the almost hidden opening of the fjord. We found, besides, some stone ruins of a smaller house, identical with those found on the west coast. These ruins are, of course, not extensive enough to demonstrate that here was situated one of the 'Bygder' (parishes) of Greenland, but they may certainly serve as sign posts for future explorers of the east coast. As soon as at anchor we went on shore, and spread in all directions in order to examine the neighbourhood. King Oscar's Harbour is surrounded by soft, close, grass slopes and flourishing shrubs. The fauna appeared to me more copious and the grass less mixed with moss than on the west coast in the same latitude. In one of the valleys a river flowed, the shores of which consisted of loose sand without any covering of grass. Here were found traces of the Esquimaux. Some of the footprints were days old, but others were so fresh that the moist sand had not had time to dry. Most probably they had taken flight on seeing the steamer forcing the barrier which had hitherto formed their shelter. We found plenty of remains of them in the shape of huts, graves, fox-pits, &c. The naturalists gathered here a quantity of fresh materials of the fauna and flora of East Greenland, among which I may specially mention the well-known *Potentilla anserina*, which is found so often near the Norse ruins in West Greenland, and which may, for that reason, be a sign of the Norse colonisation of East Greenland. We found traces of reindeer, but none of the musk-ox; neither did we see any bears or walruses, and only a few seals. Our whole bag was two ptarmigans.

[1] North of the Polar circle the east coast of Greenland is in many places easily accessible.

That the Esquimaux had decamped was very annoying, as they could no doubt have given some valuable information relating to this part of Greenland and the tribes which inhabit it."

After reconnoitring the coast still further, Baron Nordenskjöld decided that his best course was to return at once to Reikjavik. Before doing so, however, some hours were spent in dredging and in hydrographical research, as well as in photographing some of the coast scenery.

"Having thus given an account of the work of my expedition, I have to point out that we have been the first to penetrate into the heart of Greenland, and that our journey has resulted in learning something about this continent, the natural conditions of which may probably give us a clue to the true condition of Scandinavia during the Glacial period, the study of which is therefore of such great importance to the geology of North Europe. Besides this, valuable scientific data have been collected during my voyage along the east coast of the composition of the ice-belt which bars the way *from the east* to the southern part of Greenland, while many errors as to the state of the east coast of Greenland have been corrected. In addition to these objects one more has been attained, viz. the anchoring of a vessel by the shore of East Greenland, an achievement attempted in vain for centuries. If thus the work of the numerous expeditions despatched since the sixteenth century by sea to the part of Greenland lying opposite or south of Iceland to the part where the Norse Österbygd was or was not situated, it will be found that not one of them succeeded in reaching the coast.

"A few words more in conclusion as to the purely scientific results of the expedition. During the voyage of the *Sophia* along the coast of Greenland from Cape Dan past Cape Farewell to Cape York, and further from Cape York around Cape Farewell to Ingolf's Mountain, hydrographical researches and dredgings were effected whenever time and weather would permit. These labours were conducted by Herr Hamberg and Dr. Forsstrand. In addition, Herr Hamberg effected a number of analyses of sea water, and the gases contained therein, from various depths, while he brings home a series of the most carefully effected measurements of the temperature of the sea, which demonstrate that the *cold current* running along the east coast is, both in width and depth, very insignificant, and rests *even near the shore* upon one of warm water produced by the Gulf Stream. Davis Sound and Baffin's Bay, on the other hand, are filled with cold or very slightly warmed water *to the bottom*. Contrary, therefore, to the general belief, *the west coast of Greenland is washed by cold water, while a greatly heated current coming from the south runs along the east coast a distance of* 40' *to* 50' *only from the shore*. This current must exercise a great influence on the climate of the east coast, which may be more moist, but, I believe, not colder than that of the west coast.

"The dredgings have yielded Dr. Forsstrand a fine harvest of marine animals, &c., of which I may mention gigantic sponges from great depths in Denmark Sound (between Iceland and Greenland). The dredgings on the east coast were, however, greatly impeded through causes detailed above, and by the circumstance that the bottom consists mainly of huge boulders, which tore the net. Of the animal species existing on land or in fresh water, Herr Kolthoff has collected rich fresh materials of the Greenland fauna. Especially will the variety of insects collected be of great instructive value to science. On account of the limited accommodation on board, and from the circumstance that the flora of Greenland is well known through Danish and Swedish specialists, I took no botanist with me. But even in this field new materials have been gathered through the zeal given to such researches by Dr. Nathorst and Dr. Berlin whenever time permitted. The collections of microscopical plants which have been made, the true place of existence of which is the ice and the snow, must particularly be of great value. They are besides of additional interest to the expedition, as they belong to a new branch of science which has in the first instance been created by Swedish *savants*. The collections, perhaps, of most value to science have, however, been made by Dr. Nathorst from the North-West Greenland so-called basalt formation, which is remarkable for the quantity of fossil plants contained in the clay, sand, and tuff strata there. Of course some very fine palæontological collections have been brought from these parts before, especially by the Swedish expedition of 1870, and by some Danish ones under Dr. K. Steenstrup; but it is the first time that a palæontologist has visited this spot, and I am, in consequence, convinced that the objects gathered by Dr. Nathorst, when scientifically treated, will yield many new data on the copious flora which once covered the ice-laden regions round the Pole.

"Finally, the expedition has brought home some splendid specimens of the remarkable minerals found at the well known deposits at Kangerdluarsuk and Ivigtut, while I have on the inland ice collected, as previously stated, a great many samples of the dust found on the ice, and which I have named kryokonite. I hope, when this has been exhaustively analysed, to be able to furnish fresh proofs in support of the theory that this deposit is, at all events partly, of cosmic origin, and thereby contribute further materials to the theory of the formation of the earth. Dr. Nathorst was, as previously stated, prevented by the ice from reaching Cape York and examining the blocks of ironstone lying there, but their existence has been corroborated beyond doubt by the Esquimaux in the neighbourhood. Here the expedition obtained some valuable ethnographical objects, and it learnt a fact from the natives which may be of considerable importance as to the question of the wanderings of the tribes around the Pole, viz. that four 'Russian Esquimaux' had come to Wolstenholme Sound. They said they were the last survivors of a tribe which had left their place of habitation by the Behring Strait (or the northern shore of Asia?) in search of a new place of settlement, and who had at last reached Smith's Sound. These are the results of my expedition to Greenland in the *Sophia*. The scientific collections made will be distributed among the museums of my country."

A. E. NORDENSKJÖLD

THE ROTHAMSTED GRASS EXPERIMENTS[1]

THERE is at Rothamsted nothing which will more impress the visitor than the seven acres of meadow land in the Park, the many years' experiments upon which with different manures constitute the subject of the above-named memoir. The twenty parallel plots into which the area is divided appeal at once and forcibly to the eye by the obvious differences in their herbage. A plot here with rich green grasses waving luxuriantly upon it; another, on which the yellow meadow vetchling apparently constitutes the leading feature; a third, irregular, patchy, and much afflicted with the sorrel-dock; and yet another, on which, at the time of our visit (August), the white-flowered umbels of the earth-nut put everything else in the shade,—these and the like appearances convince with an eloquence which the pen is powerless to imitate.

The land in Rothamsted Park has probably been laid down with grass for some centuries. No fresh seed has been artificially sown within the last fifty years certainly, nor is there record of any having been sown since the grass was first laid down. The experiments commenced in 1856, at which time the herbage appeared to be of uniform character. With few exceptions the same description of manure has been applied year after year to the same plot; and two plots, the third and twelfth, have been continuously unmanured. For the first nineteen years the first crop only was cut and carried away, and the second crop was usually fed off by sheep who were receiving at the time no other food. Of recent years it has been more and more the practice to make the second crop also into hay, and it is intended to adhere to this plan in future, weather permitting.

The produce of every plot is weighed as hay, and the result calculated per acre. Taking the average of the first twenty years, the unmanured plots, 3 and 12, gave the lowest yields of all, 21¼ and 24 cwt. respectively. Next above these is plot 5, manured with ammonia salts[1] at the rate of 400 lbs. per acre per annum, the yield giving an annual average of 26¼ cwt. per acre. The highest average recorded, 62½ cwt. per acre, resulted from a mixed manure, containing 500 lbs. sulphate of potash, 100 lbs. sulphate of soda, 100 lbs. sulphate of magnesia, 3½ cwt. superphosphate of lime, 600 lbs. ammonia salts, and 400 lbs. silicate of soda,—a tremendous dressing, by the way. The average yields on the other plots, each one of which received different manurial treatment from that of the others, range themselves between these extremes.

But the mere quantitative estimation of the results was a comparatively simple task to that of making a qualitative examination of each crop. The proximate analysis was into the three classes of gramineous herbage, leguminous herbage, and miscellaneous herbage, the last-named containing all plants not referable to the Gramineæ or the Leguminosæ; and even this task would not be a very difficult one. But when it is stated that in certain seasons a complete botanical analysis was made, whereby each species of plant was separated from all the others, then the irksomeness of the work will be appreciated. For the details of these analyses we must refer to the memoir itself, but the following is worth reproducing. "To quote an extreme case in illustration of the difference in the character of the herbage, and of the difference in the degree of difficulty of separation accordingly, it may be mentioned that whilst a sample of 20 lbs. from one plot in 1872 only occupied from four to five days in botanical analysis, a sample of equal weight from another plot in the same year occupied thirty days."

The total number of different species of plants that have been detected on the plots is 89; of these, 20 are grasses, 10 are leguminous, and the remaining 59 belong to miscellaneous orders. The 89 species comprise 59 dicotyledons, 26 monocotyledons, and 4 cryptogams, 3 of which are mosses (Hypnum); they are arranged under 63 genera and 22 orders. Of the miscellaneous plants there are 13 species of Compositæ, 6 of Rosaceæ, 5 each of Ranunculaceæ and Umbelliferæ, 3 each of Labiatæ, Polygonaceæ, Liliaceæ, Caryophylleæ, Scrophulariaceæ, and Musci, 2 each of Rubiaceæ and Plantagineæ, and 1 each of Cruciferæ, Hypericineæ, Dipsaceæ, Primulaceæ, Orchidaceæ, Juncaceæ, Cyperaceæ, and Filices. Six genera only were represented by more than one species; these were Ranunculus, 5 species, Rumex 3, and Potentilla, Galium, Leontodon, and Veronica, 2 each. The 20 species of grass comprise 14 genera; Festuca is represented by 4 species, Avena by 3, Poa by 2, and Anthoxanthum, *Alopecurus*, Phleum, *Agrostis*, Aira, *Holcus*, Briza, Dactylis, Cynosurus, *Bromus*, and Lolium by 1 each. The fact that the four genera whose names we have italicised were only represented by one species each serves to indicate somewhat the nature of the land. Had it been wet or marshy in parts, *Alopecurus geniculatus* might have been looked for as well as *A. pratensis*. Had not the plots

[1] "Agricultural, Botanical, and Chemical Results of Experiments on the Mixed Herbage of Permanent Meadow, conducted for more than twenty years in succession on the same land." Part ii., the Botanical Results. By Sir J. B. Lawes, Bart., F.R.S., Dr. J. H. Gilbert, F.R.S., and Dr. M. T. Masters, F.R.S. *Phil. Trans.*, Part iv., 1882. Pp. about 250.

[1] "Ammonia salts"—in all cases equal parts sulphate and muriate of ammonia of commerce.

been quite away from hedgerows, several species of Bromus might have accompanied *B. mollis*, while *Arrhenatherum avenaceum* and *Brachypodium sylvaticum* might also have been looked for. The total absence of Glyceria further shows the fairly dry character of the soil. Lastly, the 10 species of Leguminosæ fall under 5 genera—of Trifolium 4 species, Lotus and Vicia 2 each, Lathyrus and Ononis 1 each.

Ten species of grasses occur on all the plots: *Anthoxanthum odoratum, Alopecurus pratensis, Agrostis vulgaris, Holcus lanatus, Avena flavescens, Poa pratensis, Poa trivialis, Dactylis glomerata, Festuca ovina*, and *Lolium perenne*. *Festuca eliator* was only found in one plot, and *F. loliacea* in two. *Phleum pratense* occurred in about one-fourth the number of plots, *Aira cæspitosa* in about one-half, *Briza media, Cynosurus cristatus, Festuca pratensis*, and *Bromus mollis* in sixteen or seventeen. No leguminous plant occurred in all the plots, but *Lathyrus pratensis* was found in nineteen plots, *Trifolium repens* and *T. pratense* in seventeen, *Lotus corniculatus* in sixteen, and *T. minus, T. procumbens, L. major, Ononis arvensis, Vicia sepium*, and *V. Cracca* only in one each.

These details will serve to indicate the nature of the flora of the plots. Certain miscellaneous plants common on many old pastures in this country are conspicuous by their absence. The dry and level character of the meadow will account for the absence of Caltha and Juncus. No species of Geranium is recorded. But the most noteworthy fact appears to be the absence of certain scrophulariaceous genera, which are by no means uncommon on old grass lands, namely, Bartsia, Euphrasia, and Rhinanthus. The quality of the land is probably too good for the first two, and the application of manure would certainly be against Euphrasia, but *Rhinanthus Crista-galli* is very common on old meadows, as, for example, in Derbyshire and Worcestershire.

The object which the authors kept in view in writing this section of their report was, in their own words, "to show both the normal botanical composition of the herbage, and the changes induced by the application of the different manuring agents, and by variation in the climatal conditions of the different seasons; and, as far as may be, to ascertain what are the special characters of growth above ground or under ground, normal or induced, by virtue of which the various species have dominated, or have been dominated over, in the struggle which has ensued." At the outset it was noticed that those manures which are most effective with cereals grown on arable land were also most active in increasing the quantity of grass amongst the herbage, and that the manures which are most beneficial to beans or clover produced the greatest proportion of leguminous herbage. Thus, the highest gramineous produce resulted from a highly nitrogenous manure, such as ammonia salts or nitrate of soda, with alkaline salts, particularly potash; but side by side with the increase in the total gramineous herbage there was a decrease in the actual number of species of grass. On the other hand, the highest percentage of leguminous produce was the result of a mixed mineral manure with potash. The percentage results on the following plots illustrate these points:—

	Plot 7.	Plots 3 and 12.	Plot 11.
Gramineæ ...	61·78	67·43	94·96
Leguminosæ ...	22·71	8·20	0·01
Other Orders...	15·51	24·37	5·03
	100·00	100·00	100·00

Plot 7 was the most favourably manured for leguminous produce, it received mixed mineral manure alone, including potash; plots 3 and 12 were the two unmanured ones; plot 11 was the most favourably manured for gramineous produce, it received 800 lbs. ammonia salts with mixed mineral manure, including potash.

