THURSDAY, JUNE 24, 1880

A STEP BACKWARDS

WE are glad that Sir John Lubbock has given notice that he will call attention to the Education Code and move a resolution, unless indeed the Government themselves are sufficiently wide awake, patriotic, and liberal in its best sense, to step in and prevent Lord Norton's resolution in the House of Lords the other day from attaining the issue desired by the educational obstructionists. Lord Norton's hostility to popular education is notorious, and on Friday he had the honour of being supported by several reverend bishops, who are supposed officially to yearn after the highest welfare of the people. The effect of Lord Norton's resolution would be to cut out everything like real education and training from our elementary schools, and leave nothing but the minimum of instruction in the three R's. It seems hard to have to go over the old ground again, and to show that the pittance of education which Lord Norton and those who side with him would allow the vast majority of the children of the nation, is really no education at all. The objection apparently of Lord Norton to the retention of the specific subjects of the fourth schedule is that their introduction has been too successful; that in some schools the talents of a few pupils under this system have been so developed that they have been continued at school beyond the age of fourteen. Considering the ample opportunities which charity has provided for the education of the children of the class to which Lord Norton and his supporters belong, it seems to us mean in them to grudge the pittance expended by the country in encouraging a few hundred clever boys of the humbler classes to pursue their education to a degree for which they have shown special aptitude. We are especially surprised to find among the supporters of Lord Norton's motion the Duke of Richmond and Gordon, who thus condemns the very code which was drawn up under his auspices and which was worked under his superintendence for five or six years without any apparent suspicion on his part that it was not the best possible of all codes. Of course our enlightened statesmen would never stoop to degrade a subject of such national importance into a party question, and therefore the Duke of Richmond and the other enlightened and reverend supporters of the persistent opponent of popular education, did not surely realise the effects of their vote. The real aim of Lord Norton's resolution, there can be no doubt, is to stifle all training in science out of elementary education. We trust Sir John Lubbock will have an opportunity of speaking on the subject in the House of Commons, and reminding our legislators of some of the facts in his impressive speech of 1877. They evidently require to be reminded of what the real object of education is. Mere reading, writing, and arithmetic is but a poor and inefficient equipment for those who will have throughout life the hardest struggle with their physical surroundings. Crime and disease, it has been again and again proved, are more the result of ignorance than of anything else—ignorance, not of the three R's so much as ignorance of our own bodies and of the laws of that nature by which we are surrounded and of which we form part. In a former discussion in Parliament on this subject Mr. Playfair showed that many people were appalled by the mere name of science as connected with education, as if it were something beyond the comprehension of any but a select few, and far too remote from human interests to be of any use in a system of elementary education. But Mr. Playfair also showed that what was meant was merely natural knowledge, a knowledge of the facts and laws of nature, a knowledge of our own bodies and of the things outside our bodies with which daily every one comes in contact. In the speech already referred to by Sir John Lubbock, and reprinted in his "Political Addresses," he shows that grammar and even history, as ordinarily taught, are far more difficult and much less interesting than the elements of natural knowledge, which he maintains ought to be introduced into our elementary schools. Much more, he shows, could be advanced against the utility of teaching grammar than against teaching the elements of physiology or domestic or political economy; and history, as taught in most text-books, is a farrago of figures, crimes, murders, and battles. Lord Norton is evidently so completely ignorant of the real nature of science—which has to do with tangible, hard, every-day facts—that he thinks all that is necessary might be learned from a judiciously compiled reading-book. The fact is no book of any kind need be required by a competent teacher, and the whole aim and end of science teaching would be missed if it dealt with words and not things.

If it is desired to turn out men and women with well-trained, observant minds, fitted to grapple with the circumstances of the every-day life of the bulk of the people of this country, then the education which results from an acquisition of some of the most elementary laws and facts of nature is absolutely necessary. Moreover it has been clearly shown that in schools where a little science is properly taught the pupils are much further advanced as readers than in schools where there is no variety apart from the old-fashioned three R's. We cannot believe that Lord Norton's resolution will meet with any support outside the House of Lords; should it reach the House of Commons we are sure that body will have too much respect for the bulk of its constituents to insult and injure them by approving of any such retrogressive step.

FRESHWATER RHIZOPODS OF NORTH AMERICA

United States Geological Survey of the Territories—Freshwater Rhizopods of North America. By Joseph Leidy, M.D., Professor of Anatomy in the University of Pennsylvania and of Natural History in Swarthmore College, Pennsylvania. (Washington: Government Printing Office, 1879.)

THE scientific history of the freshwater rhizopods begins only a little anterior to the Declaration of Independence. Rösel (1755) knew of the existence of such forms, which puzzled him. Linnæus (1760) named one of them *Volvox chaos*;—*polymorpho-mutabilis*, the form of whose body was *Proteo inconstantior*. But with the increase in the powers of the objectives used with the microscope,

so did the knowledge of these forms increase. Ehrenberg and Dujardin led the way to a brilliant series of discoveries, which have been continuous, and never more numerous than during the last twenty years.

One protozoon was on the roll-call of the *systema naturæ*—who could count the vast multitude known to us now? The very list of the provisionary classes and sub-classes would be a long one.

On some of these classes splendid monographs have been written, among which those of Stein, Carpenter, Claparède, Haeckel, Wallich, and Brady may be mentioned, while the authors of papers on special genera and species would be too numerous to quote.

Most of the authors referred to have worked among the European forms, but Carter added greatly to our knowledge of those to be met with in the Island of Bombay. Africa and America were unknown countries; while the former still remains so, the persevering efforts of Dr. Joseph Leidy for the last ten years have gradually unfolded to us the rhizopodal wealth of North America, and have culminated in the publication of the finely-illustrated work that we proceed to notice.

As preliminary we are reminded that there is no very fixed system of classification for this class. Dr. Leidy treats of the fresh-water species only, as found in the orders Protoplasta, Heliozoa, and Foraminifera, the first two being commonly designated "Freshwater Rhizopods." These, writes Dr. Leidy, are to be found almost everywhere in damp or wet, but not over shaded positions; they are especially frequent and abundant in comparatively quiet waters, which are neither too cold nor yet too much heated by the sun. They are to be found among moss in spongy places or on damp rocks. They hide away among sphagnum-leaves, at the roots of sedges and grasses on the bark of trees. Once, we remember, Dr. Leidy got quite a store of them in the fork of an old apple-tree. Sometimes a depression or fissure in a rock, sometimes even the crevice of a wall or of the pavement, affords them space enough. We have taken them almost at the equator. Dr. Wallich has described many from within the Arctic circle. The favourite habitation of many forms is the light superficial ooze at the bottom of still waters. If this be gently collected, there they will be found grazing among the desmids and diatoms fond of such quarters. The dark deep mud that will be found below this it is as well not to stir; it is a layer in which life turns to death, and its odour is never pleasant. But again, these rhizopods are to be found in that creamy, flocculent matter that half floats on the surface of great pools. The expert collector will soon get to know the difference in these "creams"—some so rich in treasures, some containing nothing but dead cells and empty lorica; then again Dr. Leidy found these rhizopods in no place in such profusion, number, and beauty of form as in sphagnous bogs, living in the moist or wet bog moss (*Sphagnum*). "Sometimes he found this moss actually to swarm with multitudes of these creatures of the most extraordinary kinds and in the most highly-developed condition. A drop of water squeezed from a little pinch of bog moss has often yielded scores of half a dozen genera and a greater number of species." "Frequently, however," he adds, "the sphagnum of many localities contains comparatively few rhizopods, though I have rarely found them entirely absent from the moss." In Ireland the very reverse of this seems to hold true, and the exceptional multitudes have not yet turned up.

Dr. Leidy's volume is issued under the modest title of a "Report," so that it seems desirable to mention that it forms a large quarto volume of 324 pages, illustrated with 48 coloured plates. The printing and paper of the volume are simply perfection, like, indeed, most of the work issued from the Government printing-office at Washington, and brought out under the superintendence of Dr. F. V. Hayden. It forms one of the volumes of the United States Geological Survey, and its publication betokens an enlightened zeal on the part of the United States geologist in charge. As to the illustrations, we think the author quite unduly hard in his estimate of them. He says: "The illustrations accompanying this work, done in chromolithography, are not equal in execution to my desire," and he regrets the absence from the States "of those accomplished artists from Germany and France." To our mind, as chromolithographs, the illustrations are excellent. The drawings are recognisable at a glance. The slight hardness in outline and sharpness of colouring are not defects to be made over much of, and we feel sure that these plates will be for the most part recognised as good and excellent representations of the forms described.

There are about seventy-five species, including those of all orders, specially described in this volume, and it is a pleasure to note how few new genera are proposed. Speaking in general terms, Prof. Leidy seems to believe in there being a very large range of variability in the species, but it is not improbable that a more lengthened study of the forms might considerably modify his views. Any discussion on such points would be out of place in the present notice. A controversy as to what is a species, what a variety, would seem captious over a book quite full of the facts in nature as Dr. Leidy found them, and from which he leaves one in full confidence to draw their own opinion.

One very lovely form to this only known from North America is called by Dr. Leidy *Hyalosphenia papilio*. It is doubly interesting as marking an era in its describer's life. It is common and at times exceedingly abundant in moist bog or sphagnum, or sphagnous swamps, but it is not found in ponds unless accidentally. "No other lobose rhizopod has more impressed me with its beauty than this one. From its delicacy and transparency, its bright colour and form as it moves among the leaves of sphagnum, desmids, and diatoms, I have associated it with the idea of a butterfly hovering among flowers. From its comparative abundance, the readiness and certainty with which it may be obtained and observed, and from its transparency, which allows its structure to be well seen, it is peculiarly well adapted for the study of the life-history of its order; I have collected it from early spring to late autumn, and have retained it alive in sphagnum in a glass case in winter. This interesting rhizopod, found together with a profusion of other remarkable microscopic forms of both animal and vegetable life, of which many are novel and yet undescribed, recalls pleasing recollections of excursions into the sphagnous bogs, cedar swamps, and pine barrens in the southern region of New Jersey. These localities have special charms for the botanical

student, on account of the diversity of beautiful and interesting plants they produce. In proper season, in most places, they are redolent with the rich perfume of *Magnolia glauca* and the fragrance of *Clethra alnifolia*. In early spring the ground is adorned with bright patches of the little *Pyxidanthera barbulata*, and the sand myrtle (*Leiophyllum buxifolium*). Later the swamps display an abundance of *Helonias bulbata*, and still later many other liliaceous plants, *Zygadenus limanthoides*, *Narthecium americanum*, besides more common ones. Rich are these woods and swamps in genera of orchids. On the dry banks grow Vaccinia and other ericaceous plants, amidst which are conspicuously to be seen the spikes of white flowers of the grassy-looking *Xerophyllum asphodeloides*, while the bogs below are as conspicuously dotted with the curious green and purple pitcher plant (*Sarracenia purpurea*) nestling among sphagnum and entangled among sundews." This rhizopod was first noticed by Prof. Leidy some thirty years ago, but it was not until 1873, on the fiftieth anniversary of his birth, that he commenced to study the rhizopods with the assistance of the microscope. He had scarcely begun to do so until he came again across this form, and he then named it as *Difflugia papilio*. It was the re-discovery of this beautiful form which he tells us impelled him to pursue the investigations which built up the material of the present work.

The greater part of this volume is taken up with the details of the "Protoplasta," of which a few species are for the first time described, but most of the peculiarly American species figured have been already described by Dr. Leidy in the *Proceedings* of the Academy of Natural Sciences of Philadelphia. In many of the species the endosarc was bright green from the presence of chlorophyll (spelled chlorophyl in this volume throughout). The forms recorded as belonging to the "Heliozoa" are not very numerous, and among them no doubt a good deal of work remains to be done. A Vampyrella form is included among these, but Dr. Leidy could detect no nucleus. Of the free forms the most interesting are *Actinophrys sol*, *Heterophrys myriapoda*, *Raphidiophrys viridis*, *Diplophrys Archeri*, *Actinosphærium eichornii*, and *Hyalolampe fenestrata*, while of the attached forms only *Clathrulina elegans* was met with, it is beautifully figured.

Of the foraminiferous order one species of Gromia (*G. terricola*) is described and figured, and a genus Biomyxa is established for a rather problematic form, consisting of what might prove yet to be the plasmodium of a fungus. No forms related to Chlamydomyxa were met with, but we forbear to linger further over special details, and we close a volume which will henceforth be as useful to the investigator of these forms in Europe as in America.

E. P. W.

THE RECENT PROGRESS OF ENGLISH PHILOLOGY

The Journal of Philology. ix. 17. (Macmillan and Co., 1880.)

The American Journal of Philology. i. 1. (Macmillan and Co., 1880.)