Special observations and complete botanical separations made at intervals of five years to determine the influence of seasonal variations show that "a given quantity of the produce grown under the same conditions as to manuring might be composed very differently in two different seasons."

The influence due to the special medium through which a particular plant-food, such as nitrogen, is presented to the plant, is aptly illustrated in the following extract:—"Because a particular grass, or other plant, is little benefited by ammonia salts for instance, it does not follow that it will not be favoured by nitrates; nor, because if while growing in association with other species it may not be specially benefited by a particular manure, does it follow that it would not derive advantage from the same substance when growing separately."

Nearly all the plants on the plots are perennials, very few are annuals, *Bromis mollis* being the only case amongst the grasses. The advantage possessed by deep-rooting over surface-rooting plants was well brought out in the droughty season of 1870, when the latter suffered considerably from lack of moisture. The locomotive power of underground stems is of great use to some plants: "the stock continues to grow at one end, year after year, the opposite end gradually dying away. In the course of a few years the plant therefore occupies quite a different position from that which it at first had." Notwithstanding the general rule that the chief effect of nitrogenous manures is to favour the extension of foliage and give it depth of colour, while that of mineral manures is to encourage stem formation and the production of seed, and notwithstanding that excessive nitrogenous manuring prolongs the development of the vegetative organs till perhaps the resources of the plant are exhausted or the season is over, while excess of mineral manures may induce premature ripening, yet so far as the experiments have gone no absolute change in the distinctive form of any plant has been effected by the prolonged use of the different manures, though changes of degree are sometimes very marked, as in the tufts of *Dactylis glomerata*.

The battle for life between the various species of plants growing in the meadow is dependent much less on the chemical composition of the soil than on its physical character, its capacity for holding water and its permeability to roots. The immediate source of victory lies very generally in the powerful root-growth of the survivors, the term "root" here covering all kinds of underground stem. The various influences affecting the struggle for existence amongst meadow plants are discussed by the authors in a fascinating manner, and this part of the memoir is of special value to the botanical student.

Every plant occurring on the plots is dealt with individually, and in the case of each grass and leguminous plant and of the more commonly occurring weeds, a table showing the relative predominance is given. The fact that plants closely allied morphologically may yet differ widely in their physiological endowments is strikingly illustrated by the two species of Poa, *P. trivialis* and *P. pratensis*. These two plants, sprung at no very distant period from a common ancestor—for this, we presume, is the morphological significance of their being placed in the same genus—differ only in the most trivial points: *P. pratensis* is smooth, stoloniferous, and has a blunt ligule; *P. trivialis* is rough, has no stolons, and possesses a long pointed ligule. We read that "the stolon-bearing *Poa pratensis* is specially benefited by nitrogenous manure in the form of ammonia salts (in combination with mineral manure), but not at all by nitrate of soda, whereas the more finely-rooted and non-stoloniferous *Poa trivialis* has declined markedly on the ammonia plots, but has remained very prominent on the nitrate plots, especially where the larger amount of nitrate was used with the mixed mineral manure." Thus in 1872, on plot 9 (mineral manure and ammonia salts) *P. pratensis* gave 22·67 per cent. of the total produce, and *P. trivialis* only 0·64; on plot 14 (mineral manure and nitrate of soda) *P. trivialis* gave 24·76, and *P. pratensis* only 2·57 per cent. It is suggested that the relatively shallow-rooting *P. trivialis* predominates on the nitrate plots by reason of its fine surface-roots arresting and taking up the nitrate before it has had time to penetrate too deeply; this plant invariably makes rapid growth upon the application of the nitrate of soda in the spring.

The remaining portion of the memoir is devoted to a discussion of the botany of each separate plot in each season of complete botanical separation, and is carried out with the same elaborate detail as the earlier portion. No one can read this memoir without being impressed with the great power, too frequently overlooked, possessed by the subterranean members of the plant body in deciding the struggle for existence; much of the internecine warfare is carried on in the dark.

It is quite possible, and indeed probable, that, had a similar series of experiments been simultaneously carried out in another part of England with a slightly different climate, and on a different kind of soil, the results might have differed, but only in slight details. Such a splendid series of experiments on grass land has never before been consummated, and the memoir embodying the results will well repay the most careful study and perusal not only of the agriculturist, but of the botanist, the chemist, and the evolutionist. It may perhaps be long before the great lessons learnt in Rothamsted Park have filtered down to those to whom they should be of most practical value, but we do not despair of a time coming when the intelligent manuring of grass lands for very specific objects will form a part of ordinary agricultural practice. Those who will put their hands to the plough in the field of agricultural research must be content to trudge along, laboriously and unnoticed, in the furrow. Their discoveries cannot be made in a week, or a month, as are many in electricity or in chemistry, but, like those at Rothamsted, which are now in their twenty-eighth year, and are still going on, they can only be looked for, even after the expenditure of much thought and of unflagging industry and perseverance, as "the long result of time."

W. Fream

PALÆOLITHIC MAN—HIS BEAD ORNAMENTS

EVERY one who has noticed the objects found in caves of Palæolithic date knows the evidence which supports the idea that cave men wore bracelets and necklaces, but the evidence that the older river-drift men wore similar ornaments is more obscure. Still, when one notices the extreme beauty and precision of make of some Palæolithic implements, one cannot help surmising that the more ancient savages of our old river sides also had sufficient personal pride and ideas of ornament to sometimes decorate their bodies with beads in a similar fashion with the cave dwellers.

Dr. Rigollot ("Mémoire sur des Instruments en Silex," p. 16) refers to the well-known foraminiferous fossil from the chalk—*Coscinopora globularis*, D'Orb. (sometimes found in river gravels with Palæolithic implements), as beads probably used by Palæolithic men; and Sir Charles Lyell ("Antiquity of Man," p. 119) says: "Dr. Rigollot's argument in favour of their having been used as necklaces and bracelets, appears to me a sound one. He says (Dr. Rigollot) he often found small groups of them in one place—just as if, when swept into the river's bed by a flood, the bond which united them together remained unbroken." Mr. James Wyatt of Bedford, in describing these bead-like fossils (*Geologist*, 1862, p. 234), says he had examined more than two hundred specimens, and on making sections of some of them he saw markings which appeared to indicate "drilling with a tool after the object was fossilised." In specimens from the chalk the hole through the fossil, though commonly straight, exhibits of course no artificial drilling but shows the structure of the foraminifer.

I am not aware of any confirmation hitherto made of the two curious observations noted above, but so little is at present known of the habits of river-drift men that the following notes may prove of some interest. Where there is so much darkness the slightest glimmer of new light is welcome.

After long searching for the Coscinopora at Bedford without result, I lighted on many examples at Kempston in 1880. In this year I found in a few days over two hundred examples; they occurred with unabraded implements and flakes and carbonised vegetable remains. After this date the Coscinopora again ceased, and from then till now I have met with but few examples. The finding of the above-mentioned large number of specimens all congregated together appeared to lend some confirmation to Dr. Rigollot's view, for it seems unreasonable to believe that so large a number could by any natural possibility find a position in one place in any river gravel.

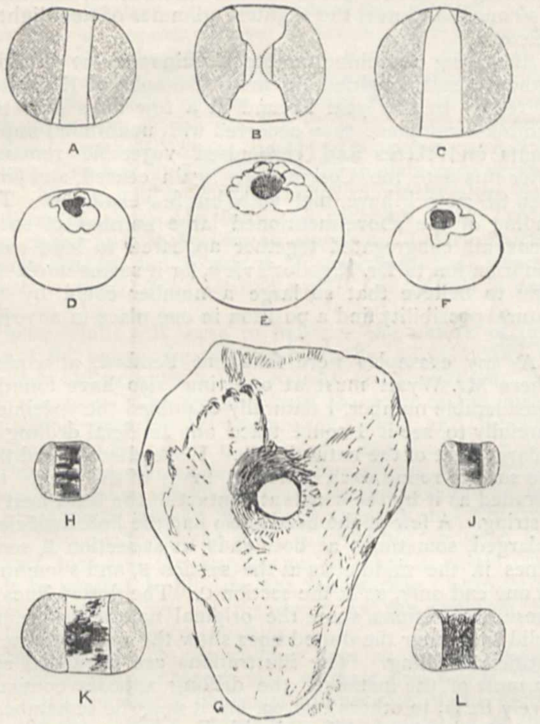
As my examples were found at Bedford, at a place where Mr. Wyatt must at one time also have found a considerable number, I naturally examined the specimens carefully to see if I could trace any artificial drilling or enlargement of the natural hole. I speedily noticed that the surface round each orifice in many of the beads was abraded as if by the constant contact of the bead next on a string. A few of the beads also had the hole artificially enlarged, sometimes at both ends, as at section A, sometimes in the middle, as at the section B, and sometimes at one end only, as at the section C. The dotted lines in these illustrations show the original natural orifice, the solid lines near the dotted ones show the enlargement by artificial drilling. The illustrations are all actual size. In most of the instances the drilling appears comparatively fresh, in others less so, but it must be remembered that the implements found with them were mostly unabraded, and vegetable remains were found. These specimens were found by myself. They were not touched or manipulated by the workmen. Other examples of these beads had one end near the orifice broken away as if in an attempt to enlarge the opening by breaking the substance of the fossil away as at D, E, F.

Whilst looking through the fallen material in the pit, the piece of naturally perforated fossil shell, illustrated actual size at G, attracted my attention. The hole is probably due to a shell-boring mollusk, but when I saw the object in the drift I distinctly noticed that a black substance entered at one side of the hole and emerged at the other; at the moment of picking the object up, this material fell to dust with part of the very friable surface of the fossil shell.

Some of the beads (as seen in section at H, J, K, L) also bore very distinct traces of a similar black substance within the orifice, although not seen till the sand and part of the black substance itself had fallen out. This black material I took to be the remains of part of the ligament on which the beads were originally strung by their Palæolithic owner, and with this idea in mind I sent some to an analytical chemist, who examined the material for me with the following result:—

"The testing for nitrogenous organic matters, of which animal tissues are composed, was tested in the same manner as testing water for such matter, that is, by converting it into ammonia; precautions were of course taken to eliminate from the results any ammonia already existing. The amount of ammonia was strikingly evident and showed with each bead examined separately. The blackening of the organic matter in the holes of the beads may have taken place in a manner similar to that of the formation of coal."

On testing the beads, which consist chiefly of carbonate of lime or chalk, without the black material in the orifice, the chemist reported that, "when treated in the same manner as those originally sent, they show the presence of a considerable amount of heterogeneous or animal organic matter, as was to be expected from their origin—but not, I think, so much as those with the black deposit."



Palæolithic Bead Ornaments (*Coscinopora globularis*, D'Orb.), showing traces of the original ligament and artificial enlargement.

Mr. A. Clarke, analytical chemist of Huddersfield, who also made an analysis for me, reported as follows :—

"I divided the bead into three portions. No. 1. The thin dark crust forming the internal portion of the ring; this is most certainly organic matter. No. 2. A powdery part between No. 1 and the main body of the ring, consisting of small quantities of carbonates of iron and lime. No. 3. The outer main body of the ring, mostly carbonate of lime, and a small quantity of silica; here there is only a trace of organic matter, but it is most distinctly present."

WORTHINGTON G. SMITH

IS IKTIS IN CORNWALL, AND DID IRON AND COPPER PRECEDE TIN?

AT Penzance on October 19, 1883, I asserted that the invention of tin-smelting was Cornish, but disputed the claim of St. Michael's Mount to be the sole claimant to the title of Iktis, the tin-shipping port described by Diodorus Siculus 1800 years ago, and I thought the inventions of metals were in this order: (1) iron, (2) copper, (3) tin. We may consider the Romans invaded Britain purposely to obtain its metals, which were then worked extensively by the British inhabitants. I believe the Romans either adopted Celtic names of places or things, or translated their meaning. I find the Cornish district, or Land's End, described by Ptolemy the geographer in the second century as "Belerium," that is the land of mines, "bal" being Cornish for a mine. The word is also met with in Irish. In the same manner the skin boats used by the Cornishmen, which so much astonished the Greek travellers, were described by the Greeks under the name of "coracles," evidently a Celtic word from the Celtic root "cren" or "croen," skin. So tin, I think, is derived from the Irish word "teine," Welsh "tan," teine probably also expressing brightness. Even in the Malay Peninsula, in the East Indies, a word of similar sound, "timah," still stands for "tin," and not the Greek term for that metal "kassiteros."

Then the Cornish term "iarnn," for iron is similar to English "iron," German "Eisen," Welsh "haiarn," Greek "seiderion," in which *ei* is the important syllable. The Latin word "ferrum" is probably a form of "ierrum," and the Sanskrit "ayas" is for iron, metal. Nearly the same word for iron is therefore used in all the Aryan languages, while "æs" or "kalkos" stands for bronze or copper, and has only a comparatively local extension. The wide spread of the name for iron, or *ei*, is important, as it points to iron being the metal made before the division of the Aryan race, and therefore before copper or tin.

There is another and I believe new argument. The most easy process of copper-smelting, which even now is largely used, may have been the only plan known in prehistoric times. To use this process it was necessary to provide iron to precipitate copper from solution. At the present time 6000 tons of iron are sent annually to the Rio Tinto mines in Spain from Great Britain in order to precipitate the copper from solution.

It is possible that the discovery of the art of producing crude iron, which would be useful for precipitating copper, may have preceded the invention of bronze, and yet the art of forging difficult pieces may have been a later invention than that of casting bronze celts in metal moulds.

Iron, if not steel, appears to have been made in Egypt both in hearths and in crucibles certainly before 3124 B.C., but bronze was more used in Greece up to 650 B.C. than iron.

The smith in the sagas and folklore is the important person, not the caster or founder of bronze weapons. Why was the smith so important? Because he melted the small particles of gold found in the streams into small lumps, and with his hammer drew them out into wire and thin plates. Gold was made in such small quantities that it did not require large crucibles such as would be necessary for bronze. As iron was made by a simple welding or forging process, its production appears to be a more ancient art than bronze casting, which required large crucibles and mixing in exact proportions with tin, a process more difficult than in the infancy of metallurgy was likely to be invented. Then one ore of iron, ochre was the first metallic ore collected, long before the discovery of any of the metal. Ochre is found collected for use as a paint to ornament the cave men in the Palæolithic period, and is associated with limestone and charcoal. Accident in the fire might have thus led to the discovery of metallic iron in very early times. Such particles of iron placed in a certain stream in the Island of Anglesea (an early peopled district) would precipitate the copper in solution in that stream in a state of pure copper ready to mix with tin to make bronze.

Another point of great interest in this question is the position of Roman roads, proving a prior metallurgical trade, and therefore some considerable civilisation. The Romans erected their Roman villas and camps always near Roman roads, and these roads appear always arranged for military or metallurgical purposes, never for protecting agriculture, or levying imposts on the Britons. There is historical evidence that the Romans did not introduce metallurgy into Britain.

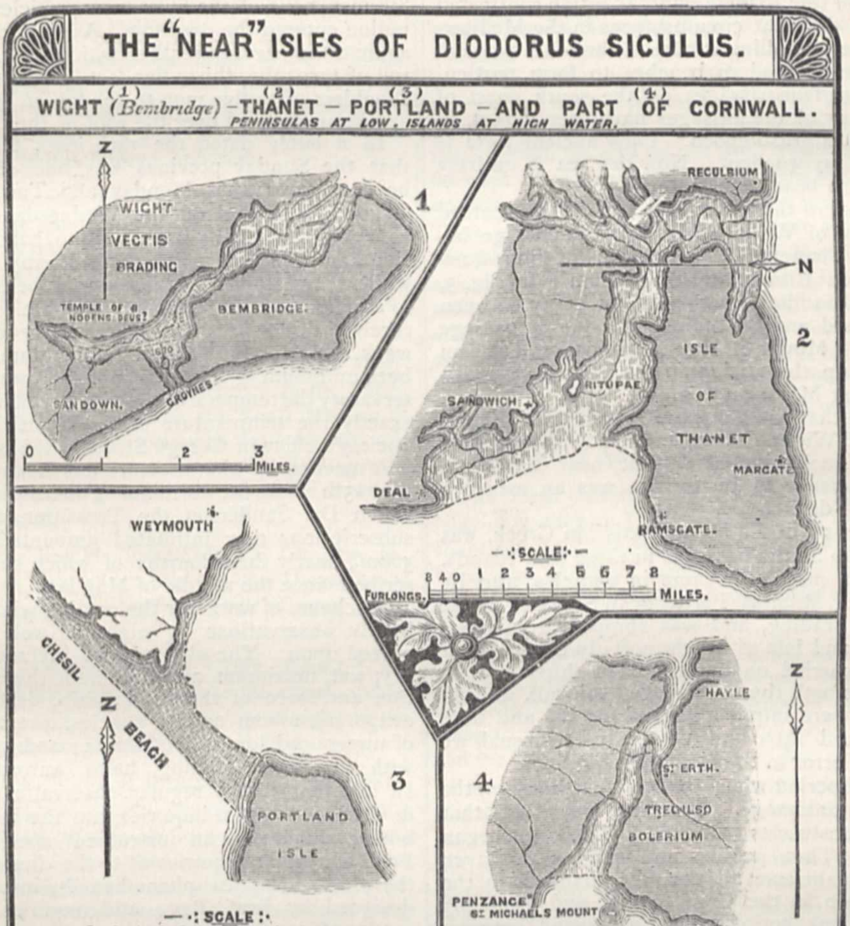
We may observe there is a great concentration of Roman roads at Winchester (Venta Belgarum). Roads meet at the point of junction from Exeter with this town, for bringing Cornish or Dartmoor tin, or lead and iron from the Mendips, to the Hampshire coast; iron from

South Wales, and lead from North Wales. There were, near Winchester, several great ports for Continental trade, viz. Magnus Portus (Portsmouth), Trisantonis and Clausentum (Southampton). Winchester is near Beaulieu. Below Beaulieu, six miles, is Stansoar (stone) Point, from "stannum," tin. This is nearly opposite Gurnard's Bay (Gubernators, across the Solent two miles), where there are remains of Roman villas. Thence to Newport and Brading, where the great Roman discoveries have been recently made. Among the "Islands of Britain" Ptolemy gives one as "Vectis," in Celtic Wyth.

Now Vectis has been hitherto treated as if it were only the name of an island, the Isle of Wight; but vectis is really the Latin term for a bolt, or security, and was probably applied to harbours, and is a translation of "Gwyth." A lock means also a canal lock.

If Prof. Rhys is right,[1] that "Ictis" and "Itius" are the same word, we may go further and say that the Portus Itius, from which Cæsar started from Britain, containing his 800 ships, was merely a technical term for a vectis or secure harbour attached to a town, such as that at the mouth of the Liane (Boulogne). It is only a century and a half since the natural basin of Boulogne has been partly filled up by the sea sand, and there was an estuary supplied by the Liane stream at the time of Cæsar, not unlike those drawn by me in shape, but without a through passage.

In fact, not only along the English coast, where



Dungeness Beach has blocked up the Roman Port Lymne, and the points where four islands have been joined to the mainland, as shown in the drawings, Figs. 1, 2, 3, and 4, but on the French coast great changes have been made by the same causes. At Sangatte and Calais, Wissant, Ambleteuse, Boulogne, St. Michael's Mount, and in fact at many places along the coast of the Pays Bas, the same filling up can be observed.

Cæsar's port of embarkation, Portus Itius, may have been named in the same sense as, according to Prof. Rhys, the old Irish wrote of the English Channel, viz. as Muir an Icht, which he renders the Sea of Icht, and which, according to the view I suggested, would be the sea of the passage, evidently a different meaning, although from the same roots, to the name, which, with the addition of Portus, we find in Cæsar. The term Portus Itius evidently was applied by the Roman writers to the harbour of Boulogne, although the city itself was called Gessoriacum. I think this philological explanation and the fact of the distance from Portus Itius (given by Strabo) thirty miles to Britain, removes every difficulty in the way of settling the position of the port from which Cæsar started. Of course the term Portus Itius might also apply to St. Valery-sur-Somme, where a passage has been partly closed, as at Marazion, in the historical period, but the distance given by Strabo is against it. Species of mollusks are found at both places, Marazion and St. Valery, not now living on the coast, and probably

[1] In a letter to A. Tylor, November 6, 1883.

these estuaries or passages were only entirely open in the Crag period.

I have said Vectis is equivalent with the Celtic word "gwyth," a passage. Now there is a closed passage or haven (a gwyth, or vectis, or iktis) from Sandown to Bembridge in the Isle of Wight (Fig. 1). From this passage the whole island gets its name "Gwyth" in Celtic, Latin "Vectis," Saxon "Wiht," English "Wight," never spelt "White," although it has white chalk cliffs.

The safety of any of the harbours called Vectis or Iktis arose from the fact of these islands (or parts of them) near the coast of Britain being peninsulas at low water and islands at high water. These were, therefore, typical natural harbours. The Greek writers, Diodorus Siculus and others, insist particularly upon this property of change with the tide. The remarkable tide contrasted strongly with the different circumstances in the Mediterranean. Now the prevailing winds on the south coast of England have caused modern beaches to form, particularly at all of these four passages on the south coast of England, and many of the passages have been closed, as we know, in the historical epoch. Their ancient form is clearly shown in my woodcut. Now the sea is entirely shut out by modern beaches and works.

The drawings show the changes which have occurred in Fig. 1, the Isle of Wight. Fig. 2 is the passage between the Isle of Thanet and Kent, closed in the historical period between Ritupæ and Regulbium. In Fig. 3, the Chesil Bank, has filled up the old waterway between the Isle of Portland and the mainland. Fig. 4, passage from St. Michael's Mount to Hayle. Gravel and stream tin-drift, closing up the ancient passage from near St. Michael's Mount at Marazion to Hayle.

The type of all that has happened is well seen, Fig. 1, Vectis, the Isle of Wight. Even in 1670 there was only a groyne and a small alluvial deposit near Sandown. Nearly all the passage to Bembridge was an estuary; now it is nearly all dry land.

The term "vectis" in Latin, or "iktis" in Greek, was no doubt applied to all the passages in these four islands.

The Cornish tin no doubt came in coracles, and by land on horses, to Magnus Portus or to Stansoar Point for shipment to Brading, and was shipped from these Hampshire ports and Isle of Wight ports to the banks of the Seine, to be carried on horseback in thirty days to Marseilles. Thus both the Bembridge peninsula and St. Michael's Mount were shipping places for tin, and both were properly called Iktis and Vectis, and as usual we find there was no error in the Greek observations.

Then as to the period when the contour lines of the south coast began to change. The Crag period was that in which the great estuaries round the British coast began to be filled up. Then pebbles and sand were driven along the coast. I believe all the four channels in the drawing, were open in the Crag period, and gradually closed up in the long period which intervened between the Crag and the present time. The continuous filling up has also occurred in the estuaries and passages on the opposite coast of the English Channel. It is probable that Portus Itius, at Gessoriacum? (Boulogne) obtained its name in a similar manner to Vectis and Iktis as I have already stated.

We find pure iron B.C. 3124 in Egypt. If iron was a necessity for the production of copper, and the metal tin was of no use without copper, we may place the inventions of the metals in the following order: (1) iron, (2) copper, (3) tin.

A. TYLOR

THE BEN NEVIS OBSERVATORY

SINCE the formal opening of the Observatory on October 17, workmen have been engaged in fitting up and finishing the interior, and pushing forward the provisioning of the establishment with tinned meats, biscuits, tea, coffee, &c., capable of lasting for six months, with fuel for a like period. Nothing that could be thought of has been left undone to render the observers as comfortable as possible during the winter. The telegraph cable is now in working order from the Observatory to Fort William, so that communication is always possible with the outer world. Mr. Omond, the superintendent, and his two assistants took up their residence on the top of the Ben about a fortnight ago; and it is extremely gratifying to learn that the building, every part of which during erection, and for some time after being roofed over, was soaked with water, is now thoroughly dry; the walls, roof, and windows have been officially inspected, and found to be perfectly tight in every respect; and in corroboration of this, during the storm of Thursday, the 8th inst., none of the finer snow particles of that elevated region entered the dwelling. As an additional protection against the severe weather which may happen, a large roll of tarpaulin, thirty-five feet long, was carried on the shoulders of twelve men to the top on Monday last week, and securely fixed over the roof of the building.

In a letter dated the 14th inst., Mr. Omond states that the Sunday previous was one of the finest days he ever saw; that Monday and Tuesday were nearly as good; and that on the Wednesday only the distant view was shut out by haze. Up to that date the top of the Ben had been all but free from stormy weather; indeed, while tempestuous weather raged below, the wind rose to a gale only on Thursday the 8th. A telegram was received direct from the Observatory on Thursday last week, which stated that the temperature for the day had been minimum 17° and maximum 28°, while inside the Observatory the temperature was 55°, which happened to be exactly the temperature of the Scottish Meteorological Society's office in George Street at the time.

A meeting of the directors was held at Edinburgh on the 15th inst., Sir William Thomson in the chair, at which Dr. Sanderson, the Treasurer, reported that the subscriptions now intimated amounted to a little over 5000*l*., nearly three-fourths of which sum had been subscribed since the middle of May last.

A scheme of work for the coming winter, consisting of hourly observations by night as well as by day, was agreed upon. The observations include the barometer; dry, wet, maximum, and minimum thermometers; direction and force of the wind; rain, sleet, snow, and hail; evaporation from snow; species, direction, and velocity of upper and lower cloud strata; and sunshine, together with thunder, lightning, halos, auroras, meteors, &c. In addition to the regular observations, Mr. Omond is to conduct physical inquiries into the hygrometry of this boreal climate by an instrument specially designed by Prof. Chrystal; inquiries as to the direction and speed of the wind and optical phenomena by instruments specially designed by Prof. Tait; and inquiries as to the best modes of conducting the observations under the special difficulties presented by the climate of Ben Nevis.

All the hourly observations will be extended on a daily sheet, three copies of which will be made, one for the Observatory, and two for the Scottish Meteorological Society, one of which will be sent to the Scottish Meteorological Council, London. Forms have also been supplied for monthly summaries of the observations. It has further been arranged that a series of similar observations at 8 and 9 a.m. and 2, 6, 9, and 10 p.m. be made at Fort William by Mr. Colin Livingstone, one of the Scottish Meteorological Society's observers.

A Redier's continuously-recording barograph and a Richard's continuously-recording thermograph have been supplied to the Observatory, and also to Mr. Livingstone, to be used as interpellation instruments. By the double set of hourly observations thus obtained, comparisons may be made between the atmospheric conditions on the top of the Ben and those at sea-level, which are of such vital importance in the larger questions of meteorology. It may be noted here that it was found necessary to take the barometer, which had been for upwards of two years exposed in the cairn to the severe weather of the Ben, to Edinburgh to be thoroughly overhauled. It has since been conveyed to its permanent place in the Observatory, and is in excellent order. The full equipment of the Observatory is delayed till next summer, when the directors will have before them Mr. Buchan's report on the instruments in use at the different European meteorological observatories he visited in the autumn, the work of the Observatory during the next eight months, and the results of Mr. Omond's investigations into different methods of observing on Ben Nevis.

NOTES

WE deeply regret to announce the death of Sir William Siemens on Monday night, at the age of sixty years. His death is attributed to rupture of the heart, the result of a fall which he sustained a fortnight since. We must defer to next week a detailed notice of Sir William's career and work.

IT is proposed to acquire for the Cambridge Museum of Comparative Anatomy the beautiful collection illustrating the fauna of the Bay of Naples, which Dr. Dohrn exhibited at the International Fisheries Exhibition. The cost will be only 80*l*., little over that of the glass jars and the alcohol in which the animals are preserved.