THE establishment of a new philological journal, devoted more especially to the study of the classical languages, seems a fitting occasion for reviewing the present condition of philology, in the narrower and German sense of the word, among English-speaking scholars. A great change has come over the study of Latin and Greek during the last half century, and the old-fashioned scholarship whose highest aim was the composition of faultless verses seems likely soon to become a thing of the past.

The change has been largely due to the rise and growth of comparative philology. The conception of law has been introduced into the study of speech, and we have learned that in language as in nature there is nothing arbitrary and capricious, that what now exists is the result of a long and gradual development determined by ascertainable conditions and causes. Above all we have come to know that we cannot pick out any one language as superior to all others in the same way that we pick out a particular literature as superior to other literatures; the only test in fact of the worth of a language is its greate or less capacity for expressing thought. The thought, it is true, may be poor; but this is the fault of the thinkers, not of their language.

Latin and Greek grammar has thus been brought down from the lofty pedestal on which it once stood and shown to be neither better nor worse than the grammar of any other form of speech. But in return a new spirit of life has been breathed into it. It is no longer a collection of arbitrary rules and lists of words compiled from the literary usages of a certain number of writers. Its rules have been explained, its words traced historically to their earlier forms, and the grammar of the classical tongues has once more become a living organism, developing and changing in accordance with scientific laws like the grammars of modern languages.

Along with this truer conception of Greek and Latin grammar has come a truer conception of the Greek and Latin languages themselves. We have come to realise that like our own mother-speech they consisted of sounds not of letters, of living words not of the written symbols that stood for them. A dead language differs from a spoken one only in that we know less about it. We cannot lay down that the particular form of language used by certain literary men at a particular period is either Greek or Latin. If we would understand what Greek really was we must study it in its various dialects, must examine it in the inscriptions which represent the language of everyday life more faithfully than an artificial literature, and by the help of comparison and induction must trace its history back to that early time when it was still but a dialect of the common Aryan tongue. So, too, we must divest ourselves of the notion that the idiosyncracies of a few literary men alone constitute correct Latin, and seek the true character and history of the language rather in the inscriptions which modern research has brought to light.

Classical philology has further felt the influence of the comparative method of linguistic science even on its purely literary side. We have ceased to regard the works of the classical writers with the wondering awe of the scholars of the Renaissance, or to determine their relative merits by the conventional standard of traditional or subjective criticism. Manuscripts are now carefully examined and collated, the accuracy of tradition is questioned and the genuineness and date of the books that have come down to us are sharply tested. We can

no longer accept any statement, no longer receive any reading, however strongly supported by authority or backed by ancient tradition, unless it be corroborated by the potent instrument of comparison. The modern scientific method is the bar before which our classical studies must all be brought.

The truth of this may be seen at once by comparing the contents of our modern philological periodicals with those that were published at the beginning of the present century. The material still remains the same, but the spirit, the method, and the aims have all been changed. In this, as in the science of language itself, Germany has led the way; but the example of Germany has now found able imitators both in this country and in America. The English *Journal of Philology* has been too long in existence for its merits to need more than a passing recognition, and the *American Journal*, the first number of which has just appeared under the editorship of Prof. Gildersleeve, promises to be a worthy rival of its English forerunner. At present, indeed, most of its articles have a touch of "rawness" inseparable from a new venture, but a large part of it is occupied in a most useful way by an analysis of the articles that have been published in kindred foreign serials. This is a feature that might be imitated with advantage by the English *Journal*. Both publications admit Oriental and general as well as purely classical subjects, and an article in the last number of the English *Journal* by Prof. Robertson Smith on "Animal Worship and Animal Tribes among the Arabs and in the Old Testament," is marked by his usual learning and acuteness. He shows in it that Mr. Maclennan's theory of a primitive totemism in connection with polyandry is fully confirmed by the early beliefs and practices of the Semites. A new light is thus cast upon the beginnings of Semitic religion, and obscure allusions in the Old Testament are cleared up.

A. H. SAYCE

OUR BOOK SHELF

Fern Etchings: Illustrating all the Species of Ferns Indigenous to the North-Eastern United States and Canada. Second Edition. By John Williamson. (Louisville, Ky., 1879.)

A HANDSOME book, consisting of etchings, with accompanying letter-press descriptions, of sixty-eight species or varieties of ferns, natives of the northern part of the American continent. The drawings are well executed and characteristic, giving a faithful idea of the general habit of the fern, though without any enlarged details; and the accuracy of the descriptions is insured by borrowing them from Gray's "Manual" or Eaton's "Ferns of North America." Of the species depicted, including all that are natives of the Northern United States and Canada, twenty-two, or about one-third, are also natives of the British Isles. The southern limit for the volume appears to be Virginia and Kentucky. The volume is an elegant ornament to the drawing-room table.

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 ensure the appearance even of communications containing interesting and novel facts.*]

A Fourth State of Matter

IN the very interesting communication from Mr. Crookes on "A Fourth State of Matter," which is contained in NATURE, vol. xxii. p. 153, there is a paragraph at the end which advances, as it seems to me, some most disputable propositions.

Like many other questions of modern science, the question he raises is to a very large extent a question of definition. But questions of definition are questions of the very highest importance in philosophy, and they need to be watched accordingly.

Speculating on the ultimate conceptions of Matter which are affected by the discovery of it in "a fourth condition," Mr. Crookes says: "From this point of view, then, Matter is but a 'mode of motion.'"

It has never appeared to me that this well-known phrase is a very happy one, even as applied to Heat. It is possible, of course, to consider Heat from this point of view. But then it is equally possible to consider all other phenomena whatever from the same point of view. Not only Heat, but Light, Sound, Electricity, Galvanism, and Sensation itself in all its forms, may be regarded as "modes of motion."

But at least in the application of this phrase to Heat there is an intelligible meaning, and not a mere confusion of thought. But as applied to Matter—as a definition of our ultimate conception of Matter—it appears to me to confound distinctions which are primary and essential. "Motion" is an idea which presupposes Matter and Space. Motion has no meaning whatever except the movement of Matter in Space. To define Matter, therefore, as a "mode of motion," is to define it as Matter in a state of motion. But this definition necessarily implies that Matter can also be conceived as without motion, and accordingly Mr. Crookes is obliged to confess that "at the absolute zero of temperature inter-molecular movement would stop," and that after that, Matter would remain with all the "properties of inertia and of weight."

Again, Mr. Crookes says: "The space covered by the motion of molecules has no more right to be called Matter than the air traversed by a rifle-bullet can be called lead." No doubt this is true; but it implies what is not true, that the common idea of Matter is nothing but "the space covered by the motion of molecules." The popular ideas attached to words of primary significance may not be always adequate or complete. But in my opinion they are generally much more near the truth and more accurately represent the truth, than most of the phrases which scientists are now inventing in the region of transcendental physics.

These phrases have their value and their interest as representing special and partial aspects of phenomena. But I hold that the unconscious metaphysics of human speech are often the deepest and truest interpretations of the ultimate facts of nature.

June 20 ARGYLL

The Fine Wire Telephone

I HAVE just read in NATURE, vol. xxii. p. 138, an abstract of the *Proceedings* of the Royal Society of London, giving an account of a new form of telephone receiver devised by Mr. Preece.

It happens, very curiously, that I was led independently to construct a practically identical instrument, with which I have been experimenting for some time in the laboratory of my colleague, Prof. Tait, and which was exhibited in action at the last meeting of the Royal Society of Edinburgh, before I was aware of Mr. Preece's invention.

The experiments of Mr. Preece and myself have been to a considerable extent anticipated by some results given in a paper by Dr. Ferguson (*Proc.* R. S. E., 1877-78, pp. 628 *et seqq.*), of which I was unaware when I made my own experiments.

It is true that Dr. Ferguson has not applied his apparatus to the transmission of music or of articulate sounds, as has been done by Mr. Preece and myself; but he made the practically very important step of attaching a mechanical telephone to the wire which conveys the varying current, and has thus rendered the observation of De la Rive's sounds in iron and other metals both easy and certain.

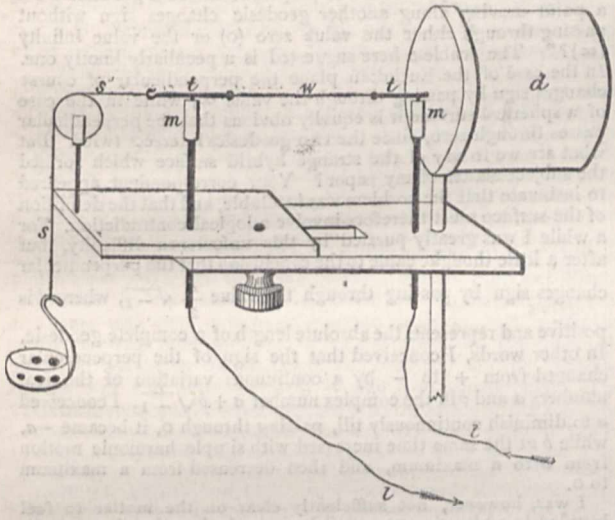
In Dr. Ferguson's paper will also be found a most important result, which I have verified since he drew my attention to it, viz., that sounds can be produced in fine wires generally by induction currents of very feeble total heating effect.

As to the theory of the action of this new kind of receiver, I agree with Mr. Preece that in weakly magnetic metals generally it is due to heating effects. I had been discussing with Mr. Blyth the theory of his receiver (described in NATURE, vol. xix. p. 72), and it was as an illustration of the explanation of all kinds of microphone receivers, suggested by his beautiful experi-

ments on loose contacts, that I thought of the experiment in question. My idea was to replace his heated point of metal by a continuous portion of the circuit which should act in the same manner. It was obvious that this part must be of small diameter to secure resistance enough to make the extension of the wire due to the variation of the heating effect sensible; and to insure that the cooling should be rapid enough to allow a musical note to be produced.

I had reason beforehand to believe that the second condition could be fulfilled in practice; because I had found in my experiments on Ohm's Law (*Reports*, British Association, 1876, p. 58, *et seq.*) that, when currents of different strengths alternated very rapidly in a fine wire, the cooling was so rapid that the resistance was sensibly greater during the passage of the strong current than it was during the passage of the weaker.

The accompanying figure represents the apparatus with which I worked. I generally used a microphone attached to a violin, belonging to Mr. Blyth, for a transmitter. In this way music was reproduced so as to be audible all over Prof. Tait's large class-room. For reproducing articulate speech I have found a small mica diaphragm, like that used by Edison, Blyth, and others, best; words spoken to the violin are reproduced in this way quite intelligibly, but as I do not possess a good microphone transmitter, I have not experimented much in this direction.



w, fine wire; *t t*, thicker copper terminals; *m m*, mercury cups over which *t t* pass; *s s*, string kept tight by small load; *l l*, line wires to microphone; *d*, drum head which distributes the sound.

So far as the limited supply of fine wire permitted, I had arrived substantially at the same results as Mr. Preece regarding the length and tension of the wire. My best results were got with a very fine silver-palladium wire given me by Prof. Tait; with it I could see the string s s move in time with the swell of the music. I also used a thicker and shorter platinum wire, heated by the current to a dull red, during silence; it was beautiful to see this wire burst into a bright glow when there came a prolonged note, more especially a high one.

Dr. Ferguson, in the paper above referred to, regards these effects as not due to heating (although he seems to think they follow the same law), but as being molecular in some other sense not very clearly defined. Except in the case of iron,[1] I do not see at present any necessity for so regarding them. The fact that induction-currents of small heating effect will produce them is not conclusive; for it must be remembered that it is not the *whole* heating effect, but the *variation* of it during a very short interval that is in question, and some calculations from rough data in my possession have led me to think that there would be no inconsistency in explaining Dr. Ferguson's ticks and the speech and music in Mr. Preece's experiment and my own as due to the same cause. I think also that it is quite possible that we might be able to hear ticks in a wire far too thick for the reproduction of music.

I have begun some experiments with a view to throw some light on questions of this kind. Possibly in the meantime Dr. Ferguson, Mr. Preece, or some other experimenter may be able to produce facts that settle the matter beyond the possibility of doubt.

G. CHRYSTAL

15, Chalmers Street, Edinburgh, June 12

[1] Iron may be anomalous on account of its powerful magnetic properties; and Prof. Tait has suggested that, at a certain high temperature, it may, for well-known reasons, be incapable of producing these effects altogether.

The Aurora Borealis and its Colours

IN reference to Mr. Backhouse's letter last week (p. 145) we have nowhere stated that "similarity in colour in electric discharges is sufficient to indicate similarity of constitution, even when their spectra are quite unlike." If Mr. Backhouse will again read our paper on the Auroræ, he will see that we say that in the same gas the colour of the discharge varies with the degree of exhaustion. In the *Phil. Trans.*, 1878, part 1, we have shown also that in the same gas at the same pressure the colour of the discharge varies with the amount of current; at pp. 180–181, for example, the strata in hydrogen at a pressure of 1·2 mm., 1579 M, were of a cobalt blue with a current of 0·019940 W, and pink with a current of 0·008504 W. In the index at p. 239 are given several references to the same phenomena; and at p. 240 references are given to a number of observations on the "spectra of strata and of glow on terminals."

It is very difficult to say for certain whether the red is below or above the green in aurora displays, by eye estimation; for although apparently above it may be really below. We adhere to our opinion that the red is at the lower level.

WARREN DE LA RUE
HUGO MÜLLER

73, Portland Place, W.

On some Points Connected with Terrestrial Magnetism

IN NATURE, vol. xxii. p. 147, our friend Prof. Balfour Stewart makes the following statement in paragraph 7:—

"Above this again we have the lower strata of the atmosphere, which are non-conductors, while above this we have the upper strata, which are conductors."

We venture to think that our researches prove that air cannot, at any degree of attenuation, be considered as a conductor of electricity in the ordinary acceptation of the term.

In the *Phil. Trans.*, Part I. p. 168, after citing a number of experiments bearing on this point, we say:—"These observations show clearly that the discharge through rarefied gases cannot be at all analogous to conduction through metals; for a wire having a given difference of potential between its ends can permit one—and only one—current to pass; whereas we see that with a given difference of potential between the terminals of a vacuum tube currents of strengths varying from 1 to 135 can flow. We are therefore led to the conclusion that the discharge in a vacuum tube does not differ materially from that in air and other gases at ordinary atmospheric pressure, that it is, in fact, a disruptive discharge."

In Part III. of our researches (an abstract of part of which appears in the same number of NATURE), *Phil. Trans.*, vol. clxxi. p. 82, we sum up a series of experiments on the electric discharge in various gases by stating that the same law holds good for a constant pressure and varying distance between flat terminals as for a constant distance and varying pressure, the obstacle in the way of a discharge being, up to a certain point, as the number of molecules intervening between the terminals.

The hyperbolic curves laid down to represent the observations in each case are perfectly continuous, and show no break from the condition of a non-conductor to that of a conductor.

WARREN DE LA RUE
HUGO MÜLLER

June 21

Calcareous Concretions in Timber

IN NATURE, vol. xxi. p. 376, I observe that in a remark of the reviewer, and also in an extract from Mr. Ball's "Jungle Life in India," the occurrence of concretions of lime in trees is spoken of as a rare and novel phenomenon. That *Terminalia tomentosa* contains calcareous matter has long been known to natives, and a reference to Tennent's "Ceylon," i. 99, will show that they make a practical use of their knowledge by using the ashes of the bark as a substitute for lime, to chew with betel. Another southern tree which contains an alkali in its bark is *Avicennia tomentosa*. It generally grows along the margins of backwaters,

and has a most wonderful provision for preventing the erosion of the banks and for adding to the dry land. It is a squat bushy tree, and round the stem, to an extent equal to the spread of its branches, it sends up thickets of straight shoots a foot or two high. These, when the tide is up or the water in flood, catch all the stray branches, leaves, grass, &c., that may be floating about, and also promote silt. By this contrivance, therefore, not only are the banks protected from the distinctive action of water, but also raised and consolidated. Again, as regards Mr. Stoney's observation of calcareous masses in timber, which was brought to the notice of the Asiatic Society of Bengal in 1870 as a fresh discovery, it seems strange that the learned body in question did not know that the existence of such concretions, so far from being very rare, is an occasional and well-known phenomenon. Thus, in the *Madras Journal of Literature and Science* for April-September, 1858, page 142, Prof. Mayer gives a qualitative analysis of a concretion of the kind found in a teak log. It consisted chiefly of magnesia, with potash, lime, silica, and a trace of iron. The substance, he says, "Must be looked on as a mixture, and not a true chemical compound." Again, he observes, "as a whole the substance thus hardened is insoluble in cold, and but slightly so in water of higher temperature. At 212°, however, there is sensible action after a time. In diluted hydrochloric acid solubility ensues, hastened by increased temperature. Solution is attended by slight effervescence, some carbonic acid being liberated." He then proceeds to give an explanation of the process by which such mineral matters may be taken up from the soil and deposited in the tree. So far as I know the occurrence of such concretions in India was first brought to notice by Lieut., now Col. Hawkes, of the Madras Army, in 1858. He had seen them only in teak logs, and remarked that they generally occur "in what carpenters call a shake in the wood, but with this exception the logs are perfectly sound, and no communication whatever with the external air has been observed."

G. BIDIE

Government Central Museum, Madras, May 13

Remarkable Discovery of a Murder in Bermuda

THE following account of a murder which was committed in Bermuda in the autumn of 1878 is taken from a letter written to Gen. Sir J. H. Lefroy, C.B., F.R.S., lately Governor of these islands, and author of the "Annals of Bermuda," by the Attorney-General of the islands, Mr. S. Brownlow Gray. The mode of discovery of the crime is so remarkable that I think it ought to be put on record, and Sir J. H. Lefroy has kindly permitted me to make extracts from the letter for that purpose. I believe no account of the circumstances of the case has as yet been published in Europe. There seems to be no likelihood as to mistake regarding the facts. The special occurrence could probably only happen in the tropics in warm water.

H. N. MOSELEY

"In the autumn of 1878 a man committed a terrible crime in Somerset, which was for some time involved in deep mystery. His wife, a handsome and decent mulatto woman, disappeared suddenly and entirely from sight, after going home from church on Sunday, October 20. Suspicion immediately fell upon the husband, a clever young fellow of about thirty, but no trace of the missing woman was left behind, and there seemed a strong probability that the crime would remain undetected. On Sunday, however, October 27, a week after the woman had disappeared, some Somerville boatmen looking out towards the sea, as is their custom, were struck by observing in the Long Bay Channel, the surface of which was ruffled by a slight breeze, a long streak of calm such as, to use their own illustration, a cask of oil usually diffuses around it when in the water. The feverish anxiety about the missing woman suggested some strange connection between this singular calm and the mode of her disappearance. Two or three days after—why not sooner I cannot tell you—her brother and three other men went out to the spot where it was observed, and from which it had not disappeared since Sunday, and with a series of fish-hooks ranged along a long line dragged the bottom of the channel, but at first without success. Shifting the position of the boat, they dragged a little further to windward, and presently the line was caught. With water glasses the men discovered that it had caught in a skeleton which was held down by some heavy weight. They pulled on the line; something suddenly gave way, and up came the skeleton of the trunk, pelvis, and legs of a human body, from which almost every vestige of flesh had disappeared, but which, from the minute fragments remaining, and the terrible stench, had evidently not lain long in the water. The husband was a fisherman, and Long Bay Channel was a favourite fishing-ground, and he calculated, truly enough, that the fish would very soon destroy all means of identification; but it never entered into his head that as they did so their ravages, combined with the process of decomposition, would set free the matter which was to write the traces of his crime on the surface of the water. The case seems to be an exceedingly interesting one; the calm is not mentioned in any book on medical jurisprudence that I have, and the doctors seem not to have had experience of such an occurrence. A diver went down and found a stone with a rope attached, by which the body had been held down, and also portions of the scalp and of the skin of the sole of the foot, and of clothing, by means of which the body was identified. The husband was found guilty and executed."

On the Simplest Continuous Manifoldness of Two Dimensions and of Finite Extent

THERE appeared in your pages some three years ago (vol. xv. p. 515) an article of mine "On the Simplest Continuous Manifoldness of Two Dimensions and of Finite Extent." In a succeeding number a correspondent (Mr. Monro, of Barnet) propounded a query which may be shortly stated as follows:—"How does it happen that the perpendicular on a geodesic from a point moving along another geodesic changes sign without passing through either the value zero (o) or the value infinity (∞)?" The problem here suggested is a peculiarly knotty one. In the case of the Euclidian plane the perpendicular of course changes sign by passing through the value ∞, while in the case of a spherical surface it is equally obvious that the perpendicular passes through zero, since the two geodesics intersect twice. But what are we to say of the strange hybrid surface which formed the subject-matter of my paper? Your correspondent appeared to insinuate that the problem was insoluble, and that the definition of the surface must therefore involve a logical contradiction. For a while I was greatly puzzled by this unforeseen difficulty, but after a little thought came to the conclusion that the perpendicular changes sign by passing through the value $\frac{l}{2}\sqrt{-1}$, where l is positive and represents the absolute length of a complete geodesic. In other words, I conceived that the sign of the perpendicular changed from + to − by a continuous variation of the real numbers a and b in the complex number $a + b\sqrt{-1}$. I conceived a to diminish continuously till, passing through o, it became $-a$, while b at the same time increased with simple harmonic motion from o to a maximum, and then decreased from a maximum to o.

I was, however, not sufficiently clear on the matter to feel justified in addressing you until I received, the other day, a copy of a paper by Prof. Simon Newcomb, of the United States Observatory, entitled "Elementary Theorems relating to the Geometry of a Space of Three Dimensions and of Uniform Positive Curvature in the Fourth Dimension."[1] The subject-matter of this masterly paper is in reality the simplest continuous manifoldness of *three* dimensions and of finite extent. It therefore naturally includes all that had been worked out in my own paper and a little more besides. In particular it throws strong light on the difficulty raised by your correspondent. For an exactly parallel anomaly presents itself in the theory of Prof. Newcomb's solid space, and is stated in his 13th Proposition as follows:—"*The two sides of a complete plane*[2] *are not distinct, as in a Euclidian surface.*" If a being were to travel along a complete plane in a geodesic line, he would, on his return, find himself on the opposite side of the plane to that on which he started, and would have to repeat his journey in order to regain his original poise. "In this property," Prof. Newcomb says, "we find a certain amount of reason for considering the complete plane as a double surface." The corresponding anomaly in space of two dimensions—*i.e.*, the specific feature noticed as an anomaly by your correspondent—is then explained as Proposition XIV.: "The following proposition is intimately connected with the preceding one. If, moving along a right line, we erect an indefinite series of perpendiculars, each in the same Euclidian plane with the one which precedes it, then, on completing the

[1] Abdruck aus dem *Journal für die reine und angewandte Mathematik*, Bd. 83. Druck von G. Reimer in Berlin.

[2] A "complete plane" is a geodesic surface of Prof. Newcomb's space. It is in all respects identical with the surface treated of in my paper.

line and returning to our starting point, the perpendiculars will be found pointing in a direction the opposite of that with which we started." Here then is the solution of the difficulty. As we move over our surface along a geodesic, the instantaneous Euclidian plane containing the beginnings of successive perpendiculars (for *small initial* portions of two successive perpendiculars to a geodesic will lie in a Euclidian plane) rotates about the instantaneous tangent to the geodesic, and it does not complete a rotation until we have travelled *twice* the complete length of the geodesic. The perpendicular is a vector quantity, and changes sign by passing through $\frac{l}{2}\sqrt{-1}$. Also, a geodesic does not divide the surface into two completely separate regions, as a great circle does a sphere or a straight line a plane. The two regions are continuous with one another, and it is possible to get from the one to the other along a finite path without crossing the geodesic. F. W. FRANKLAND

Registrar-General's Office, Wellington,
New Zealand, April 14

Ascent of Etna

IT was a bright sunny sky on the last day of April when we started, with Giuseppe Sedici as guide, from the Grand Hotel at Catania in a carriage and pair bound for Nicoloni, *en route* to the summit of Etna. A dusty drive of two and a half hours, and we were at the door of the inn in the centre of the village. Its appearance was somewhat forlorn, and its fare rather meagre, but the civility of mine host compensated for all other defects. Here we engaged two mules, a porter, and a driver, an operation which took more than two hours, and then set off again for the Casa del Bosco, which we reached in the middle of the afternoon after a ride of two and a quarter hours. A climb up a neighbouring hillock to see the sunset, dinner, and a few hours' rest filled up the time till 11 p.m., when we started off again and rode for about half an hour, till the appearance of snow made it necessary to dismount and continue the remainder of the journey on foot. Our guide was very slow, and on any attempt to force the pace stood still and ejaculated: "Fermo, Signore! Piano, Piano!" so that we did not arrive at the Casa Inglese till 5 a.m., and were obliged to content ourselves with seeing the sun rise from here instead of from the top, as we had intended. It did not much matter, as it was a cloudy morning, and the view was very poor, but still it was a disappointment. The Casa Inglese was covered with snow to the eaves of the roof, the observatory buried altogether, the Val del Booe a sea of white. After a short rest we trudged on again; so far it had been good walking up an easy ascent of crisp snow, but now it became a work of difficulty to pick one's way through deep drifts and treacherous-looking holes, which seemed to explain the guide's reluctance to undertake this part of the route by moonlight. Arrived however at the foot of the cone, the snow ceased, and a heavy climb up the frozen side under a biting wind began. Half way up matters were not improved by a severe attack of sickness; but at length the top was reached at 6.20 a.m. There was no distant view; within the crater the steam and smoke kept being blown hither and thither, and cleared off at times sufficiently to show parts of what looked like a bottomless pit. It was a curious and weird sight altogether, and well repaid the fatigues of the journey. During the descent the notes of the cuckoo and some very sweet violets found by chance under the snow reminded us that, notwithstanding the mountain's wintry mantle of white, it was really spring time, and that the morning sun had ushered in the merry month of May, a fact which we had well nigh forgotten but a few hours before, when our fingers were numb with cold and our ears threatened to become a thing of the past. G.