LIEUT. WISSMANN, the African traveller, has just left Hamburg again on another three years' exploration in the Congo region. He has undertaken to furnish the Royal Museum at Berlin with all the natural history specimens which he may collect during his travels, and has even been prevailed upon by some anthropologists to take plaster casts of all the races he may come in contact with.

THE widow of the late Mr. John Elder, of Glasgow, has given the munificent sum of 12,500*l*. to the University of Glasgow for the purpose of endowing a chair of naval architecture.

WE regret to learn of the death of Mr. James Stewart, C.E., who has done so much for the exploration of the region around Lake Nyassa. At the time of his death he was engaged in the formation of a road between Lakes Nyassa and Tanganyika.

DR. HECTOR, F.R.S., stated at a recent meeting of the Wellington (N.Z.) Philosophical Society, that his two self-registering barometers had shown a remarkable up and down vibration on the revolving drum upon which the record is marked on dates corresponding with those of the Sunda earthquake, and a severe earthquake twenty-six hours afterwards, which was felt all along the northern coast of Australia. This agitation was quite distinct from those caused by ordinary atmospheric influences. He attributed the curious tidal disturbances which occurred on the New Zealand coast in August to those earthquakes.

IN a letter from Maranhao, Brazil, the writer states that from August 31 up to September 6, the sun, until 7 a.m., could be looked at without the least difficulty, its light being as soft and pale as the moon's.

AT its meeting, October 27, *Science* states, the Philosophical Society of Washington listened to a communication by Dr. T. N. Gill on the ichthyological results of the voyage of the *Albatross*, and to one by Prof. A. Graham Bell on fallacies concerning the deaf. Dr. Gill described two anomalous fishes, one of which required the institution of a new order.

HERR JACOBSON, who has spent four years on the north-west coast of America in making ethnological collections for the Berlin Museum, has recently returned, and will sail for Europe. Dr. Leonhard Stejneger has arrived in San Francisco, *en route* for Washington. He has spent a year in Behring Island in the study of its fauna, and in collecting remains of the extinct Arctic sea-cow.

AT the recent meeting of the American Association, Mr. C. V. Riley read a paper on "Some recent discoveries in reference to Phylloxera." Every new fact, he said, in the life-history of the insects of this genus has an exceptional interest, because of its bearing on the destructive grape-vine Phylloxera. The genus is most largely represented in this country by a number of gall-making species on our different hickories, and the full annual life-cycle of none of them has hitherto been traced. The galls are produced, for the most part, in early spring; the winged females issue therefrom in early summer; and thence forth, for the remainder of the year, the whereabouts of the insect has been a mystery. The author has for several years endeavoured to solve this mystery, and at last the stem-mother (the founder of the gall), the winged agamic females (issue of the stem-mother), the eggs (of two sizes) from these winged females, the sexed individuals from these eggs, and the single impregnated egg from the true female, have been traced in several species. There is some evidence, though not yet absolutely conclusive, that this impregnated egg hatches exceptionally the same season; also, of a summer root-inhabiting life. In *Phylloxera spinosa*, which forms a large roseate somewhat spinous gall on *Carya alba*, and which has been most closely studied, the impregnated egg is laid in all sorts of crevices upon the twigs and bark and in the old galls, in which last case they fall to the ground. Up to this time they have remained unhatched, and will in all probability not hatch till next spring, thus corresponding to the "winter egg" of the grape Phylloxera.

THE *Times* Calcutta Correspondent, in speaking of the possibility of opening up Thibet to Indian trade by way of Darjeeling, states that the Prime Minister of the Lama at Shigatze, said to be a most intelligent man, sent recently to Darjeeling for a supply of English books, photographic and other scientific apparatus.

THE piercing of the Arlberg Tunnel was unexpectedly completed on Tuesday afternoon last week. In length the new tunnel ranks third among the great tunnels of the world, its length being 10,270 metres, while the Mont Cenis Tunnel is 12,323, and the St. Gothard 14,900 metres. But while the excavation of the first lasted no less than fourteen years and a half, and that of the second about eight, the Arlberg Tunnel will have taken, when vaulted and ready to receive the first locomotive, not more than four years, thanks to the experience acquired during the construction of the first two Alpine tunnels, and to some innovations which constitute another important step in the art of engineering required for the construction of large tunnels. The engineers of the St. Gothard Tunnel introduced dynamite for blowing up the rock, already pierced through by the boring machine, which useful tool was naturally not disregarded in the construction of the new tunnel. It was also only natural that the Ferroux percussion boring machine, first introduced at the Mont Cenis works, should be again employed, under the supervision of the inventor himself, who in the meantime had considerably improved his powerful boring instrument; but this time the Brandt turning borer, first employed at the works of the St. Gothard, was allowed to compete with the Ferroux percussion borer, the former being used in boring on the tunnel's western side, and the latter on the eastern. To this end, several streams from the heights of the snow-covered Arlberg were gathered on the eastern side into reservoirs, from which two turbines and three water columns were directed to the machines, which compressed the air to five atmospheres, with which the Ferroux borer was worked; while on the western side pumped water was pressed through pipes to the tension of over a hundred atmospheres, to work the Brandt turning borer, which cuts cylindrical blocks of rock from the mountain. The eastern entrance to the Arlberg Tunnel—namely, St. Anton—is 1300 metres above the level of the sea, while the western entrance is only 1215 metres, by which difference a good ventilation of the future railway tunnel seems secured. The vaulting and all other necessary works will be finished at the latest on August 1, 1884.

A MEETING has been held at Chester, presided over by the Duke of Westminster, to take steps to provide the city with a museum, which is intended to be a centre of scientific information for Cheshire and North Wales. North Wales was represented at the meeting by the Duchess of Westminster, Earl Grosvenor, and Sir Robert Cunliffe, Bart.; the Chester Natural Science Society by its president, Prof. T. McKenny Hughes; and the Chester Archæological Society by Dean Howson and Mr. H. Tollemache, M.P. It was decided that the building should accommodate both these societies and the School of Art. The Duke of Westminster announced his intention of giving the greater part of the proposed site, and 4000*l*. towards the building fund.

THE Council of the New University College of South Wales, at Cardiff, have resolved to try to raise 3000*l*. for mechanical laboratories.

THE inaugural meeting of the International Electrical Association took place in Paris on the 15th in the large hall of the Société d'Encouragement. M. Cochery was voted by acclamation Honorary President, and M. Berger Acting President. The number of adhesions exceeds 1000.

THE following is an illustration of what private enterprise may effect for the benefit of science. When the Swedish ship *Monark* was leaving Sweden last year for Australia the second officer on board applied to the Zoological Museum at Upsala for the loan of a trawl and some vessels for preserving natural history objects. The results have been a collection of some 120 species of fish, 50 of insects, some birds, and about 100 varieties of the lower sea fauna of the Pacific, which have now arrived at Upsala.

ON November 2 the Imperial Russian Academy of Science celebrated its hundredth year with great ceremony. Count Tolstoy, the President and Minister of the Interior, acted as chairman.

MR. GAMÉL of Copenhagen has placed the *Dijmphna* at the disposal of Lieut. Hovgaard for an Arctic expedition next year.

AT the Royal Institution Prof. Dewar will give six lectures at Christmas (adapted to a juvenile auditory) on "Alchemy in Relation to Modern Science." Before Easter, 1884, courses of lectures will be given by Mr. R. Stuart Poole, Professors McKendrick, Pauer, Tyndall, and Henry Morley, Capt. Abney, and others. The programme of the Friday evening arrangements will be issued shortly.

A SLIGHT shock of earthquake was felt on Friday at Malaga. A shock was also felt at Chios on the 16th. An earthquake occurred on the 19th at Vallo della Lucernia in the province of Salerno, Italy.

THE additions to the Zoological Society's Gardens during the past week include an Ourang-outang (*Simia satyra* ♂) from Borneo, presented by Mr. William Cross; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mrs. F. R. Flindell; a Hobby (*Falco subbuteo*), captured at sea, presented by Mr. C. Heat; six American Box Tortoises (*Terrapene carinata*), a Stink-pot Terrapin (*Aromochelys odorata*), seven Spotted Lizards (*Holbrookia maculata*), a Long-nosed Snake (*Heterodon nasicus*), two Striped Snakes (*Tropidonotus sirtalis*) from North America, presented by Mr. Samuel Garman, C.M.Z.S.; a Common Viper (*Vipera berus*), British, presented by Mr. W. H. B. Pain; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Cerastes Viper (*Vipera cerastes*) from Egypt, deposited; a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa, a Negro Tamarin (*Midas ursulus*) from Guiana, an Indian Badger (*Arctonyx collaris*) from Assam, two Père David's Deer (*Cervus davidianus*) from Northern China, a Downy Owl (*Pulsatrix torquata*) from South America, purchased; a Sambur Deer (*Cervus aristotelis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

BRORSEN'S COMET.—Of the known comets of short period, two will arrive at perihelion in 1884, viz. D'Arrest's on January 13, and Brorsen's about September. The former has been sought after for several months, but hitherto, so far as we are aware, without success, and there now seems a probability that (as indeed was rather to have been anticipated) it will pass unobserved at this return. The second comet was discovered by Brorsen, an amateur at Kiel, on February 26, 1846, and ten days' observations sufficed to show that its period of revolution was about five and a half years: it afforded one of the most striking instances of a close approximation to the period being deduced from a short course of observation, Mr. Hind having inferred a revolution of 5·519 years from observations between February 28 and March 10 (*Astron. Nach.*, No. 557), while the exact period at the time is now known to have been 5·568 years. The comet has been since observed at its returns in 1857, 1868, 1873, and 1879, though missed in 1851 (perhaps through some confusion as to the date of perihelion passage), and again in 1863. The ephemeris for the last appearance in 1879 was prepared by Prof. L. R. Schulze of Dobeln, after the calculation of planetary perturbations since the return in 1873, the perihelion passage being fixed to March 30·0771 Greenwich M.T. The computed positions differed considerably from those observed, as was shown in M. Otto Struve's comparison with his own observations (*Bulletin de l'Académie des Sciences de St. Petersbourg*, t. v.), and these differences led him to remark:—"Eine Änderung in der angenommenen Perihelzeit würde für sich allein wahrscheinlich nicht genügen." It will be found, however, at the end of April or beginning of May. The errors may be removed by the assumption of a later time of perihelion passage; or by taking it March 30·5418 Greenwich M.T., a difference of + 0·4674d. from the computed epoch. Thus for the observation on April 30, we find, taking the differences in the order (c – o):—

	$\Delta\alpha$	$\Delta\delta$
By ephemeris	+ 1m. 38s. ...	+43′·8
With corrected perihelion	– 0m. 6s. ...	+ 0′·2

The mean sidereal motion determined by Dr. Schulze for 1879 would, without perturbation, bring the comet to perihelion again about 1884, Sept. 14·5, at which time it would be situate in about right ascension 154° with 14° north declination, distant from the earth 1·41, consequently rising more than two hours before the sun. The conditions are therefore likely to approach those under which the comet was observed in 1873.

Some six months after the discovery of this comet in 1846 attention was directed by Mr. Hind (*Astron. Nach.*, No. 582, and in a note to the Royal Astronomical Society) to the near approach which it must have made to the planet Jupiter in May, 1842, a first calculation indicating that on May 20 the distance between the two bodies was less than 0·05 of the earth's mean distance from the sun. This point was more closely examined by D'Arrest from improved elements in 1857 (*Astron. Nach.*, No. 1087); he found that the closest proximity occurred May 20·6924 Berlin M.T., when the comet was distant from the planet only 0·05112, and, carrying his computation backwards to the time when the comet entered the sphere of activity of Jupiter, he assigned approximately its elements previous to that time. A more elaborate investigation of the circumstances attending this near approach has been lately made by Dr. Harzer, in an inaugural dissertation published at Leipzig in 1848; he finds for the time of perijove passage, 1842, May 27·2849 Berlin M.T., and for the distance 0·05471; the elements prior to the great perturbation in this year are determined, and have been already transcribed in NATURE; they present a resemblance to those of the first comet which appeared in 1798, about which year Brorsen's comet might have been in perihelion; Dr. Harzer nevertheless expresses the opinion that, although Messier's observations of the comet of 1798 might be open to some degree of uncertainty, it is doubtful whether they would admit of being represented by an elliptical orbit with a short period. He had found the revolution prior to 1842 to be 5·170 years.

THE NAUTICAL ALMANAC.—The volume of this ephemeris for 1887 has been published during the past week, the contents being generally the same as in previous years. The track of the total solar eclipse of August 19 is given in detail for the greater part of the course, and the maximum duration of totality is found to be 3m. 50s., the central eclipse with the sun on the meridian falling in longitude 102° 0′ E. and latitude 53° 47′ N. The Greenwich list includes four occultations of *Aldebaran* during the year and one of *Regulus*.

The average annual sale of the *Nautical Almanac* during the last five years has exceeded 15,500, though many maritime nations have now their nautical ephemeris.