Colour Combinations

THE production of white by red and green solutions is well seen on mixing cobalt and nickel solutions together in proper proportions. Another interesting example is that of electrically deposited copper immersed in a solution of copper sulphate. The first notice of this, so far as I know, occurs in Shaw's "Manual of Electro-Metallurgy" (1842), p. 33, in the following terms:—

"This phenomenon may be observed in great perfection by the electrotype; the solution of sulphate of copper is of an intense and pure blue; and the newly-precipitated ductile copper is of an equally pure orange; let the reader take a vessel containing the cupreous solution and place it in the sun, in order to have an abundance of light, and immerse in it, in a horizontal position, a piece of new electrotype copper; immediately the metal sinks beneath the surface of the blue solution the orange tint fades, and by placing it at a proper depth altogether vanishes, and the metallic plate appears intensely white; when nicely adjusted the plate so much resembles plaster-of-paris that a person unacquainted with the nature of the experiment would with difficulty be persuaded that it was not made of that substance."

Birmingham and Midland Institute, C. J. WOODWARD
June 14

P.S.—In mixing red and green solutions is it correct to speak of them as *producing* white? I take it that the mixture absorbs more light than the two solutions would do if separate, *i.e.*, the solution of nickel transmits a greenish white, the cobalt solution a reddish white, but together the red and green destroy each other, the excess of white light passing through. This is shown forcibly by using strong solutions, when the deep red and green produce, not white, but black.—C. J. W.

Wild Swans—Notes of Birds

THERE are at present eight wild swans in a lake not far from here. I believe them to be part of a flock of sixty which were there all through the winter. Wild swans in summer were never, so far as I know, heard of in this part of the world before. I have always carefully preserved the wild fowl on this lake, and I pay increased attention to the swans, which I hope will be safe from poachers. They swim in pairs, but show no signs of nesting.

The *major* cuckoo noticed in my letter (NATURE, vol. xxii. p. 76) is still here without any other *major* that I could find in this place or in the neighbourhood. Referring to your polite correspondent A. N., in p. 97, I must remark, for the fair fame of the cuckoos, that his theory relating to sex seems quite unsustainable. Certainly if all the minor cuckoos about here were males and the single major a female it would show an instance of polyandry (if the term can be applied to birds) such as could scarcely be matched in the whole range of natural history. I quite agree with Mr. Newton (p. 122) that the female cuckoo does not sing; and it might perhaps be unamiably suggested that the comparative silence of the females among the lower animals seems among the most marked distinctions between them and the human race.

Regarding Mr. Allen's letter (same page) I can only say that, while his experiences are so different from mine, there must be an imperfection of ear in either of us, and, without any notion of insisting on the correctness of my own, I should like, at least, to hear the testimony of other parties in the matter. Of course I referred to cuckoos in full voice in the height of the season. When their voice begins to decline, their notes vary, and, as a friend of mine expresses it, they "sing *anyhow*."

Millbrook, Tuam, June 18 J. BIRMINGHAM

Anchor-Ice

ALLOW me to say in reply to Mr. Rae's kindly criticism (NATURE, vol. xxii. p. 54) that I did not assert that the original ice-crystals *are* "at least as heavy as water," but that they "*seem*" to be so (vol. xxii. p. 81).

I have seen them collect upon stones at the bottom of waterways two or three feet in depth—where the stream though swift was smooth and unbroken,—and I have thought that this might be the result of their having a greater specific gravity than ordinary ice.

In my desire to be concise I had the misfortune to use a phrase that gave Mr. Rae the impression that I was asserting as a fact that which at best I have only regarded as possible.

Boston, June 7 C. F. C.

SCIENTIFIC RESULTS OF THE HOWGATE POLAR EXPEDITION, 1877-78

THE fifteenth *Bulletin* of the United States National Museum (Washington, 1879) consists of contributions to the Natural History of Arctic America, made in connection with the Howgate expedition in 1877-78, by Ludwig Kumlien, naturalist to the expedition, who gives

a most valuable and interesting account of his ethnological observations and important notes on the habits of the birds and mammals of the region explored. Capt. Howgate's expedition was one which had several different ends in view. The primary object of it was the collection of skins, sledges, dogs, Eskimo, and other necessaries for a future colony in Lady Franklin Bay. A secondary object was scientific exploration, whilst the only remuneration of the crew was derived from ordinary whaling operations, every one excepting the scientific men on board the *Florence* having a "lay" in the voyage. The *Florence*, in which the voyage of the expedition was made, was a fore-and-aft schooner of fifty-six tons, which had before been engaged in sealing in the southern seas. Mr. Kumlien necessarily found so small a vessel extremely disadvantageous for scientific operations. He had to leave valuable skeletons of mammalia behind, and could have procured more in addition, if only stowage room had been available.

The explorations of the expedition were made in Hogarth Sound on the western coast of Davis Straits. Hogarth Sound, the Cumberland Straits of Baffin, lies in Baffin's Land, and its western coast is called Penny's Land, after Capt. Penny, who visited it in 1839. The northern part of the Sound is crossed by the Arctic Circle. The Sound is about thirty miles wide at its widest part, its length is uncertain, but over 150 miles. It has been frequently visited by Scotch and American whalers during the last twenty-five years.

The *Bulletin* commences with a long paper by Mr. Kumlien on the Eskimo of the Sound, from which we gather the following interesting statements. The natves are fast diminishing in numbers, and the total population of the Sound is estimated by the author at not more than 400 individuals. The Eskimo are peaceful now, but have numerous traditions of former wars, in which they relate that the hurling of stones was the most effective and common mode of warfare.

The natives have, as usual, suffered by contact with white men, and the Hogarth Sound Eskimo of to-day, with his breech-loading rifle, steel knives, cotton jacket, and all the various trinkets he succeeds in procuring from the ships, is worse clad, lives poorer, and gets less to eat than did his forefathers, who had never seen or heard of a white man. He barters a seal-skin that should have been used for repairing the tent, for a little tobacco, or some valueless trinket which is soon thrown aside.

The children are, when young, quite fair; the adults are so begrimed with soot and grease, that it is impossible almost to tell their real colour, but there are some pure bred Innuits whose skins are no darker than a white man's would be if subjected to the rigours of wind and cold.

"There are at present so many whaleboats owned by the Eskimo, that they experience little difficulty in making quite extensive cruises, three or four families constituting a boat's crew. They will load a whale-boat to within an inch or two of the gunwale, and then set out for a few weeks' enjoyment and abundance. The squaws do the rowing and the captain stands majestically in the stern with the steering-oar, whilst the rest of the men are either asleep or on the look-out for game. The cargo consists of the tent-poles, the skin-tents, pots, and lamps, with sundry skin-bags containing the women's sewing and skinning utensils. The hunting-gear forms, of course, quite a conspicuous portion of the contents of the boat. Very few there are at present who have not become the possessors of half a barrel, and this vessel occupies a conspicuous place in the boat, and is constantly receiving additions of animal matter in some shape; a few young eiders or gulls will soon be covered up with the intestines of a seal and its flesh. From this receptacle all obtain a piece of meat whenever they feel hungry. This vessel is never emptied of its contents except by accident or when scarcity of material forbids its repletion; and as the temperature at this season is well up in the sixties during the day, this garbage heap becomes so offensive as to be unbearable to any but an Eskimo."

The powers of endurance of these Eskimo appear to be no better than those of whites. Few of them could stand a tramp through the snow all day long better than the members of the expedition, but, as in the case of other savages, it was in "tracking" that they showed their superiority most markedly. "They will follow animal tracks in the snow for a whole day when we confess we could not discover the faintest trace of a track except at long distances apart."

The women's dress differs from that of the men in that their trousers are composed of three separate pieces, the lower reaching from a little below the knee to the middle of the thigh; when at work in their igloos they take off the lower pieces and use their bare thighs as boards for cleaning sealskins on. Amongst most races, as in England, the dress of young children—both boys and girls—resembles that of their mothers, but Eskimo little girls wear trousers like those of the men, made all in one piece, until they are twelve years old.

Most of the Eskimo cannot count higher than ten, and many not higher than six; some are said to have numbers to twenty, but they are few. The names of the same numerals are differently pronounced, and difficulty was experienced in finding a native who knew the names well enough to give them all up to ten.

When a woman is about to be confined she is placed in a small skin tent in summer or a small snow hut in winter, with a little girl only to attend her. This is done for fear the mother or child may die, in which case the tent and all in it could never be used again. For the same reason any native when very ill is carried out to die. In some instances this custom is obliged to be modified. For example, a tent cover thus under tabu is sometimes cut off at about two feet from the ground all round, and the top is used. In one case a man's wife shot herself accidentally in her igloo; the gun was too great a sacrifice for the husband; he used it, but everything else was left to waste away where it lay. After the birth of the child the mother, with the child on her back, is conducted by an aged female ancoot to a level spot on the ice, where a curious ceremony of marching in circles is performed.

The following legend gives directions as to how a person may become an *ancoot* or *angekok*. It is interesting because it does not differ essentially from the Greenlanders' account of the same thing. An "ancoot" may be regarded as the most primitive representative of the priestly office.

"Any one wishing to be an ancoot must go away a long distance from where there is any other person. Then he must find a large stone and seat himself by it, and call on *Torngarsuk* (the greatest spirit of good and evil; the name is now used by instructed natives for the devil). This spirit will then make himself present to him. The would-be ancoot will at first be very much frightened at the arrival and appearance of the spirit, so much so that he is seized with severe pains and falls down and dies, and remains dead for three days. Then he comes to life again, and returns home a very wise man."

An ancoot's duty is, first, to heal the sick by muttering over them; secondly, to talk to Torngarsuk and get useful information: thirdly, by this means to foretell deaths and misfortunes. He leads in such ceremonies as the killing of the evil spirit of the deer, an extraordinary jumping, shouting, and stabbing performance directed against an imaginary deer. A successful ancoot of long standing may reach higher grade and become a great ancoot by means of periods of fasting and an existence for a time in the condition of a walrus.

If an ancoot's prophecy does not come to pass, he says that a halo, corona, aurora, or some such phenome-

non which has occurred has broken the spell; but often he is truly oracular in his utterances, as in a case overheard by the author, in which one was asked by a young woman if her child would be a boy or a girl. He went outside the hut for a time, and on returning said it would "be a boy," but "if it is not a boy it will be a girl." His fee for this was three sealskins and a knife.

The Hogarth Sound Eskimo, unlike the Greenlanders, have no permanent habitations. They live in snow houses (*igloos*) till June, when the snow melts, and then take to their skin tents or *toopiks* till the latter part of October, when they build igloos again.

A detailed account of the mode of making of the igloos is given, and a horrible one of the condition of the inhabited interior. Behind and around the lamps the Eskimo pile up their meat, and the pile soon becomes extremely offensive both to sight and smell. Meat is sometimes brought in that is already spoiled, although the temperature may be 50° below zero. This often happens with deer, which, unless disembowelled as soon as killed, rapidly decompose inside before freezing through.

Bows and arrows have been discarded for fire-arms, but are, as usual amongst other races, maintained in use by the children, who kill snow-birds and lemmings with them. The Eskimo are not very expert at making traps or snares apparently, but the simple box-trap of ice for foxes seems to be very effective. The slab of ice which falls and closes it is simply supported by a small upright of ice resting on the bait, and comes down directly the fox pulls at the meat. The author tried steel traps for the foxes, without success; the wily foxes always dug under the traps in the snow, and got at the bait from below.

Nearly all the Eskimo become snow-blind in spring, and generally do not put on their well-known wooden eye-blinkers until the condition of their eyes forbids their going out without them.

The ceremony of greeting a stranger on his arrival at a village is curious, and ends by the ancoot and the stranger stepping out before the villagers and dealing one another alternately a knock-down blow on the cheek, the ancoot of course having first hit: the two then kiss. In another ceremony vestments are used, that is to say, the ancoot puts on a great many pairs of trousers, as a preparation. Formerly all the implements of a dead man were left to rot in his grave, as amongst other American races and so very many peoples in various parts of the world, but of late years the Eskimo have amended this usage, and after the things have remained a short time in the grave, they are taken out and used again by the relatives. In very recent graves tin cups and pots, knives, and even one fork, a photograph, and a *Harper's Weekly Newspaper* were found, a fact which reminds us of having seen a sewing machine rusting on the grave of a Chinook woman in Oregon.

Charms of very various kinds are worn about the person by the Eskimo, and much prized and handed down for generations; one such consisted of two small stones, one a bluish flint, the other apparently meteoric iron. An ancestor discovered by accident that the two would strike fire, and became, in consequence of their possession, a great man amongst the people. The old woman to whom this charm belonged, considered it of inestimable value, for she said, "No one has yet died while wearing this charm." The ancoots are often very expert jugglers. A common trick is for one of them to come into a hut with a harpoon toggled in his breast and the handle sticking in his back, the wound bleeding profusely.

Of the creation of man the Eskimo say: "In the beginning there grew up from the earth a man; he got a wife from one of his *thumbs*, and from this pair the race has originated. But the whites, whom they call *cablunet*, or *codlunak*, they have sprung from dogs. An Eskimo woman at one time gave birth to human beings and dogs. The latter she put in an old boot, and threw them out into the sea, saying, Go hence, and become white people. From this it happens that the whites live on the sea and their ships are like Innuit's boots, round at both ends. This is a very different notion from the Australian "tumble down, black fellow, jump up, white fellow," and less complimentary to the pale faces.

A good deal of the information about the Eskimo given by the author is of course not new, but the descriptions are very fresh and good, and it is of importance to have so full an account of the present condition of the natives of the west coast of Davis Straits.

An account of the mammalia of Hogarth Sound by the same author follows the ethnological ones. The mammalia seem to be disappearing from the neighbourhood with great rapidity. Bears, walrus, and the hooded seal are very scarce up the sound, and of the musk-ox the traces remain only in the personal name "omingmuk," which is used commonly amongst the Eskimo, who know the animal well as found far to the north.

In the account of the Eskimo dogs the curious theory is upheld by Mr. Kumlien that the peculiar rabies of which they so commonly die is produced in the males by unrequited affection towards the opposite sex, and instances in proof are cited. At least four-fifths of the dogs so dying are males.

There is an interesting account of the various seals of the coast and their habits, and of the modes of catching them adopted by the Eskimo, and also of the whales. The author has known the white whales (*Beluga catodon*) to come in close proximity to the ship and lie along her sides for protection when pursued by the grampus or killer, *Orca gladiator*. The white whales ascend the sound as soon as the ice begins to loosen, but for what purpose seems uncertain; the mothers already have their young with them, and as little or nothing is found in the animals' stomachs when killed, they do not appear to go up the sound for food. In July they repair in hundreds to the sand-beaches of the fjords. The author suggests that perhaps they roll against the sand to free themselves of parasites. Numerous seals (apparently *Pagomys fœtidus*) were found inhabiting a fresh-water lake, Lake Kennedy, lying at a considerable distance inland.

In the account of the birds, also by Mr. Kumlien, some curious notes on the habits of ravens, which are extraordinarily common on the sound, are given. Six or seven hunting in company soon kill a young reindeer, and "in the capture of the young seal, *Pagomys fœtidus*, the birds evince a considerable degree of intelligence. I have on different occasions witnessed them capture a young seal that lay basking in the sun on the ice near its hole. The first manœuvre of the ravens was to sail leisurely over the seal, gradually lowering with each circle, till at last one of them suddenly dropped directly into the seal's hole, thus cutting off its retreat from the water. Its mate would then attack the seal, and endeavour to drag or drive it as far away from the hole as possible. The attacking raven seemed to strike the seal on the top of the head with its powerful beak, and thus break the tender skull. In two instances I allowed the combat to proceed until the seal was killed, and then drove the ravens away. I found no marks upon the seal except those of the blows upon the head, which had fractured the skull in two places." Two ravens were seen to chase a hare in concert and kill it.

We regret that we cannot follow the author further.

The *Bulletin* contains lists of the fishes collected in addition, by Mr. T. H. Bean, with descriptions of species; of the crustacea by Mr. S. S. Smith; of the annelides, tunicata, bryozoa, echinoderms, and cœlenterates by Prof. Verrill; of the mollusca by Mr. W. H. Dall; of the insects by Messrs. Edwards and Scudder; and of the plants by Prof. Asa Gray and Messrs. E. Tuckerman and W. G. Farlow.

EXPERIMENTAL RESEARCHES IN ELECTRICITY[1]

II.

THE experiments were made in a bell-jar, containing the terminals, which could be gradually exhausted after having been filled with air or other gas. One of the terminals was fixed to the bottom plate, the other could be adjusted to any distance from it by a rod sliding through a stuffing-box in the glass cover. The foot of the stand was insulated by a disk of ebonite, on which it stands. One such bell-jar is 9¼ inches (23·4 centims.) high, and 5⅝ inches (14·9 centims.) in diameter; its cubical content, ascertained by covering the open ends with glass plates and filling with water from a graduated measure, was found to be 3,787 cub. centims.

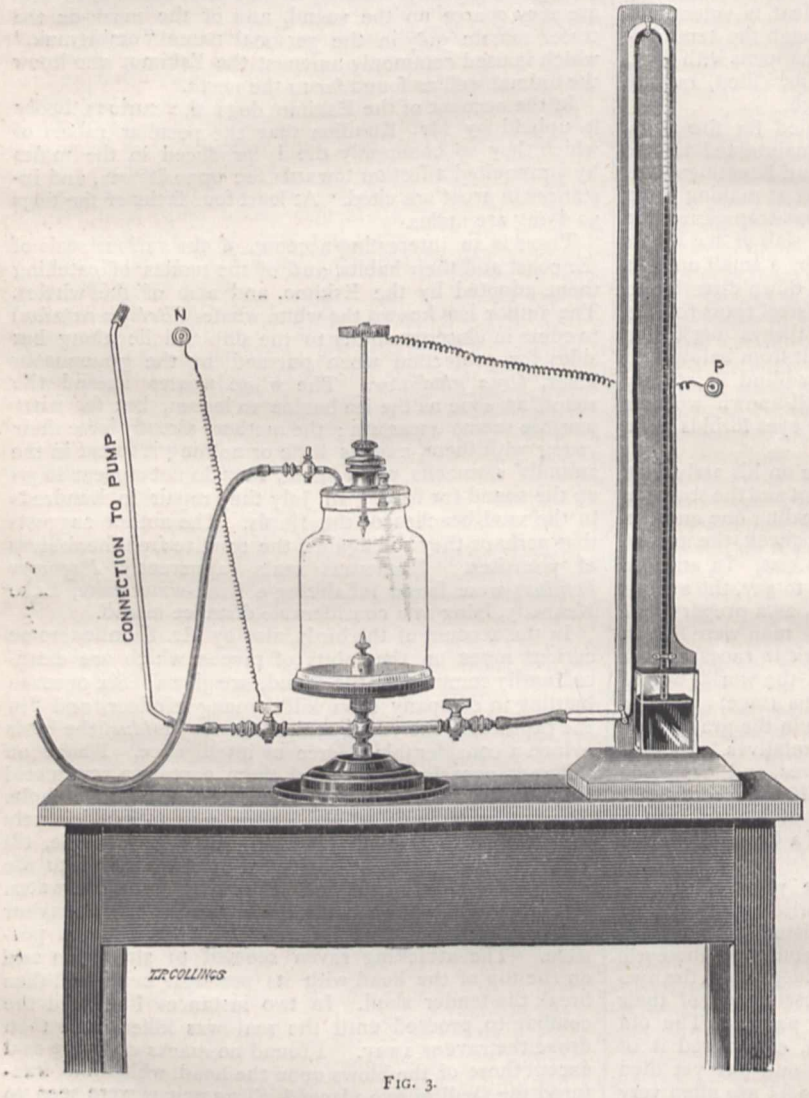


FIG. 3.

A remarkable phenomenon was observed on making connection between the terminals and the battery by means of the discharging key, namely, that within certain limits of pressure in the bell-jar a sudden expansion of the gas took place, and that as soon as the connection was broken the gas then as suddenly returned nearly, but not quite, to its original volume in consequence of a slight increase of temperature. The effect was exactly like that which would have been produced if an empty bladder had been suspended between the terminals and suddenly inflated and as suddenly emptied.[1]

The following experiment in rarefied air, at a pressure of 56 mm., at a temperature of 17°·5 C., will give an idea of the amount of instantaneous expansion which occurs when the terminals are connected with the poles of the battery of 11,000 cells, current 0·01102 W; the resistance of the bell-jar was reproduced by substituting 600,000 ohms wire resistance.

	mm.	M.
Distance of the terminals—the top one a point, the lower a disk—6 in.; pressure	56	... 73,684
On making contact the arc passed and the column of mercury was depressed ...	15·8	... 20,789
Pressure on connection ...	71·8	= 94,473

The increased was to the normal pressure in the ratio of 1·282 to 1; as the gas was kept at a constant volume, and supposing the expansion to be due to an increase of temperature, the pressure would vary as the absolute temperature,[2] therefore

$$\frac{T'}{T} = \frac{71{\cdot}8}{56} = 1{\cdot}282, \text{ whence}$$

$$T' = 1{\cdot}282 \times 291{\cdot}2 = 373°{\cdot}3 \text{ C.};$$

$$(373{\cdot}3 - 273{\cdot}7) = 99°{\cdot}6 \text{ C.},$$

the temperature of the bell-jar, and $(99{\cdot}6 - 17{\cdot}5) = 82°{\cdot}1$, the rise of temperature while the discharge was taking place. But the temperature of the bell-jar as determined by a thermometer inclosed in it with its bulb uppermost only rose 0° 64 C. per second, taking into account the rate of cooling. It is evident, therefore, that the increase of pressure cannot be ascribed to the instantaneous heating of the bell-jar 82° C.

Taking the dimensions of the arc from a photograph shown in the plate, Fig. 30, it was calculated that it must have attained the enormous temperature of 16,114° C., if the increase of pressure was really due to heat. It was found that platinum wires 0·001 inch in diameter supported in various parts of the arc, as shown in the plate, Fig. 30, were immediately fused; the temperature of the arc was therefore as high as the fusion-point of platinum, and possibly considerably higher.

If the whole of the heat evolved by a current of 0·01102 W, through a resistance of 600,000 ohms had been communicated to the air in the jar, weighing 0·339 grm., it would raise it 215°·6 C. in one second. It is known from direct experiment that this enormous evolution of heat was not communicated to any extent to the air in the bell-jar, because its temperature only increased about 0°·64 C. per second; the heat must consequently have escaped almost instantaneously by radiation. It is difficult consequently to realise the conjecture that the enormous dilatation which occurred instantaneously could have been caused by increase of temperature. And it points to its being produced by a projection or scattering of the molecules by electrification causing them to press outwards against the walls of the containing vessel, this pressure being distinct from the motion caused by heat.

[1] "Experimental Researches on the Electric Discharge with the Chloride of Silver Battery," by Warren De La Rue, M.A., D.C.L., F.R.S., and Hugo W. Müller, Ph.D., F.R.S. Continued from p. 153.

[1] De la Rive noticed that oscillations occurred in the mercury of a gauge attached to an exhausted tube as soon as the current passed.

[2] Absolute zero = 273·7 C., 273·7 + 17·5 = 291·2

The authors proceed to describe the appearance of the arc with terminals of various forms at different distances and with various pressures. It was found that the light emitted by different parts of the arc was not of the same intensity throughout, and that from the first there was a tendency to break up into distinct entities, as shown at A, B, C, D, E, F in the diagram, Fig. 4, which only indi-

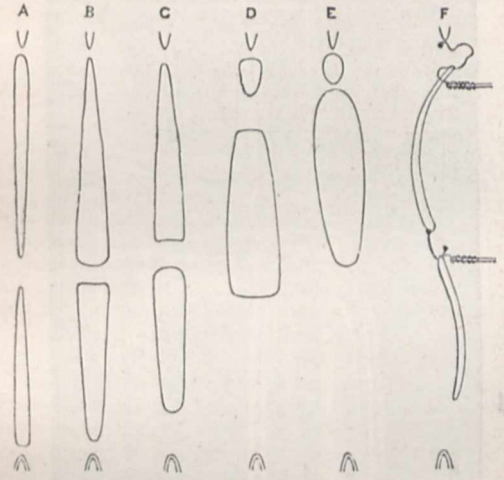


FIG. 4.

cates the central bright portion of the arc, this never quite reached the negative terminal, near which there was always the well-known dark discharge.