THE PHILOSOPHICAL SOCIETY OF GLASGOW

THE *Proceedings* for 1882–83, pp. 592, 23 plates, and 3 maps, have just been issued, and contain the following papers:—On insensibility arising from a deficiency of oxygen in the air, by Dr. Wallace, president; on technical education, by David Sandeman and E. M. Dixon, B.Sc.; on the decay of building stones, by Dr. Wallace; on some new infusoria, by William Milne, M.A.; note on Lippmann's capillary electrometer, by Dr. McKendrick; on milk and milk pollution, by Dr. John Dougall; on Struther's process for pulverising diamondiferous ore, by Wallace Fairweather, C.E.; on the use of litmus, methyl orange, phenacetolin, and phenolphthalein as indicators, by R. S. Thomson; on approximative photometric measurements of sun, moon, cloudy sky, and electric and other artificial lights, by Sir William Thomson; on the preservation of food by cold, by J. J. Coleman; on the clauses in the Glasgow Police Bill having reference to the prevention and mitigation of disease, by Dr. Ebenezer Duncan; on the ships and shipping trade of Great Britain, by N. Dunlop; on the iron ore industry of the north of Spain, by J. J. Jenkins; on the use of rosolic acid as an indicator, with additional notes on phenolphthalein and methyl orange, by R. S. Thomson; on architecture in Glasgow, by J. Sellars, jun., I.A.; on the water highways of the interior of Africa, with notes on slave hunting and the means of its suppression, by James Stevenson, F.R.G.S.; on a new seismograph, by Thomas Gray, B.Sc.; on the fertilisation of flowers, by Rev. A. S. Wilson, M.A.; on algin, a substance obtained from some of the commoner species of marine algæ, by E. C. C. Stanford; on chemical industries, by R. R. Tatlock; on nitroglycerine, dynamite, and blasting gelatine, by George McRoberts, manager of the Works of Nobel's Explosives Company; on the action of heat and the chlorides of phosphorus upon the water salts of hypophosphorus, phosphorus, and phosphoric acids, by Dr. Otto Richter; on a volumetric process for the estimation of cobalt and nickel, by Dr. John Clark; and, on the development and generic relations of the corals of the carboniferous system of Scotland, by James Thomson, F.G.S.

The society has at present 19 honorary, 10 corresponding, and nearly 700 ordinary members, and is about to enter on its eighty-first session. In addition to the ordinary meetings of the society, held fortnightly, there are sections for architecture, biology, chemistry, sanitary science and social economics, and geography and ethnology.

RESEARCHES ON SPARK SPECTRA

The Disappearance of Short Lines

IT was shown in a former Report of this Committee (Southampton meeting) that the spectra of metallic solutions were the same as those from metallic electrodes line for line, even short and weak lines being reproduced. The principal difference observable in the two spectra was a lengthening of the short lines when spectra were taken from solutions, so that discontinuous lines became long or continuous lines. A few instances of short lines disappearing have also been noticed, but such disappearances occur only when the lines are so short, mere dots, in fact, that no solution can contain a quantity of the metal sufficient to yield an image of them. Certain very short lines in the spectrum of metallic zinc are an example of this. Very short lines in the spectrum of aluminium were not reproduced by solutions of the chlorides except when the solutions were very strong, and then they always appeared. It may thus be seen that the quantity of metal present in the compound determines the presence of these lines.

The Lengthening of Short Lines.—It was remarked that in certain cases metallic electrodes showed a different spectrum according to whether the spark was passed between dry or wet electrodes. Thus it was pointed out that when iridium electrodes are moistened with calcic chloride, discontinuous lines which are very numerous in this spectrum become continuous; and on further examination into this matter it has been found that even moistening with water has the same effect. Hence the supposition, of which there seemed some possibility but no proof, that a chloride of the metal was formed is found to be untenable. The very short lines in the spectrum of zinc were lengthened by the action of water upon the electrodes. It has now been proved beyond doubt that this peculiar variation in the spectra is caused by the cooling action of the water upon the negative electrode, which in effect is the same as a strengthening of the spark, since by heating the electrodes a reverse action is the result.

Alterations in the Spectrum of Carbon.—As already stated in the previous Reports, graphite electrodes have been generally employed for the production of spark spectra from solutions. A portion of the work in connection with this subject included an investigation of the effect of water and of saline solutions in varying the spectrum of carbon. It will of course be readily understood that as carbon is capable of combining with oxygen and nitrogen, that different spectra might be obtained by making one or other of these gases the atmosphere surrounding the electrodes, but it is not so easy to explain why graphite points should give two different spectra in air when dry, and a third spectrum, again different, when moist, the same spark conditions being maintained.

Three such spectra have been photographed, but without the aid of maps their peculiarities are not capable of exact description. The maps which were drawn were presented to the Royal Society, together with a communication on this subject, three months since, so that they are not at present available. It may be said, however, that the difference between the two spectra taken from dry electrodes in air consists of the omission of a certain number of the less refrangible lines, which lines have undoubtedly been identified with carbon.

Spectra of the Non-Metallic Constituents of Salts.—A long series of experiments has been made with the object of determining the non-metallic elements which are capable of yielding spark spectra when in combination with the metals. Fluorides, chlorides, bromides, iodides, sulphides, nitrates, sulphates, selenates, phosphates, carbonates, and cyanides yield nothing. On the other hand, hydrochloric acid solutions of arsenites and antimoniates yield the spectra of arsenic and antimony. Borates and silicates in solution yield very characteristic spectra of the non-metallic constituents, but if the solutions be prepared from sodium salts the lines of the metal do not appear in the case of borates, and only the strongest sodium line ($\lambda = 3301$) can be observed in the spectra of silicates, even when concentrated solutions are used.

Line Spectra

BORON Wave-lengths	SILICON Wave-lengths
3450·1	2881·0
2497·0	2631·4
2496·2	2541·0
	2528·1
	2523·5
	2518·5
	2515·5
	2513·7
	2506·3
	2435·5

These are the first spectra of boron and silicon obtained from metallic salts.

[1] Report of the Committee on the Comparison of the Spark Spectra of the Elements with Spectra of Solutions of their Compounds, drawn up by Prof. W. N. Hartley.

In Messrs. Liveing and Dewar's map of the carbon spectrum (*Proc. Roy. Soc.* vol. xxxiii. p. 403), and in the list of the carbon lines and in the map of the iron spectrum (*Phil. Trans.* part 1, 1883), a number of lines are given which are absent from the photographs of the spectrum of graphite published in the *Transactions of the Royal Dublin Society* and in the *Journal of the Chemical Society* (vol. xli. p. 90). Many hundreds of spectra taken between graphite poles have failed to show a trace of these lines, and as the spectra have been photographed under very various conditions, it is scarcely likely that the lines in question are really carbon lines. They have now been identified in the spectrum of silicon.

Liveing and Dewar's carbon lines: Spark [1]		Arc [2]		Silicon lines (Hartley)
—	...	2881·1	..	2881·0
2541·0	...	—	...	2541·0
2528·2	...	2528·1	...	2528·1
2523·6	...	2523·9	...	2523·5
2518·7	...	2518·8	...	2518·5
2515·8	...	2515·8	...	2515·5
2514·0	...	2514·1	...	2513·7
2506·3	...	2506·6	...	2506·3
		2478·3	...	—
		2434·8	...	2435·5

From this it appears that, in the spectrum of the arc, carbon yields but one line in the ultra-violet, wave-length 2478·3. It is perhaps a little doubtful whether the line with wave-length 2434·8 is due to silicon or not.

The Spectrum of Beryllium.—The researches made for the purpose of this report have been useful in furnishing evidence leading to a determination of the probable position of beryllium among the elements. It has been proved that the spectra of metallic solutions are identical with those of the metals themselves, and it is therefore obvious that characteristic spectra may be obtained from concentrated solutions of nitrates or chlorides when metallic electrodes are not procurable.

It was resolved to photograph the spectrum of beryllium, as obtained from its chloride, in order to observe the character of its lines and the manner of their grouping. The following were the lines observed :—

Spectrum of Beryllium

Wave-length		Description
3320·1	... ...	Strong, sharp.
3129·9	... ...	Very strong, extended.
2649·4	... ...	Strong, sharp.
2493·2	... ...	,, ,,
2477·7	... ...	,, ,,

The first two numbers differ slightly from those given in the *Journal of the Chemical Society* (June, 1883), but they are believed to be the more accurate. The previous measurements of the lines of beryllium were two given by Thalén (Watts's "Index of Spectra"), with wave-lengths 4487 and 4575, and two lines very close together given in Cornu's "Map of the Solar Spectrum," wave-lengths 3130 and 3130·4. It will be observed that in the spark spectrum only one line corresponding to the first of these is observed, viz. 3129·9. There is probably a difference in this case between the arc and the spark spectra, because there is no difficulty in distinguishing between two lines differing by 0·4 of a tenth-metre, and under various conditions two lines have never been observed at this point in the spark spectrum. On the other hand, such differences are by no means unusual.

Regarding the views held by Emerson Reynolds, Nilson and Pettersson, and Brauner on the subject of beryllium, however wanting in harmony they may be in detail, they at least agree in assigning a value not greater than 13·8 and not less than 9·2 to its atomic weight. The former number implies that the metal is a triad, the latter that it is a dyad. In the former case it must belong either to the series of elements of which aluminium, gallium, and indium are members, or to a sub-group of rare earth-metals, to which yttrium and scandium belong. In attempting to accommodate the element with a position in either series we are met by a serious difficulty, namely, that not only is the atomic weight out of keeping with the periodic law (a point which cannot be discussed here), but its spectrum is altogether different from the spectra typical of either class.

There is a periodic variation in the spectra of the elements as well as in their atomic weights and chemical properties, and we cannot put the periodic law out of mind in considering the position of beryllium.

[1] *Proc. Roy. Soc.* [2] *Phil. Trans.*

Now the spectra typical of the triad group, of which aluminium and indium are the first and third terms, consist of three pairs of lines harmonically related, the intervals between the individuals of each pair increasing with increased refrangibility of the rays in each spectrum, while the intervals between the individuals in each pair in different spectra increase with the increase of atomic weight. The interval between each pair of lines contains an isolated ray. As the atomic weight of beryllium is less than that of aluminium, it should have a spectrum in which the same grouping appears, but the intervals between the pairs of lines should be shorter, and the individuals of each pair should be closer together.

The lines of beryllium are not characteristically grouped like those of aluminium and indium; it cannot therefore belong to this series of elements. If we attempt to classify beryllium in a manner which accords with Nilson and Pettersson's views (*Proc. Roy. Soc.*, 1880, vol. xxxi. p. 37), the elements scandium and yttrium, with atomic weights 44 and 89 respectively, must yield spectra typical of the series, and the similarity between the spectra of the two metals, beryllium and scandium, must be exceedingly close. Now Thalén's spectra of scandium and yttrium, though both totally unlike the spectra of any other element, have many characters in common (*Kongl. Svenska Akademicus Handlingar*, vol. xii. p. 4, and *Comptes Rendus*, vol. xci. p. 45); both spectra contain highly characteristic groups of lines in the orange and yellow, the lines or bands degrading towards the red, and the number of lines which have been measured are no fewer than 103 and 90 respectively.

From these two spectra that of beryllium is entirely different, as well in the character and grouping as in the number of the lines. Of the remaining rare earth-metals at present known, cerium is a tetrad, didymium is a pentad, and lanthanum a triad; their spectra are quite dissimilar from that of beryllium. In consideration of these facts it is impossible to classify the spectrum of beryllium along with the spectra of the rare earth-metals of the triad group.

Let us now consider the question of the dyad groups. On the assumption that beryllium has an atomic weight of 9·2, there is no difficulty in placing it at the head of the second series, in which position it stands in the same relation to the sub-groups Mg, Zn, Cd, and Ca, Sr, Ba, that Li occupies with regard to Na, K, Rb, Cs, and Cu, Ag, Hg. Its position will also be similar to that of B and of C in their relation to the triad and tetrad metals. The spectra belonging to Mg, Zn, Cd, have a very definite constitution; they consist of (1) a single line, (2) a pair of lines, (3) three to four groups of triplets, (4) a quadruple group, and (5) a quintuple group of lines. The intervals between the individual lines in their different groupings increase with the increase in the atomic weights of the elements. In fact these spectra present a considerable addition to the body of evidence in support of the view that elements whose atomic weights differ by an approximately constant quantity, and whose chemical character is similar, are truly homologous bodies, or, in other words, are the same kind of matter in different states of condensation (*Journal of the Chemical Society*, September, 1883, p. 390, *Trans.*). Their particles are vibrating in the same manner, but with different velocities. In the spectra of the metals Ca, Sr, Ba, successive pairs of lines are a strong feature, in addition to which there are some other groups in the spectrum of barium. The individuals of each pair are separated by smaller intervals the more refrangible the lines, and by larger intervals the higher the atomic weights. It cannot be said that the spectrum of beryllium is precisely similar in constitution to either of these groups of elements.

There is some slight resemblance in character to the spectrum typical of the calcium group, beryllium having two pairs of lines, the individuals of the first or less refrangible pair being separated by a greater interval than those of the second pair. It is a spectrum analogous to that of lithium, hence it was concluded that beryllium is the first member of a dyad series of elements to which probably calcium, strontium, and barium are more strictly homologous than magnesium, &c. It is to be understood that this is a conclusion drawn from one point of view only, and is open to correction or modification when fresh facts shall have been discovered, but so far the classification of beryllium among the dyads is confirmed and maintained by its position being in harmony with these spectrum observations. The metal is shown to be quite out of place among the triad elements.

SPLENIC FEVER IN THE ARGENTINE REPUBLIC[1]

THE author stated that he did not think any one who had worked much on the subject of splenic fever could doubt that the bacilli which caused that disease were capable of considerable variation in their effects on animals and man. Whether this disease, which is without doubt the one which has been most thoroughly investigated of all zymotic affections, gave any support to the views of Dr. Carpenter was another matter, but there could be no doubt that the *Bacillus anthracis* can be so modified by artificial means that the disease which it produces when introduced into animals, such as sheep and cattle, varies considerably as to duration, amount of fever produced, as well as to its mortality.

That, on the other hand, this bacillus has at least a very strong tendency to retain the characters which it at present presents in Europe is shown by the fact that in the Argentine Republic,—into which the affection was introduced at least thirty years ago, and where the conditions are very different from those which exist in Europe,—we find that the minute organism retains its characteristic form and the properties with which we are so well acquainted in Europe, and that the disease which it produces is practically identical with the European disease. That it should vary in some particulars is perhaps only to be expected, but Dr. Roy preferred leaving that point to be treated of elsewhere and occupying the time at his disposal with an account of the observations which he had made as to the means of protecting from the disease by means of inoculation.