As the pressure was diminished the arc widened out, until at last the entire surface of the negative disk was covered with a luminous halo, and the discharge took up a stratified appearance.

The appearances presented by the arc in air, hydrogen, and carbonic acid are illustrated by copies of photographs and drawings in mezzotint, as shown in the Plate.

The arc in air between two points at various distances and pressures with a constant number of cells. Temp. 12·7 *C. The references are to the Plate*

11,000 cells, distance 0·54 inch, pressure atmospheric, current 0·02456 **W**; the total resistance of battery and arc was found to be 461,500 ohms, that of the arc, by substituting wire resistance, 27,550; whence the potential between the terminals was 657 cells. The appearance of the arc is shown in the plate, Fig. 20; it exhibits clearly the tendency to break up into luminous entities; the photograph of which this is a copy is nearly full size, and was obtained in twenty seconds. All the other copies of photographs are on a reduced scale. As the batteries were undergoing the annual overhauling, the number of cells, some being removed from time to time, was somewhat less in the following experiments, namely, 10,940.

Fig. 1, from a photograph obtained in 10 seconds.—Pressure atmospheric 748·6 mm., 985,000 **M**, distance 0·58 inch, current not observed, no depression of the mercury in the gauge was noticed; indeed, it will be seen that at the higher pressures the depression is generally less than at the lower, up to a certain point.

Fig. 2, from a photograph in 15 seconds.—Distance 0·58 × 2 = 1·16 inch, pressure 294·9 mm., 388,026 **M**, current 0·02881 **W**, depression 16 mm., total pressure 294·9 + 16 = 310·9; ratio of increased to normal pressure as 1·054 to 1. It will be observed that the central spindle has become bifurcated about midway.

Fig. 3, from a photograph in 15 seconds.—Distance × 3 = 1·74 inch, pressure 191·3 mm., 251,711 **M**, current 0·04060 **W**, depression 17 mm., total pressure 208·3 mm.; ratio of increased pressure 1·089. The bifurcation is apparent in this also.

Fig. 4, in which the central spindle is broken up into several luminosities.—Distance × 4 = 2·32 inches, pressure 142·6 mm., 187,631 **M**, current 0·04474 **W**, depression 19 mm., total pressure 161·6 mm.; ratio of increased pressure 1·133.

Fig. 5, from a photograph in 15 seconds; in this the central spindle is split up into bright entities connected by less bright portions.—Distance × 5 = 2·9 inches, pressure 112·6 mm. 148,157 **M**, current 0·03459 **W**, depression 19 mm., total pressure 131·6; ratio of increased pressure 1·169.

Fig. 6, from a photograph in 15 seconds. The luminous entities still seen, but are less marked.—Distance × 6 = 3·48 inches, pressure 99·4 mm., 130,789 **M**, current 0·03071 **W**, depression 21 mm., total pressure 120·4 mm.; ratio of increased pressure 1·211.

Fig. 7, from a photograph in 15 seconds.—Distance × 7 = 4·06 inches, pressure 85·9 mm., 113,026 **M**, current 0·03259 **W**, depression 22 mm., total pressure 107·9 mm.; ratio of increased pressure 1·256. The central spindle is divided into two luminosities, with a tendency to form a third near the negative.

Fig. 8, from a photograph in 15 seconds.—Distance × 8 = 4·64 inches, pressure 71·6 mm., 94,210 **M**, current 0·02693 **W**, depression 22 mm., total pressure 93·6 mm.; ratio of increased pressure 1·307. The central spindle nearly of the same character as Fig 7.

Fig. 9, from a photograph in 15 seconds —Distance × 9 = 5·22 inches, pressure 65·5 mm., 86,184 **M**, current 0·02693 **W**, depression 22 mm., total pressure 87·5 mm.; ratio of increased pressure 1·336. The bright entities show a tendency to break up into less bright portions.

Fig. 10, from a photograph in 15 seconds.—Distance × 10 = 5·8 inches, pressure 64·4 mm., 84,737 **M**, current 0·03071 **W**, depression 20 mm., total pressure 84·4 mm.; ratio of increased pressure 1·310. The arc resembles that seen in Fig. 9.

The appearance of the arc between disks in hydrogen at the various pressures used in determining the potential necessary to produce a discharge, is represented in the plate, Figs. 11-19.

		M		Cells			Seconds
Fig. 11	at pressure of	18,684,	with	602,	from a photograph	taken in	50
,, 12	,,	58,684	,,	1200	,,	,,	50
,, 13	,,	141,974	,,	2400	,,	,,	50
,, 14	,,	252,368	,,	3600	,,	,,	50
,, 15	,,	386,316	,,	4800	,,	,,	20
,, 16	,,	558,816	,,	6300	,,	,,	4
,, 17	,,	558,816	,,	6300	,,	,,	1
,, 18	,,	651,316	,,	7760	,,	,,	5
,, 19	,,	1,008,421	,,	10,920	,,	,,	5

The arc in hydrogen between two points. Temp. 16°·2 C., 10,940 *cells*

Distance 0·75 inch, pressure 745 mm., 980,263 **M**, current 0·01575 **W**, the appearance is represented in the plate, Figs. 21 and 22, the first copied from a photograph obtained in 5 seconds, the second in 15 seconds. The central spindle breaks into a brush-like form towards the negative, there is then a dark interval between it and the glow on the negative.

Fig. 26, from a drawing.—Distance 0·9 inch, pressure 745 mm., 980,263 **M**, the discharge passed intermittently, so that the current could not be read off on the galvanometer. The appearance is represented full size.

Figs. 23, 27, 28.—Distance 0·9 × 2, 1·8 inch, pressure 385·6 mm., 507,368 **M**, current 0·01575 **W**, depression 14 mm., total pressure 399·6 mm., ratio of increased pressure 1·04. Fig. 23 is from a photograph in 13 seconds. The distance between the brush-like termination of the central spindle and the glow on the negative has relatively increased. Figs. 27 and 28 are other representations copied from drawings.

Fig. 24, from a photograph in 15 seconds.—Distance × 3, 2·7 inches, pressure 317·8 mm, 418,158 **M**, current 0·00580 **W**, depression 13 mm., total pressure 330·8 mm.,

ratio of increased pressure 1·04. The central spindle relatively still shorter. At times only the terminals were illuminated, but sometimes strata formed on the positive terminal. Fig. 29 is another representation copied from a drawing.

Fig. 25.—Distance × 4, 3·6 inches, pressure 170·5 mm., 224,342 M, 6300 cells, current not measured. The central spindle has decreased relatively still more.

Fig. 34, Distance × 7, 6·3 inches, pressure 3 mm., 3947 M, 1200 cells, the bottom point positive current 0·03896 W, a splendid stratification, though somewhat unsteady; the figure partly copied from a photograph, partly from drawings. It was thought at first that well-defined strata would not be formed in a jar of such large diameter with the quantity of current at disposal, but this experiment shows that this conjecture was unfounded. The negative glow completely fills the neck of the jar.

Fig. 31.—Distance 6·3 inches, pressure 2·4 mm., 3158 M, 1200 cells, current 0·02728 W, a very steady stratification when the bottom point was positive; this curious stratification completely overlapped the whole surface of the bottom point and the brass holder, as if pushed back by a force emanating from the negative, the glow around the negative completely filled the upper portion of the jar.

An inner tube was now inserted in the bell-jar in order to ascertain whether the contraction of the space surrounding the discharge would have any effect on the production of strata. A number of holes had been drilled in opposite sides of the tube, which is 8 inches long and 1·8 inch in diameter. These holes were drilled with the object of straining very fine platinum wires across at different heights for ascertaining the temperature of the arc at these positions, but in the experiments about to be described there were no wires.

The bell-jar was refilled with hydrogen and exhausted; distance of points 6·3 inches, pressure 2 mm., 2,632 M, 2,400 cells; when the top point was positive there was a production of ordinary strata resembling (Fig. 32). But when the bottom was positive a very remarkable phenomenon was observed, namely, the protrusion of strata through the small holes, $\frac{1}{4}$th inch in diameter, in the walls of the inner tube, this being accompanied by an overpouring of negative discharge above the top of it (Fig. 33). It seemed as if the positive discharge sought a complete neutralisation with negative electricity beyond the confines of the tube, the area of which was too small to permit of complete relief. The close confinement of the discharge at the bottom end of the tube which rests on the glass plate of the pump may account for the non-oozing out of strata through the holes when the top point was positive.

Some gas let in, pressure 4 mm., 5,263 M, 2,400 cells, current 0·15470 W, a well-defined stratification occurred when the bottom point was negative, but no oozing out through the holes in the tube, Fig. 32.

In order to prosecute their experiments in a vessel of still greater capacity, the authors had constructed a larger jar with a neck at each end, or more properly speaking, perhaps, a tube supported horizontally on ebonite crutches. It is 37 inches long and $5\frac{3}{8}$ inches in diameter, its cubical content was found to be 14,435 cub. centims., or 3·8 times that of the bell-jar employed in the experiments on the electric arc. The tube is shown in Fig. 5.

The experiments with this tube will necessarily occupy a considerable period, partly on account of the long time it takes to exhaust it after each set, partly on account of the variety of experiments it is intended to make with it; consequently they describe only a few of the first results hitherto obtained.

For Example in Air

Pressure 3 mm., 3,947 M, 6,300 cells. Two luminosities were formed, the ring negative being surrounded with a nebulosity which completely filled the end of the tube. The tube glowed brilliantly with a blue fluorescent light, which proved to have great actinic power. A dry-plate photograph obtained in five seconds records a very curious phenomenon, namely, that the outer boundary of the

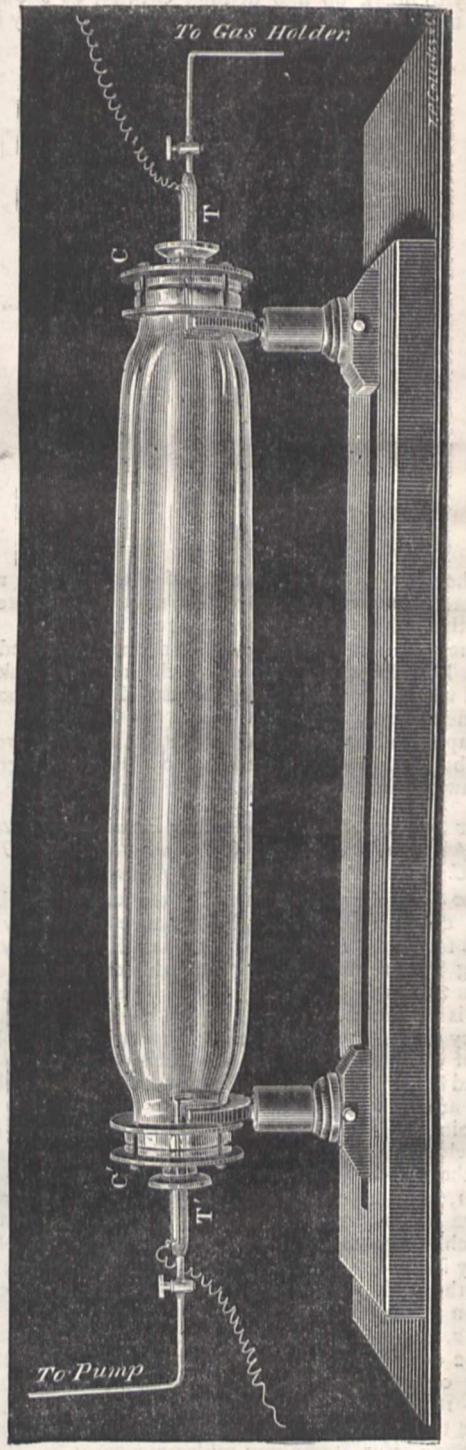
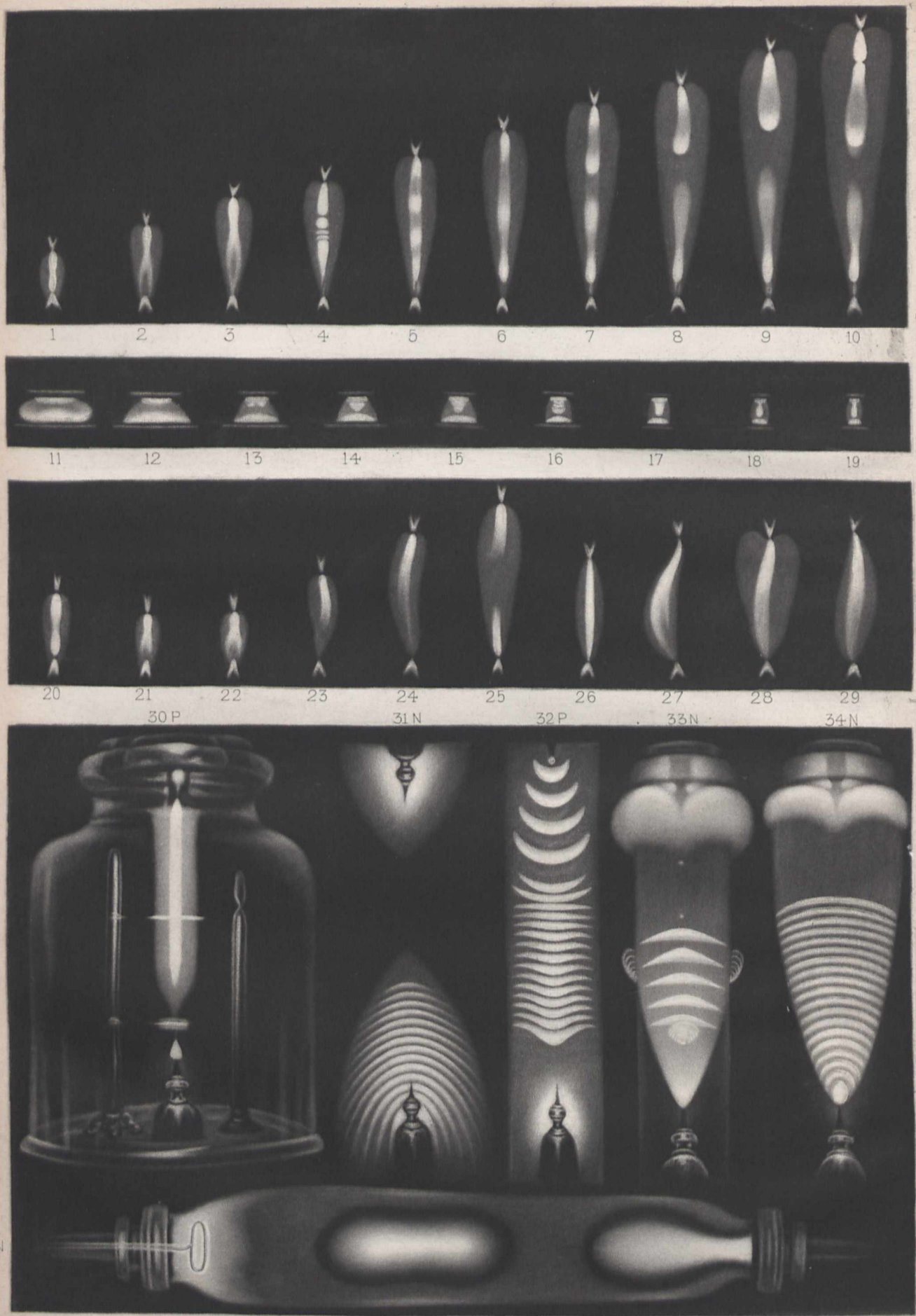


Fig. 5

luminosity appears *darker* than the tube (Fig. 35). It is to be remarked that while the discharge was reddish (nitrogen), the fluorescence of the tube was blue; the effect appears to be due to the absorption of a portion of the fluorescent light emanating from the back of the



D.J. Pound, Sculpt.

tube in passing through the red luminosity. The effect was quite unexpected, and it was thought at first that it might have arisen from some peculiarity in the development of the dry plate; it was not therefore until the result had been confirmed by other photographs that they ventured on the explanation above given.

A few experiments were made with hydrogen in this same tube; and the appearances observed are shown in Fig. 6, A B C.

Pressure 22 mm., 28,948 M, 11,000 cells, current 0·01412 W. The glow on negative extended to three-eighths of an inch, a spear-head luminosity on the positive wire, to which it was attached by a very bright wire-like stem not greater in diameter than the terminal, A (Fig. 6).

Pressure 15 mm., 19,737 M, 11,000 cells, current 0·03071 W. A spindle-shaped luminosity at the positive about 1½ inch long, and the negative ring completely surrounded with a glow which had increased considerably since A. After a short time the spindle on the positive lengthened out and nearly reached the negative, hugging the underside of the tube as in B (Fig. 6). It was not sensitive to the approach of the finger, although close to the glass; 6,300 cells produced the same phenomena.

Pressure 4 mm., 5,263 M, 6,300 cells, current 0·03459 W. The discharge in the latter case was partially stratified, C.

The paper closes with the following conclusions:—

1. *For all gases there is a minimum pressure which offers the least resistance to the passage of an electric discharge. After the minimum has been reached, the resistance to a discharge rapidly increases as the pressure of the medium decreases.* With hydrogen the minimum is 0·64 mm., 842 M; at 0·002 mm., 3 M, it is as great as at 35 mm., 46,000 M.

2. *There is neither condensation nor dilatation of a gaseous medium in contiguity with charged terminals.*

3. *When the discharge takes place there is a sudden dilatation of the medium in addition to, and distinct from, that caused by heat. This dilatation ceases instantaneously when the discharge ceases.*

4. *The potential necessary to produce a discharge between parallel flat surfaces at a constant distance and various pressures, or at a constant pressure and various distances, may be represented by hyperbolic curves. The resistance of the discharge between parallel flat surfaces being as the number of molecules intervening between them.*

5. *This law does not hold with regard to points. In Part I. it has been shown that the potential necessary to produce a discharge at the atmospheric pressure and various distances is as the square root of the distances, while with a constant potential and various distances, the pressure has to be diminished in a greater ratio than that of the increase of distance in order to permit a discharge to take place.*

6. *The electric arc and the stratified discharge in vacuum tubes are modifications of the same phenomenon.*

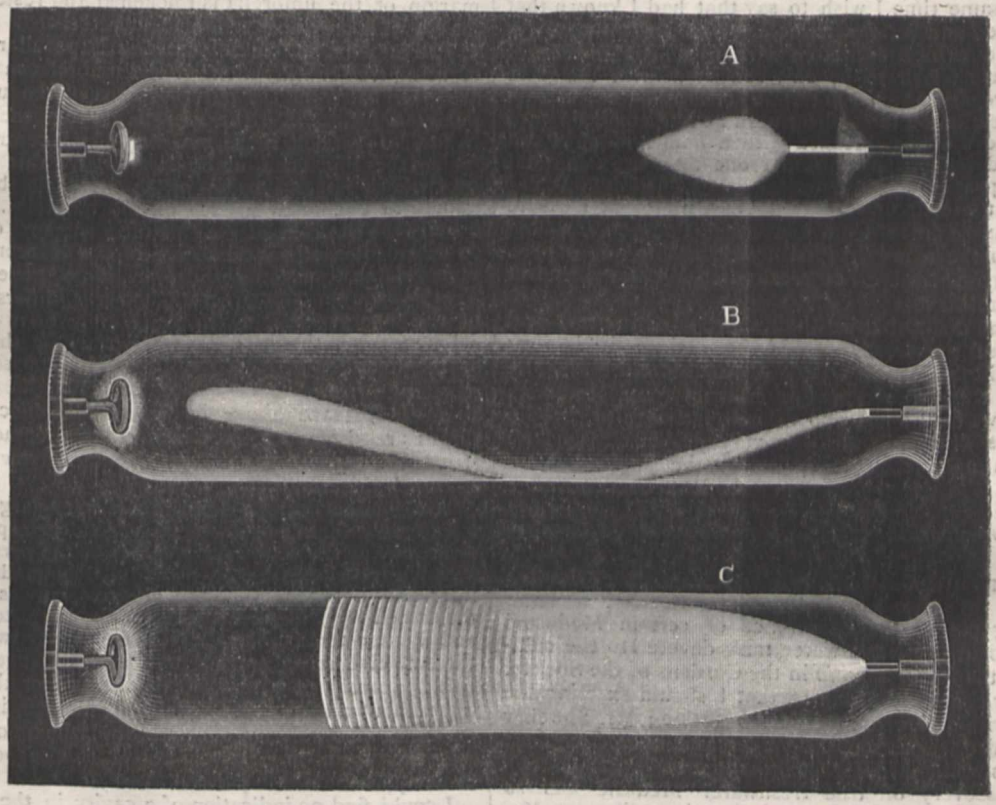


FIG. 6.

Lastly, the authors say:—

"We have again pleasure in thanking Prof. Stokes for his much-valued advice during the course of our investigations. To our assistant, Mr. Fram, we are indebted for his able co-operation; and we have to thank Mr. H. Reynolds for his aid and skill in taking photographs."

THE NEW FRESHWATER JELLY FISH

WE have received the following communications on this subject:—

The Freshwater Medusa

WHEN I last week sent you an account of the new genus of freshwater Medusæ, to which I gave the name Craspedacustes, I was not aware that Prof. Allman had prepared, or even that he was intending to prepare, an account of the same animal for the Linnean Society's

meeting of Thursday (your day of publication). The specimens on which I worked were given to me by Mr. Sowerby, the secretary of the Botanical Society, who discovered the animal, and in reply to my particular inquiry as to whether any naturalist had been charged by him with the task of working it out, he said that no one had, but that he had freely given specimens to several gentlemen. He asked me to find a name for the new Medusa, and I promised to send him a copy of what I should publish on the subject.

I hold it to be a very excellent thing that there is a certain kind of honour attaching to the priority of description of new and important genera among zoologists. It appears to me to give a zest and stimulus to hard work in the cause of zoology which is very far from being a thing to be despised. I confess to having worked at that Medusa day and night when I first obtained it, with the object of having the pleasure and honour of being the first to expound its structure to my brother naturalists.

At the same time I wish to say that had I known that so esteemed and veteran a zoologist as Dr. Allman was anxious to associate himself with this little novelty, I should have felt it to be only consistent with the great personal regard which I entertain for him to abstain from any publication on the subject until he had come forward to provide the new Medusa with a name, which I am sure would have been a prettier one than my somewhat unwieldy proposal.

Under these circumstances it gives me great pleasure to say that, so far as I am concerned, I am quite willing to give up the name Craspedacustes, and to adopt Prof. Allman's name for the new freshwater Medusa whenever he may publish it.

I have no doubt that we shall shortly hear a great deal more about the freshwater Medusa, since it is very abundant in the Regent's Park lily-house, and since Mr. Sowerby, with true scientific liberality and courtesy, freely allows naturalists who desire specimens to provide themselves with such, and has very properly placed no restriction upon their study or on the publication of results.

E. RAY LANKESTER

On "Limnocodium victoria," a Hydroid Medusa of Fresh Water

A SHORT time since I received from Mr. Sowerby, Secretary of the Royal Botanical Society, a letter informing me of the occurrence of certain Medusoid organisms in the warm-water tank devoted to the cultivation of the *Victoria regia* in the Gardens of the Society. The letter contained a request that I should examine the animals with a view to their determination; Mr. Sowerby accompanied it with rough sketches, and offered to place specimens at my disposal for investigation.

The discovery of true freshwater Medusæ was so startling a fact that I lost no time in calling on Mr. Sowerby, with whom I visited the tank, and carried away such specimens as were needed for examination.

The water in the tank had then a temperature of 86° F., and was literally swarming with little Medusæ, the largest of which measured nearly half an inch in transverse diameter. They were very energetic in their movements, swimming with the characteristic systole and diastole of their umbrella, and apparently in the very conditions which contributed most completely to their well-being.

As it now became evident that the Medusa belonged to a generic form hitherto undescribed, I prepared for the Linnean Society a paper containing the results of my examination, and assigning to the new Medusa the name of *Limnocodium victoria* (λίμνη, a pond, and κώδων, a bell). This was received and recorded by the secretaries on June 14, and read at the next meeting, on the 17th.[1]

[1] Some facts in addition to those contained in my original paper are included in the present communication.

The umbrella varies much in form with its state of contraction, passing from a somewhat conical shape with depressed summit through figures more or less hemispherical to that of a shallow cup or even of a nearly flat disk. Its outer surface is covered by an epithelium composed of flattened hexagonal cells with distinct and brilliant nucleus. The manubrium is large; it commences with a quadrate base, and when extended projects beyond the margin of the umbrella. The mouth is destitute of tentacles, but is divided into four lips, which are everted and plicated. The endoderm of the manubrium is thrown into four strongly-marked longitudinal plicated ridges.

The radial canals are four in number; they originate each in an angle of the quadrate base of the manubrium, and open distally into a wide circular canal. Each radial canal is accompanied by longitudinal muscular fibres, which spread out on each side at the junction of the radial with the circular canal.

The velum is of moderate width, and the extreme margin of the umbrella is thickened and festooned, and loaded with brownish-yellow pigment cells.