Some six months ago he had been requested by a City company who possess a large tract of land in the Argentine Republic, to pay a visit to their property in order to investigate a disease which was causing much mortality amongst the cattle, sheep, and horses, and which was affecting the *employés* as well to a very serious extent. This disease, he found on arriving at the River Plate, was splenic fever, of which the absence of efficient veterinary surgeons and the general apathy of the owners of stock had prevented the recognition. Having spent some time in studying the characters of the disease, he proceeded to make observations on the best means of protecting the stock by means of inoculation, which work was much facilitated by the liberality of the company (the "Las Cabezas Estancia Company") who gave him "carte blanche" as to the number of animals which he might employ for his experiments. Having previously found, in a small series of observations made in this country in conjunction with Dr. E. Klein, that splenic fever virus from white mice was of the proper strength to protect sheep from the disease, he proceeded in the same lines, employing such animals as were available to produce the inoculating fluid. After a number of animals had been tried, he found that the blood of *Biscachas* (prairie dog) which had died of the disease gave satisfactory results when used to inoculate cattle and horses. It was, however, a little two powerful, as 1 or 2 per cent. of the cattle so inoculated died. The pecuniary loss entailed by this was, however, more than counterbalanced by the arrest of the mortality from the natural affection. With regard to sheep, greater difficulties were encountered, and no animals were found giving a virus sufficiently mitigated to cause only a slight form of the disease with subsequent protection. Unfortunately it was impossible to repeat on a large scale the successful experiments which Dr. Roy and Dr. Klein had made with virus from white mice, these animals not being obtainable. Virus from field-mice and rats did not prove satisfactory.

Under these circumstances the speaker then proceeded to investigate the results obtained by artificial mitigation of the bacilli in the laboratory. He first employed the method of Toussaint, which consists in warming the fluid containing the pathogenic organisms to a temperature of 55° C. for a period varying from a half hour to one hour and a half. It was found possible by this means to diminish the strength of the virus so that it took longer to kill, and by graduating the duration of the heating it is not difficult to obtain a virus which will only kill a small percentage of the animals inoculated. But unfortunately, in weakening the virulence of the organised poison, this process weakens also its power of protecting from a second attack, and it was easy to kill the animals so inoculated by subsequently introducing into their system strong virus which had not been subjected to heat. This method having failed, Dr. Roy proceeded to Buenos Ayres, where, in the laboratory of the "Collegia Nacional," which was kindly placed at his disposal, he manipulated the virus by the method of Pasteur, which consists in cultivating the virus in sterilised chicken broth at a temperature of 42°—43° C. At this temperature the bacilli grow much les readily than at one more nearly approaching blood heat. The bacilli so cultivated diminish in virulence day by day, and after being cultivated for six or eight days no longer caused the death of full-grown sheep, although they still killed lambs and prairie dogs.

Careful experiments with inoculating fluid prepared in this manner showed that with it a slight fever could be induced which suffices to protect, at least for some time, from a second attack of the disease. The same objection, however, which characterises the inoculating fluid prepared by Toussaint's method exists, though to a less extent, with regard to Pasteur's fluid; in the case of the latter as well as the first named, the protecting power is seriously diminished at the same time that the virulence of the bacilli (as indicated by the mortality) is lessened. With care it is possible, however, to prepare a liquid which, while its virulence has been brought sufficiently below the lethal limit to insure that none of the inoculated animals succumb to the inoculation, still retains enough protecting power to enable the sheep to resist the effects of strong virus employed some ten to fifteen days after the first inoculation. Dr. Roy was, therefore, able to confirm the assertions of M. Pasteur regarding the attributes of his inoculating fluid in so far that it is possible effectually to protect sheep from anthrax by its use. Still, it was impossible to overlook the fact that its employment necessitated very careful graduation of the strength of the mitigated virus to the resisting power of the animals inoculated. The speaker did not think that the method was one which was likely to be adopted universally, and he rather looked forward to the general acceptation of some inoculating fluid which had been mitigated by cultivation in the bodies of some animal distinct in species from that which it was desired to protect. In the case of cattle the virus taken from *Biscachas* seemed to protect in all cases, whether the illness produced by the inoculation was mild or severe. It was to be hoped that more extended inquiries would confirm the favourable results obtained by employing the virus from white mice to protect sheep. The speaker stated that he proposed communicating the results of his observations on this subject to the Royal Society at an early date.

[1] Abstract of a paper read at the British Association by Dr. C. S. Roy.

SUGGESTIONS FOR FACILITATING THE USE OF A DELICATE BALANCE

IN some experiments with which I have lately been occupied, a coil of insulated wire, traversed by an electric current, was suspended in the balance, and it was a matter of necessity to be able quickly to check the oscillations of the beam, so as to bring the coil into a standard position corresponding to the zero of the pointer. A very simple addition to the apparatus allowed this to be done. The current from a Leclanché cell is led into an auxiliary coil of wire coaxial with the other, and is controlled by a key. When the contact is made, a vertical force acts upon the suspended coil, but ceases as soon as the contact is broken. After a little practice, the beam may be brought to rest at zero at the first or second application of the retarding force.

This control over the oscillations has been found so convenient that I have applied a similar contrivance in the case of ordinary weighings, and my object in the present note is to induce chemists and others experienced in such operations to give it a trial. Two magnets of steel wire, three or four inches long, are attached vertically to the scale pans, and underneath one of them is fixed a coil of insulated wire of perhaps fifty or one hundred turns, and of four or five inches in diameter. The best place for the coil is immediately underneath the bottom of the balance case. It is then pretty near the lower pole of the magnet, and is yet out of the way. The circuit is completed through a Leclanché cell and a common spring contact key, placed in any convenient position. The only precaution required is not to bring other magnets into the neighbourhood of the balance, or, at any rate, not to move them during a set of weighings.

The other point as to which I wish to make a suggestion relates to the time of vibration of the beam. I think that with the view of obtaining a high degree of sensitiveness the vibrations are often made too slow. Now the limit of accuracy depends more upon the smallness of the force which can be relied upon

[1] Paper read at the British Association by Lord Rayleigh, F.R.S.

to displace the beam in a definite manner, than upon the magnitude of the displacement so produced. As in other instruments whose operation depends upon similar principles, *e.g.* galvanometers, it is useless to endeavour to increase the sensitiveness by too near an approach to instability, because the effect of casual disturbances is augmented in the same proportion as that of the forces to be estimated. If the time of vibration be halved, the displacement due to a small excess of weight is indeed reduced in the ratio of four to one, but it is not necessarily rendered any more uncertain. The mere diminution in the amount of displacement may be compensated by lengthening the pointer, or by optical magnification of its motions. By the method of mirror reading such magnification may be pushed to almost any extent, but I am dealing at present only with arrangements adapted for ordinary use.

In the balance (by Oertling) that I am now using, the scale divisions are finer than usual, and the motion of the pointer is magnified four or five times without the slightest inconvenience by a lens fixed in the proper position. The pointer being in the same plane as the scale divisions, there is no sensible parallax. In this way the advantage of quick vibrations is combined with easy visibility of the motion due to the smallest weights appreciable by the balance.

To illuminate the scale, the image of a small and distant gas flame is thrown upon it by means of a large plate-glass lens. This artificial illumination is found to be very convenient, as the instrument stands at some distance from a window, but it is not at all called for in consequence of the use of the magnifying lens.

ON THE DEVELOPMENT OF PERIPATUS[1]

AMONG the acquisitions I made during my journey to the West India Island of Trinidad, a rich collection of Peripatus stands in the first rank. This has put me in a position to correct many mistakes, and to contribute a good deal to the knowledge of the histological anatomy of this interesting animal form, as well as especially to follow the process of development from beginning to end. Postponing for the present the anatomy of the adult animal, inasmuch as we have on this subject a good many studies, some of which are very good (for instance, that of Gaffron in *Zool. Beiträge*, edited by Dr. A. Schneider), I shall confine myself to a preliminary notice of the earliest stages of the development of Peripatus, although my investigations have not as yet been brought to a conclusion, nor have I been able to devote any attention to the development of the organs. I do this chiefly because the treatise published by Moseley and Sedgwick from the posthumous notes of Balfour contains some representations of embryos and cross-sections of the same, upon whose accuracy in details I, with my rich and well preserved collection of specimens, and observations on fresh objects, must cast some doubt, and the interpretation of which does not bear investigation. And yet these already serve as evidence for some theoretical explanations of embryonic processes in other groups of animals, which it would be well to avoid in such a case.

I collected in Trinidad over a hundred specimens of *Peripatus Edwardsii*, and a small number of a new species which is distinguished by its size from all those hitherto known, and which may briefly be thus characterised: The females, which are considerably larger than the males, attain a length of 15 cm. and a diameter of 8 mm.; the males grow to a size of about 10 cm. Their colour is a plain reddish brown above, darkening a little towards the middle line of the back, and growing pale a little towards the sides. The head, or, more correctly, the forehead, as well as the antennæ, is black, and marked off on the dorsal side by a light yellow necklace, which is often slightly interrupted in the middle, from the rest of the body. The under side is of a dark flesh colour. This species is especially characterised by possessing forty-one to forty-two pairs of feet, which is the highest recorded number, and a number which differs greatly from that of all other species. I call this new species *Peripatus torquatus*.

The ovaries are two small, elongated bodies, which are generally united along their whole length, and so appear as a narrow, spindle-shaped body, which is connected by one or often by two delicate muscular threads to the body wall. The ovaries are prolonged into the two horns of the uterus, which, each forming a bow with several curves, unite immediately before reaching the genital pore to form a very short vagina. At the point where the ovaries pass over into the uterus is situated a small, nipple-shaped gland and a spherical receptaculum seminis, the orifice of which every egg has to pass before it can enter the uterus. Now as a large number of embryos, from the "just furrowed" egg to the matured young, are always found in the uterus, it is very probable that each female Peripatus is only fertilised once.

[1] Translated from a notice, by Dr. J. von Kennel of Würzburg, in the *Zoologischer Anzeiger* for October 8, 1883.

The eggs of Peripatus contain no yolk, and seeing that in spite of this an animal of half the length that it attains when adult develops itself in the uterus out of a small egg whose diameter is about 0·04 mm., there must be some quite peculiar means for its nutrition, and this is the case to the most astonishing extent and in the most surprising manner.

As soon as the fertilised egg enters the thin portion of the uterus, a small enlargement takes place in its lumen, which is very narrow and is surrounded with very deep cylinder epithelia. Simultaneously with this the epithelium cells mass themselves a little together; the furrowed egg settles upon the epithelium, and immediately the lumen widens a good deal by the epithelial cells of the uterus becoming very depressed at that spot; so flattened do they become that they form a very thin pavement-epithelium, whereas before and behind the "breeding-nidus" (*Bruthöle*) an embankment is formed by the thickening of the connective tissue of the uterine walls, so as nearly to fill up the uterine canal.

In this stage we find a hemispherical mass of homologous cells attached by a broad basis to the extraordinarily thin lining of the uterine cavity, a lining which has been formed out of the two cells that originally surrounded the egg. Presently a small depression develops in this hemispherical mass, and now the embryo forms something like the half of a hollow sphere, still consisting of but a few cells. Through the multiplication of these the hemisphere and the cavity in it become a little larger, and now a difference is perceptible between the cells of the embryo which are situated immediately upon the uterine epithelium and the rest. The former, which I shall for brevity's sake here call basal cells, have a long, narrow, and very compact nucleus, whereas the others have a large, circular, granular nucleus. The basal cells multiply, and in doing so close the opening of the hemisphere, and form a layer which, lying between the embryo and the uterine epithelium, fastens the former to the latter. In the meantime the cells of the hemispherical mass have also multiplied to such a degree that the side looking towards the lumen of the uterus appears thickened by the cells mutually displacing each other.

In this stage the whole condition of the embryo resembles that of a flattened hollow sphere whose free wall has been thickened; the longer diameter is 0·09 mm., and the lesser 0·07mm. The basal cells of the embryo now spread themselves out a little, a few isolated ones come out from under the embryo, and thus enlarge the basis of attachment—they form an *embryonic placenta*. From them is also developed a very delicate membrane, which becomes closely applied to the uterine epithelium, and envelops the embryo—it may be shortly designated as *amnion*.

In the meanwhile changes are also going on in the uterus; the epithelium of the "breeding-nidus" has become a little thicker, the nuclei have increased in number, and a number of small dark brown pigment granules have developed and collected in the protoplasm of the flat cells, which for a long time mark off sharply the uterine epithelium from the embryonic portions.

The basal cells now multiply to a remarkable extent, partly so as to increase the size of the placenta, and partly in a direction perpendicular to it, forming a solid stalk upon which the embryo is pushed out free into the lumen of the "breeding-nidus." The whole now forms a pyriform mass; the little head of the pear, the actual embryo, is, however, now no longer hollow; cells have been thrust in from the side furthest away from the stalk, which have filled up the whole "furrow cavity"; a sharp limit, however, is visible between them and the ectoderm at every point except the place where they have been invaginated; this point, which is comparable to the blastopore of other embryos, persists for a long time as the spot where material for the inner germinal layers is being continually provided by invagination, and is still demonstrable in embryos in which the form of Peripatus has long since been recognisable.

As soon as the "furrow cavity" has been filled up in the manner that has been described, a new cavity develops by fission in the central mass of cells. This is the definite visceral cavity. It develops by the embryo becoming composed of two layers (ectoderm and entoderm) in the half that is nearest to the stalk, whereas a thick prominence in which no differentiation can be made out, lies on the side furthest from the stalk. One must, however, regard its innermost cell layer as belonging to the entoderm, which also is continued into it.

While these changes have been taking place in the embryo, the "breeding-nidus" has increased considerably in size, the uterine epithelium has become thicker, and consists of a finely granular mass of protoplasm in which large round nuclei are found, and often lie in several layers one on top of another; cell boundaries are no longer recognisable, and the pigment granules, which are disappearing, still form a narrow border towards the lumen of the uterus. Before and behind the breeding-nidus is almost altogether closed by great thickenings of the uterine walls. In the region of the breeding-nidus, however, there is a fissure in the connective tissue wall of the uterus which is probably a blood space.

The next stage in the development of the embryo may be shortly characterised as the mushroom form; the embryo becomes more clearly marked off from its stalk, and expands in all directions, but most of all in the direction of the longitudinal axis of the uterus, and now for the first time a bilateral symmetry can with certainty be made out; the whole embryo resembles a mushroom with a thick stalk; the pileus is oval, as seen from above, and is a little broader at one end than at the other, and on the surface, towards the narrower end, is to be seen a shallow depression, which is limited towards the broader end by a slight prominence. This depression corresponds to the spot where the meso- and entoderms have been invaginated. There is as yet no opening to connect the visceral cavity with the outer world. The broader end of the embryo is the head end, the stalk side the back, the surface that projects into the lumen of the uterus the future ventral surface. In this stage a multiple layer of cells has already freed itself from the ectoderm, in front of the place where the invagination took place, and it lies, passing over behind into the undifferentiated cell-mass, between the ecto- and entoderm, but is marked off from both of them by a distinct boundary.

Now while the embryo increases in length, more and more cells press in from the ectoderm at the spot that has been indicated, and specialise themselves towards the front into a real mesoderm, which, however, at first, and for a long time afterwards, occupies only the ventral aspect and also the lateral regions between ectoderm and entoderm, where it of course multiplies independently.

In the meanwhile the thickening of the uterine epithelium has gone on; it now forms a ring, which surrounds three-quarters of the circumference of the breeding-nidus, and which as a broad zone divides the breeding-nidus into two halves, where, by the way, the epithelium has been thickened to a considerable though a less degree; the pigment granules have now disappeared, the placenta has become very large, and the amnion, which has attained a high degree of development, and which consists of numerous large cells with large nuclei, lies closely applied to the uterine epithelium.

It is only when the embryo has still further increased in length, the part posterior to the stalk increasing very quickly in size, that the anus and mouth are formed, but not from a common opening, the blastopore of Balfour. The anus develops as a small fissure in the median line upon the prominence in front of the spot where the invagination has taken place; but the mouth develops far further forwards as an invagination of the ectoderm, consisting of only very few cells. This invagination has an inclination obliquely from behind forwards as it proceeds, and reaches the intestine, dividing its epithelium at the point of junction. This mouth invagination has as yet no lumen; this makes its appearance later, when the embryo already shows its segmentation plainly.

The first trace of this segmentation is the appearance of a cavity on each side in the oldest portions of the mesoderm, *i.e.* in the anterior extremity of the embryo, which splits the mesoderm plates into an inner membrane adjoining the intestine, and an outer one adjoining the ectoderm. These, however, are still connected to each other dorsally and ventrally. Soon afterwards a second pair of similar cavities develops behind, and so on from before backwards. These cavities that appear in segments, and which in their appearance closely resemble the original segmental formation of a vertebrate animal, are the first rudiments of the body cavity. The different structures that develop out of its walls cannot be made out till later. With the exception of the further growth of the posterior end of the embryo, which soon curves itself, rolls itself up spirally, and finally forms manifold loops, and of the progress of the segmentation, and of the corresponding formation of cavities in the mesoderm, no changes take place in the interior of the embryo. Embryos of *P. Edwardsii* of 1–1·5 mm. length always present the same appearance on cross-section: an ectoderm slightly thickened on the ventral aspect, an extraordinarily thin entoderm, and between them on each side a pocket of mesoderm, whose walls touch each other in the ventral median line, and which in well-preserved embryos always are closely applied to the ectoderm, as well as to the entoderm, but which always present a sharply-defined boundary line. The anus is still nothing more than a narrow longitudinal fissure; the mouth has at last opened. Behind the anus is situated the depression, with the place where invagination has taken place.

Externally, on the other hand, a distinct segmentation of the body has taken place corresponding to the cavities in the mesoderm; the anterior segment (head segment) exceeds all the others in size; it consists of two symmetrical, spherical halves, to which the other segments are connected posteriorly; the ventral aspect of the head segment contains the mouth opening. I remark here that the mouth and anal opening that have been mentioned must be regarded as primary in Peripatus; the latter closes at a later stage to make room for a later-developing structure, and the former is thrust in further by a new invagination of the ectoderm, and becomes converted into the œsophageal opening of the intestine. (These two observations require to be checked, and I shall have to do so by examining other embryos.) Each segment carries on each side a prominence which is the rudiment of the limbs that are developed later. The first pair of limbs is surrounded by a number of secondary papillæ, and is drawn into a wide mouth cavity to be utilised as a jaw; the second pair gives the papillæ on whose apices the large slime glands afterwards have their orifices. The tentacles are simply dorsal comtinuations or prolongations of both head cavities. Now at last, after the embryo has attained its full complement of segments, the first appearance of the nervous system can be made out as a paired ventral thickening of the ectoderm, which, soon separating itself from the ectoderm, extends in two separate threads from one end of the body to the other, only united by the brain, which has been developed in a similar manner in the head. The embryo itself, until it develops a definite gullet, is intimately connected by its ectoderm, by means of the placenta with the maternal organism, and receives its nutriment through its dorsal stalk, which can be quite properly characterised as a navel-string, and which belongs to the first body segment. As soon, however, as it can swallow by help of its gullet, this connection is loosened, and the embryo now eats the food that is provided by the extraordinarily thickened uterine epithelium, which is rich in protoplasmic materials. At any rate, from that time forward coagulated protoplasm is always to be found in the intestine of the embryo, which was previously always empty.

This is, in a few words, an abstract of the most important results of my investigations up to date, which have been made upon something like a hundred young embryos. I here abstain for the sake of brevity from all discussion, but must, however, call attention to the fact how little Balfour's illustrations and the descriptions of the editors agree with the facts as they are here given. I hope it will not be long before I shall be able to lay before my fellow-workers my investigations, which I hope soon to complete, of these interesting and exceedingly anomalous phenomena of embryonic development, accompanied by numerous illustrations.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—By a mistake last week the stipend of the Professorship of Botany was given as 500*l.* instead of 700*l.* with a residence rent free. An election will take place in the course of Hilary term. The duty of the professor is to lecture and give instruction in botany. He will also have charge and supervision of the Botanical Garden and of the botanical collections belonging to the University; and it will be part of his duty to make such gardens and collections accessible to and available for the instruction of students attending his lectures. Candidates are requested to send to the

Registrar of the University their application, and also any documents which they may wish to submit to the electors, on or before Saturday, January 26, 1884.

The Professorship of Rural Economy—now separated from that of Botany—will be filled up in December. Candidates are requested to send to the Registrar of the University their applications, and any documents they may wish to submit to the electors, on or before Monday, December 10, 1883. According to the regulations sanctioned by the Court of Chancery, the Sibthorpian Professor of Rural Economy shall lecture and give instruction on the scientific principles of agriculture and forestry. He shall be entitled to the emolument of 200*l*. derived from the benefaction of Dr. John Sibthorp, Doctor of Medicine, and assigned to the professorship. The professor holds his office for a period of three years from election, and no longer. He may be re-elected for a second period of three years, and no longer; but no professor shall hold the professorship for more than six years consecutively. The professor will have the use of the garden appropriated for making experiments on the subjects of his professorship. The professor shall give not less than twelve lectures in the course of the academical year, in full term, and not more than two in any one week.

CAMBRIDGE.—The following are the speeches made to the Senate of the University by the Public Orator (Mr. J. E. Sandys) in presenting Professors Foster and Macalister for the complete degree of M.A. *honoris causâ*, on November 8:—

"Dignissime domine, domine procancellarie et tota Academia: In hoc ipso loco, duodecim abhinc annos, unum e Collegii maximi Prælectoribus auspiciis optimis titulo vestro honorifico exornastis. Hodie eundem, tot annorum usu et experientia spectatum probatumque, et Academiæ totius Professoribus merito adscriptum, senatus nostri in ordinem honoris causa adsciscimus. Quantum interim, hujus præsertim laboribus, inter alumnos nostros creverit vigueritque physiologiæ studium, vosmet ipsi omnes animo grato recordamini. Ut animantium in corporibus ex ipso corde, velut e fonte quodam, salutares illi sanguinis rivi per membra omnia fluunt refluuntque; non aliter corporis Academici in partes quam plurimas ex hoc fonte scientiæ flumina effluxisse atque inde rursus redundasse dixerim. Tali e fonte quot alumnis vires novæ redditæ sunt: quotiens ex alumnis rivuli fontem ipsum denuo auxerunt! E discipulis vero tam multis cum magistro tanto feliciter consociatis, plurimos adhuc superesse, nonnullos etiam adesse hodie gaudemus; unum illum non sine lacrimis desideramus qui nascentis vitæ primordiis hujus auxilio sagacissime investigatis, nuper inter Alpium culmina, in ipso ætatis flore, morte immatura e nobis est abreptus. Talium filiorum progenies Matri Almæ indies nova succrescat: magistrorum talium accesionibus et Professorem et Senatorum ordo identidem nobis augeatur!

"Vobis præsento Collegii sacrosanctæ Trinitatis socium, Physiologiæ Professorem illustrem, MICHAELEM FOSTER."

"In Professoribus novis vestro omnium nomine salutandis, fato quodam iniquo successoris laudes decessoris desideria nonnunquam aliquatenus imminui videntur. Hodie vero ornat adhuc Professorum ordinem eloquentissimus ille Anatomiæ Professor quem diu sumus admirati. Integro igitur sinceroque gaudio Professorem illum salvere jubemus, quem Caledonia Hiberniæ quondam donavit, Hibernia Britanniæ nuper reddidit. Salutamus virum qui corporis humani scientiam interiorem, antiquissimum illud atque regium (uti nuper audivimus) scribendi argumentum, quasi propriam provinciam penitus exploravit; qui ne his quidem finibus contentus, sed etiam in alias rerum naturæ regiones egressus, non modo de zoologia et de comparativa quæ dicitur anatomia egregie meritus est, sed geologiæ quoque operam singularem impendit, petrographiæ præsertim recentiores, progressus curiositate minuta perscrutatus. Idem et litterarum amore et linguarum peritia insignis, inter rerum antiquarum monumenta ne hieroglyphica neglexit, neque historiam ecclesiasticam intactam reliquit. Ergo non uni tantum Collegio sed toti Academiæ gratum est, virum tot tantisque animi dotibus instructum, societati illi tam cito esse adscriptum, cui medicinæ studia commendavit olim vir et de litteris antiquis et de scientiis recentioribus præclare meritus, Thomas Linacre.

"Vobis præsento Collegii Divi Johannis socium, Anatomiæ Professorem insignem, ALEXANDRUM MACALISTER."

The allusions to the growth of the physiological school, to the loss of Prof. F. M. Balfour, to Prof. Macalister's inaugural lecture with its happy antiquarian illustrations, and his speedy enrolment as a Fellow of St. John's, were heartily taken up by the members of the Senate and the undergraduates present.

The Special Board for Medicine publish for the guidance of students proceeding to medical and surgical degrees the following schedule defining the range of the examination in elementary biology under the regulations which come into effect on the first day of January, 1884 (Grace, November 15, 1883). The examination in elementary biology will have reference to (1) the fundamental facts and laws of the morphology, histology, physiology, and life-history of plants as illustrated by the following types: *Saccharomyces*, *Protococcus*, *Mucor*, *Spirogyra*, *Chara* or *Nitella*, a fern, *Pinus*, and an angiospermous flowering plant; (2) the fundamental facts and laws of animal morphology, as illustrated by the following types: *Amœba*, *Paramœcium* or *Vorticella*, *Hydra*, *Lumbricus*, *Astacus*, *Anodon*, *Amphioxus*, *Scyllium*, *Rana*, *Lepus*. Under the head of vegetable physiology the student will not be expected to deal with special questions relating to the more highly differentiated flowering plants. He will be expected to show a practical knowledge of the general structure of each of the animal types above specified, and an elementary knowledge of the chief biological laws which the structural phenomena illustrate. He will also be expected to show an elementary knowledge of the general developmental history of *Amphioxus* and of *Rana*. He will not be expected to deal with purely physiological details.

The subject announced for the next Adams Prize to be adjudged in 1885, is as follows: Investigate the laws governing the interaction of cyclones and anticyclones on the earth's surface. In order to give precision to this, the following suggestions are given to the examiners:—An infinite plane has surface density $\frac{g}{2\pi}$ (where g is gravity); on one side of it is air in equilibrium, the density of which must diminish according to the barometric law as we recede from the plane. The system revolves as a rigid body, about an axis perpendicular to the plane, with a constant angular velocity ω. If one or more vortices, with a revolution either consentaneous with ω (cyclones), or adverse thereto (anticyclones), be established in the air, investigate their motions. It may be well to consider the axes of the vortices as either straight or curved, and perpendicular or inclined to the plane. If possible, pass to the case in which the vortices exist in the atmosphere surrounding a rotating globe.

The Rev. H. W. Watson has been approved for the degree of Sc.D.—Prof. Darwin is arranging to give a course of practical teaching in astronomy with the instruments under his charge. Next term Mr. H. H. Turner of Trinity College will undertake this course.—The General Board of Studies, in reissuing its recommendations as to Readers, Demonstrators, &c., has asked that power be given to the Museums and Lecture Rooms Syndicate to obtain plans for a foundry for the Department of Mechanism, for buildings for Botany, and for additional buildings for Comparative Anatomy and Physiology.—It is recommended that a Curator of the Museum of General and Local Archæology be appointed, at a salary of 100*l*. per annum.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, vol. cxvi. No. 694, October, 1883.—The commercial and dynamic efficiencies of steam-engines, by Prof. R. H. Thurston. In this paper there are calculated the ratio of expansion to furnish power most economically, the maximum efficiency of a given plant, and maximum efficiency of fluid, when such data are taken into account, as total annual cost of steam, and total annual cost of all items variable with size of steam-cylinder.—Mr. R. Grimshaw, in a paper on the steam-engine indicator as a detector of lost motion, describes the use of the indicator to pick out defective setting of cranks, cross-heads, &c.—The next three articles are on the water supply of cities in ancient times, on oil-dressed belting, and a report on the pressure-governed gas-meter and burner.—The address by Prof. Rowland, entitled "A Plea for Pure Science," lately reprinted in NATURE, is also reproduced *in extenso*.

Annalen der Physik und Chemie, xxii. No. 10, contains a long memoir by Professors Sohncke and Wangerin on interference phenomena obtained with thin and especially with wedge-shaped laminæ. The article will be continued in the next number.—On the changes of volume of metals and alloys on melting, by Prof. Eilhard Wiedemann. The metals were cast in thin rods, then dropped into a nearly-fitting glass tube, ending into a capillary. The wide end was sealed, and a dilatometric fluid such as oil introduced. The conclusions arrived at are that tin, soft solder, and probably also lead, expand on melting; but bismuth contracts. Many observations were made on alloys of bismuth and lead.—On the liquefaction of oxygen, nitrogen, and carbonic oxide, by S. von Wroblewski and C. Olszewski. Intense cold was obtained by evaporation, under reduced pressure, of liquefied ethylene in an apparatus modified from that of Cailletet. Temperatures were measured by a hydrogen pressure-thermometer. Oxygen proved to be liquefiable at temperatures varying from $-129°\cdot6$ to $-135°\cdot8$ C., under pressures varying from 27·02 to 22·2 atmospheres. The liquefaction of nitrogen and of carbonic oxide proved more difficult, and was not accomplished at a temperature of $-136°$ C., even under a pressure of 150 atmospheres, though a sudden release of pressure produced a temporary mist of condensed spherules, and a slower release of pressure yielded a deposit of liquid with a distinct meniscus. Liquefied nitrogen and liquefied carbonic oxide are both colourless and transparent.—On the internal friction of certain solutions, and on the viscosity of water at different temperatures, by K. F. Slotte. The results confirm those previously obtained by Rosencrantz and Poiseulle.—On a lecture apparatus for demonstrating Poiseulle's law, by W. C. Röntgen.—On the deduction of the crystal systems from the theory of elasticity, by H. Aron; a mathematical discussion of the possible cases arising from the position of planes of symmetry, proving that no others than the recognised six systems of crystals can exist.—On the properties of benzine as an insulator and as a substance exhibiting electric reaction, by H. Hertz. *Pure* benzine appears to be remarkably good as an insulator and remarkably free from reaction effects.—On the influence of galvanic polarisation on friction, by K. Waitz. Treats of the phenomenon discovered by Edison, and recently examined by K. R. Koch.—On the properties of calc-spar in the homogeneous magnetic field, by Fr. Stenger.—Notes on a photometric apparatus, by Leonhard Weber.—On "the Exhibition of the Treatise on Light" of Ibn al Haitam, by E. Wiedemann.—On the Cologne air-pump of the year 1641, a historical notice by Dr. G. Berthold.—Remarks on the memoir of Herr Christiansen, "Researches on Heat-Conductivity," by A. Winkelmann.

Atti of the Royal Academy dei Lincei, July 12-15, 1883.—Obituary notice of William Spottiswoode.—Two communications from Signor Tacchini on the observations made by him at Caroline Island during the solar eclipse of May 6, 1883.—On the average variation in tension of the atmospheric aqueous vapour according to latitude and elevation in Italy, by A. Lugli.—Meteorological observations at the Royal Observatory of the Campidoglio for the months of June and July.—Most of the present number is occupied with the new reforms and statutes of the Academy, whose constitution has recently been remodelled. There are also long inventories of the works of art, furniture, and fixtures of the Palazzo Corsini, which has been purchased as the future home of the Academy.

Rivista Scientifico Industriale, Florence, September 15-30.—The total eclipse of May 6. Results of the observations of Tacchini, Janssen, and others, in Caroline Island.—Eclipses and terrestrial magnetism, by P. Denza. All connection is denied between eclipses and magnetic phenomena.—On the compressibility of water, by S. Pagliani and G. Vicentini.—A new electrodynamometer, by Prof. Bellati.—On the deformation detected by Gouy in polarised electrodes, by A. Volta.—An improved reversible magnetico-electric machine, by M. Delaurier.—Anatomical description of two extremely rare birds (*Somateria mollissima* and *Phalaropus fulicarius*) preserved in the Civic Museum of Venice, by P. A. Ninni.—On the fossil vertebrates of the Miocene formations in the Venetian Alps, by Baron Achille de Zigno.—On the fossil gastropods, cephalopods, and corals of the lower titonic formations of Sicily, by Dr. G. de Stefano.

SOCIETIES AND ACADEMIES

London

Chemical Society, November 15.—Dr. Perkin, F.R.S., president, in the chair.—It was announced that a ballot would take place at the next meeting (Dec. 6).—The following papers were read:—On the estimation of starch, by C. O'Sullivan. The method may be briefly described as follows:—About five grms. of the finely ground grain are successively extracted with ether, alcohol (sp. gr. 0·90), and water at 35° to 38°. Fat, sugar, albuminoids, amylams, &c., are thus got rid of. The starch in the washed residue is gelatinised by boiling with water, cooled to 62°, about 0·03 grm. diatase (prepared by precipitating a cold, aqueous extract of malt with alcohol) added; the starch is thus converted entirely into maltose and dextrin, and by a quantitative determination of these two products the starch originally present can be calculated. The author states, as the result of his experience with the method, that the difference in results obtained by any two observers need not exceed 0·5 per cent. of the total starch.—On the illuminating power of ethylene when burnt with non-luminous combustible gases, by P. F. Frankland. The author summarises his results as follows:—Pure ethylene burnt at the rate of five cubic feet per hour from a Referees Argand burner, emits a light of 68·5 standard candles; the illuminating power of equal volumes of mixtures of ethylene with either hydrogen, carbon monoxide, or marsh gas is less than that of pure ethylene; when such mixtures contain 60 per cent. of ethylene or more, the illuminating power of the mixture is but slightly affected by the nature of the diluent; in mixtures containing less than 60 per cent. of ethylene, the illuminating power is the highest when marsh gas, and lowest when carbon monoxide, is the diluent.—On the products of decomposition of aqueous solutions of ammonium nitrite, by G. S. Johnson. The nitrogen evolved from alkaline solutions of ammonium nitrite contains no oxides of nitrogen; nitrogen is evolved from aqueous solutions below 100°; by adding crystallised cupric chloride, a continuous evolution of pure nitrogen takes place in the cold. When solutions are acid, the nitrogen may contain 4 per cent. of nitric oxide. About 2 per cent. of the nitrogen evolved by the cupric chloride is stated by the author to possess peculiarly active properties, and forms ammonia when passed with hydrogen over spongy platinum.—On the estimation of iron by standard potassium bichromate, by E. B. Schmidt. The author recommends the above process, but states that zinc should not be used to reduce the iron, as it interferes with the end reaction with potassium ferricyanide. He prefers Kessler's method of reduction with stannous chloride.

Western Microscopical Club, November 5.—Mr. W. Crookes gave a lecture on "Recent Discoveries in High Vacua." He illustrated his theme with a series of brilliant and interesting experiments. The effects were produced by a large electric coil, having sixty miles of secondary wire, and worked by two cells of a storage-battery. The coil, when attached to its full complement of thirty cells, would give a spark in air of twenty-four inches. "High vacua" were defined as those ranging from above the 1/1000 to the 1/100,000,000 of an atmosphere. Air and all gases are conceived to consist of myriads of excessively minute molecules, which in the ordinary state vibrate with enormous velocity; but being crowded together in that condition their extent of vibration is impeded by each other, and is, in fact, limited to a path of only 1/10,000 of a millimetre. When, as in a partial vacuum, there are fewer of these molecules, they have more room in which to vibrate, and hence their "mean length of path" is increased. Under the influence of electricity these molecules are driven in straight lines from the negative pole. In a comparatively low vacuum, on the passage of an electric current, the residual air assumes a stratified condition, showing alternate light and dark bands. The width of the dark bands marks the length of the excursions of the molecules. Further exhaustion increases the width of these bands, so that in a vacuum of 1/1,000,000 of an atmosphere the free path of the molecules was seen to extend to about four inches. By means of an exhausted V-shaped tube it was shown that these molecules are driven from the negative pole in straight lines, and hence cannot turn a corner. First one limb of the V, then the other, was connected with the negative pole of the coil, with the result that each in turn was in darkness. In another vacuum-tube a concave negative pole was fixed; the molecules were driven normally from this concave surface, and, meeting the cylindrical surface of the glass inclosure, were thrown into beautiful caustic curves. That these molecules, under the influence of electricity, possessed mechanical force was shown by causing them to impinge on the vanes of a radiometer, when a rapid rotation took place. On reversing the current, the direction of rotation was also reversed. That this was not due merely to the passage of an electric current was shown by a vacuum-tube containing a small, horizontal "water-wheel." Its upper and lower floats being struck equally by the radiant matter, no motion took place; but on diverting the flow of radiant molecules by means of the external application of a magnet, the molecules were caused to strike the upper floats only, when revolution took place. By reversing the magnet, the path of the molecules was diverted so as to strike the lower floats, and thus to reverse the rotation. Radiant molecules are not attracted by one pole of a magnet and repelled by the other, but tend to rotate round the north pole in one direction and round the south pole in the opposite direction. Hence, with a horseshoe magnet, they are deflected in a line at right angles to the line that joins the two poles. The mechanical effect of the impact of these radiant molecules was further shown by converging them by means of a concave negative pole to a focus in which was a small bundle of platinum wires. These wires were rapidly raised to a white heat by the vigorous though inaudible bombardment. Further, the impact of radiant molecules on certain bodies produces phosphorescent light; thus they give to potash-glass a green and to lead-glass a blue tinge. If in an exhausted tube an obstacle, such as a piece of mica in the shape of a cross, be set up, a dark shadow of it is thrown on the positive end of the tube, the part surrounding the shadow being rendered phosphorescent by the impact of the molecules. On suddenly removing the obstacle, the part that was in shadow glows brighter than in surrounding luminous space. This effect is due to the molecules acting suddenly on a new and, as it were, untired surface.

CAMBRIDGE

Philosophical Society, October 29.—The following officers for the ensuing year were elected:—President, Mr. Glaisher; Vice-Presidents: Prof. Cayley, Prof. Stokes, Lord Rayleigh; Treasurer, Mr. J. W. Clark; Secretaries: Mr. Trotter, Mr. Glazebrook, Mr. Vines; New Members of Council: Prof Humphry, Prof. Babington, Prof. Adams, Prof. Newton, Mr. F. Darwin, Mr. Shaw, Mr. Sedgwick.—The following papers were communicated to the Society:—On the effect of viscosity upon the tides, by Rev. Osmond Fisher.—Note on Mr. Larmor's communication on "Critical Equilibrium," by Mr. Greenhill.—On some general equations which include the equations of hydrodynamics, by Mr. M. J. M. Hill.

EDINBURGH

Mathematical Society, November 9.—Mr. J. S. Mackay, F.R.S.E., in the chair.—The opening address of the session was delivered by Prof. Tait, who chose for his subject "Listing's Topologie."—The office-bearers elected were:—President, Thomas Muir, F.R.S.E.; Vice-President, A. J. G. Barclay; Secretary and Treasurer, A. Y. Fraser; Committee: R. E. Allardice, William Peddie, Robert Robertson, David Traill, B.Sc.

PARIS

Academy of Sciences, November 12.—M. Blanchard, president, in the chair.—On the velocities acquired in the interior of a vessel by the diverse elements of a fluid during its discharge through a lower orifice, and on the simple means possible to be employed in determining very approximately the numerical residuums of slightly converging double series, by MM. de Saint-Venant and Flamant.—Extract from a letter addressed to M. Daubrée by M. Nordenskjöld on the results of his recent expedition to Greenland.—On a tribasic oxalate of alumina, by M. Mathieu-Plessy.—Note on the letter communicated to the Academy by M. Martial, Captain of the *Romanche*, on his return from Tierra del Fuego and neighbouring waters, by M. Alph. Milne-Edwards. Soundings and dredgings were taken at depths of 600 metres; a careful study was made of the fauna and flora on the mainland, as well as of the Fuegian aborigines, and 167 cases of collections were brought back, including two skeletons of whales, and several living specimens of animals and plants. On his return M. Martial determined the presence of a deep trough about the twentieth meridian south of the equator, 7370 metres deep, near the ridge of submarine banks discovered by the *Challenger* and *Gazelle*.—Observations on the Pons-Brooks comet made at the Observatory of Nice (Gautier-Eichens equatorial), and comparison with MM. Schulhof and Bossert's ephemerides, by M. Perrotin.—On certain astronomical formulas of Hansen and Tisserand, by M. P. Appell.—On the asymptotic lines of wave surfaces, by M. G. Darboux.—On the functions of two independent variables rendered invariable by the substitutions of a discontinued group, by M. E. Picard.—Note on the nature of an algebraic relation between two uniform functions of an analytical point (x, y), by M. E. Goursat.—On an algebraic problem in the theory of elimination, by M. Cyparissos Stéphanos.—A description of the differential pyrometer patented in February, 1882, by M. E. H. Amagat.—On an optical photometer, by M. L. Simonoff.—On the measurement of electromotor forces (two illustrations), by M. E. Reynier.—On an electric sounding apparatus for great depths (four illustrations), by M. E. de la Croix.—On a rapid method for determining the work absorbed or produced by a dynamo-electric machine, by M. Pierre Picard.—On a new series of combinations of titanium, by M. A. Piccini.—Qualitative research and quantitative analysis of zinc and lead in iron ores, by M. A. Deros.—On the formation of considerable quantities of alcohol in the fermentation of bread stuffs, by M. V. Marcano.—Determination of the causes tending to diminish the susceptibility of certain regions of the organism to the virus of bacterian or symptomatic charbon, transforming a fatal into a prophylactic inoculation, by MM. Arloing, Cornevin, and Thomas.—On the source of the imperfectly-oxydised sulphur present in urine, by MM. R. Lépine and G. Guérin.—On the development of the branchia of cephalopods, by M. L. Joubin.—On the functions of the renal sac in heteropods, by M. L. Joliet.—Remarks on the *Crocodilus robustus*, Vaill. and Grand., of Madagascar, by M. L. Vaillant.—On the osmotic force of diluted solutions, by M. Hugo de Vries.—On the interpretation of an experiment by Hales touching the function of vegetable vessels, by M. J. Vesque.—Note on the direct observation of the movement of water in plants, by M. G. Capus.—Remarks on the saccharoid and serpentine limestones of the northern slopes of the Pyrenees, by M. Dieulafait.—On the causes of abnormal winters (five illustrations), by M. L. Teisserenc de Bort.—The election was reported of M. Charcot in place of M. Cloquet in the Section of Medicine and Surgery.

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