The attachment of the tentacles is peculiar. Instead of being free continuations of the umbrella margin, they are given off from the outer surface of the umbrella at points a little above the margin. From each of these points, however, a ridge may be traced centrifugally as far as the thickened umbrella margin; this is caused by the proximate portion of the tentacle being here adnate to the outer surface of the umbrella. It holds exactly the position of the "mantelspangen" or *peronia*, so well developed in the whole of the Narcomedusæ of Haeckel, and occurring also in some genera of his Trachomedusæ. Its structure, however, differs from that of the true *peronia*, which are merely lines of thread-cells marking the path travelled over by the tentacle as the insertion of this moved in the course of metamorphosis from the margin of the umbrella to a point at some distance above it, while in Limnocodium the ridges are direct continuations of the tentacles whose structure they retain. They become narrower as they approach the margin.

The number of the tentacles is very large in adult specimens. The four tentacles which correspond to the directions of the four radial canals or the perradial tentacles are the longest and thickest. The quadrant which intervenes between every two of these carries, at nearly the same height above the margin, about thirteen shorter and thinner tentacles, while between every two of these three to five much smaller tentacles are given off from points nearer to the margin, and at two or three levels, but without any absolute regularity; indeed, in the older examples all regularity, except in the primary or perradial tentacles, seems lost, and the law of their sequence ceases to be apparent.

I could find no indication of a cavity in the tentacles; but they do not present the peculiar cylindrical chorda-like endodermal axis formed by a series of large, clear, thick-walled cells which is so characteristic of the solid tentacles in the Trachomedusæ and Narcomedusæ. From the solid tentacles of these orders they differ also in their great extensibility, the four perradial tentacles admitting of extension in the form of long, greatly-attenuated filaments to many times the height of the vertical axis of the umbrella, even when this height is at its maximum; and being again capable of assuming by contraction the form of short thick clubs. Indeed, instead of presenting the comparatively rigid and imperfectly contractile character which prevails among the Trachomedusæ and the Narcomedusæ, they possess as great a power of extension and contraction as may be found in the tentacles of many Leptomedusæ (Thaumantidæ, &c.). These four perradiate tentacles contract independently of the others, and seem to form a different system. All the tentacles are armed along their

length with minute thread cells, which are set in close somewhat spirally-arranged warts.

The lithocysts or marginal vesicles are, in adult specimens, about 128 in number. They are situated near the umbrellar margin of the velum, between the bases of the tentacles, and are grouped somewhat irregularly, so that their number has no close relation with that of the tentacles. They consist of a highly refringent spherical body, on which may be usually seen one or more small nucleus-like corpuscles, the whole surrounded by a delicate transparent and structureless capsule. This capsule is very remarkable, for instead of presenting the usual spherical form, it is of an elongated piriform shape. In its larger end is lodged the spherical refringent body, and it thence becomes attenuated, forming a long tubular tail-like extension which is continued into the velum, in which it runs transversely towards its free margin, and there, after usually becoming more or less convoluted, terminates in a blind extremity.

The marginal nerve-ring can be traced running round the whole margin of the umbrella, and in close relation with the otolitic cells. Ocelli are not present.

The generative sacs are borne on the radiating canals, into which they open at a short distance beyond the exit of these from the base of the manubrium. They are of an oval form, and from their point of attachment to the radial canal hang down free into the cavity of the umbrella. Some of the specimens examined contained nearly mature ova, which, under compression, were forced from the sac through the radial canal into the cavity of the stomach.

While some of the characters described above point to an affinity with both the Trachomedusæ and Narcomedusæ, this affinity ceases to show itself in the very important morphological element afforded by the marginal bodies. In both Trachomedusæ and Narcomedusæ the marginal bodies belong to the tentacular system; they are metamorphosed tentacles, and their otolite cells are endodermal, while in the Leptomedusæ, the only other order of craspedotal Medusæ in which marginal vesicles occur, these bodies are genetically derived from the velum. Now in Limnocodium the marginal vesicles seem to be as truly velar as in the Leptomedusæ. They occur on the lower or abumbral side of the velum, close to its insertion into the umbrella, and the tubular extension of their capsule runs along this side to the free margin of the velum, while the delicate epithelium of the abumbral side passes over them as in the Leptomedusæ. It is true that this point cannot be regarded as settled until an opportunity of tracing the development is afforded; but in very young specimens which I examined I found nothing opposed to the view that the marginal vesicles were derived, like those of the Leptomedusæ, from the velum.

Important points still remain to be cleared up regarding the development of Limnocodium and the determination of the question whether the Medusa be derived from the egg directly or only through the intervention of a hydranlid trophosome. I have arranged with Mr. Sowerby some methods of observation by which I hope to obtain data for determination of these points.

If this be the case Limnocodium will hold a position intermediate between the Leptomedusæ and the Trachomedusæ; but as the greatest systematic importance must be attached to the structure and origin of the marginal vesicles, its affinity with the Leptomedusæ must be regarded as the closer of the two. GEO. J. ALLMAN

Physiology of the Freshwater Medusa

THE structure of this remarkable animal has already been investigated and described by Professors Allman and Lankester, with the result of showing that, although constituting a new genus, it is in all respects a true Medusa. After the publication of their papers I began to work out the physiology of the new form, and the following are the results which so far I have obtained.

The natural movements of the Medusa precisely resemble those of its marine congeners. More particularly, these movements resemble those of the marine species which do not swim continuously, but indulge in frequent pauses. In water at the temperature of that in the Victoria Lily-house (85° F.) the pauses are frequent, and the rate of the rhythm irregular—suddenly quickening and suddenly slowing even during the same bout, which has the effect of giving an almost intelligent appearance to the movements. This is especially the case with young specimens. In colder water (65° to 75°) the movements are more regular and sustained; so that, guided by the analogy furnished by my experiments on the marine forms, I infer that the temperature of the natural habitat of this Medusa cannot be so high as that of the water in the Victoria Lily-house. In water at that temperature the rate of the rhythm is enormously high, sometimes rising to three pulsations per second. But by progressively cooling the water, this rate may be progressively lowered, just as in the case of the marine species; and in water at 65° the maximum rate that I have observed is eighty pulsations per minute. As the temperature at which the greatest activity is displayed by the freshwater species is a temperature so high as to be fatal to all the marine species which I have observed, the effects of cooling are of course only parallel in the two cases when the effects of a series of higher temperatures in the one case are compared with those of a series of lower temperatures in the other. Similarly, while a temperature of 70° is fatal to all the species of marine Medusæ which I have examined, it is only a temperature of 100° that is fatal to the freshwater species. Lastly, while the marine species will endure any degree of cold without loss of life, such is not the case with the freshwater species. Marine Medusæ, after having been frozen solid, will, when gradually thawed out, again resume their swimming movements; but this freshwater Medusa is completely destroyed by freezing. Upon being thawed out, the animal is seen to have shrunk into a tiny ball, and it never again recovers either its life or its shape.

The animal seeks the sunlight. If one end of the tank is shaded, all the Medusæ congregate at the end which remains unshaded. Moreover, during the daytime they swim about at the surface of the water; but when the sun goes down they subside, and can no longer be seen. In all these habits they resemble many of the sea-water species. They are themselves non-luminous.

I have tried on about a dozen specimens the effect of excising the margin of the nectocalyx. In the case of all the specimens thus operated upon, the result was the same, and corresponded precisely with that which I have obtained in the case of marine species. That is to say, the operation produces immediate, total, and permanent paralysis of the nectocalyx, while the severed margin continues to pulsate for two or three days. The excitability of a nectocalyx thus mutilated persists for a day or two, and then gradually dies out—thus also resembling the case of the marine naked-eyed Medusæ. More particularly, this excitability resembles that of those marine species which sometimes respond to a single stimulation with two or three successive contractions.

A point of specially physiological interest may be here noticed. In its unmutilated state the freshwater Medusa exhibits the power of localising with its manubrium a seat of stimulation situated in the bell. That is to say, when a part of the bell is nipped with the forceps, or otherwise irritated, the free end of the manubrium is moved over and applied to the part irritated. So far, the movement of localisation is precisely similar to that which I have previously described as occurring in *Tiaropsis indicans* (*Phil. Trans.*, vol. clxvii.). But further than this, I find a curious difference. For while in *T. indicans*

these movements of localisation continue unimpaired after the margin of the bell has been removed, and will be ineffectually attempted even after the bell is almost entirely cut away from its connections with the manubrium; in the freshwater Medusa these movements of localisation cease after the extreme margin of the bell has been removed. For some reason or another the integrity of the margin here seems to be necessary for exciting the manubrium to perform its movements of localisation. It is clear that this reason must either be that the margin contains the nerve-centres which preside over these localising movements of the manubrium, or, much more probably, that it contains some peripheral nervous structures which are alone capable of transmitting to the manubrium a stimulus adequate to evoke the movements of localisation. In its unmutilated state this Medusa is at intervals perpetually applying the extremity of its manubrium to one part or another of the margin of the bell, the part of the margin touched always bending in to meet the approaching extremity of the manubrium. In some cases it can be seen that the object of this co-ordinated movement is to allow the extremity of the manubrium—*i.e.*, the mouth of the animal—to pick off a small particle of food that has become entangled in the marginal tentacles. It is therefore not improbable that in *all* cases this is the object of such movements, although in most cases the particle which is caught by the tentacles is too small to be seen with the naked eye. As it is thus no doubt a matter of great importance in the economy of this Medusa that its marginal tentacles should be very sensitive to contact with minute particles, so that a very slight stimulus applied to them should start the co-ordinated movements of localisation, it is not surprising that the tentacular rim should present nerve-endings so far sensitive that only by their excitation can the reflex mechanism be thrown into action. But if such is the explanation in this case, it is curious that in *Tiaropsis indicans* every part of the bell should be equally capable of yielding a stimulus to a precisely similar reflex action.

In pursuance of this point I tried the experiment of cutting off *portions* of the margin, and stimulating the bell *above the portions of the margin which I had removed.* I found that in this case the manubrium did not remain passive as it did when the *whole* margin of the bell was removed; but that it made ineffectual efforts to find the offending body, and in doing so always touched some part of the margin which was still unmutilated. I can only explain this fact by supposing that the stimulus supplied to the mutilated part is spread over the bell, and falsely referred by the manubrium to some part of the sensitive—*i.e.*, unmutilated—margin.

But to complete this account of the localising movements it is necessary to state one additional fact which, for the sake of clearness, I have hitherto omitted. If any one of the four radial tubes is irritated, the manubrium will correctly localise the seat of irritation, whether or not the margin of the bell has been previously removed. This greater case, so to speak, of localising stimuli in the course of the radial tubes than anywhere else in the umbrella except the margin, corresponds with what I found to be the case in *T. indicans*, and probably has a direct reference to the distribution of the principal nerve-tracts.

On the whole, therefore, contrasting this case of localisation with the closely parallel case presented by *T. indicans*, I should say that the two chiefly differ in the freshwater Medusa, even when unmutilated, not being able to localise so promptly or so certainly; and in the localisation being only performed with reference to the margin and radial tubes, instead of with reference to the whole excitable surface of the animal.

All marine Medusæ are very intolerant of fresh water, and therefore, as the freshwater species must presumably have had marine ancestors,[1] it seemed an interesting question to determine how far this species would prove tolerant of sea water. For the sake of comparison I shall first briefly describe the effects of fresh water upon the marine species.[2] If a naked-eyed Medusa which is swimming actively in sea water is suddenly transferred to fresh water, it will instantaneously collapse, become motionless, and sink to the bottom of the containing vessel. There it will remain motionless until it dies; but if it be again transferred to sea water it will recover, provided that its exposure to the fresh water has not been of too long duration. I have never known a naked-eyed Medusa survive an exposure of fifteen minutes; but they may survive an exposure of ten, and generally survive an exposure of five. But although they thus continue to live for an indefinite time, their vigour is conspicuously and permanently impaired. While in the fresh water irritability persists for a short time after spontaneity has ceased, and the manubrium and tentacles are strongly retracted.

Turning now to the case of the freshwater species, when first it is dropped into sea water at 85° there is no change in its movements for about fifteen seconds, although the tentacles may be retracted. But then, or a few seconds later, there generally occurs a series of two or three tonic spasms separated from one another by an interval of a few seconds. During the next half minute the ordinary contractions become progressively weaker, until they fade away into mere twitching convulsions, which affect different parts of the bell irregularly. After about a minute from the time of the first immersion all movement ceases, the bell remaining passive in partial systole. There is now no vestige of irritability. If transferred to fresh water after five minutes exposure, there immediately supervenes a strong and persistent tonic spasm, resembling rigor mortis, and the animal remains motionless for about twenty minutes. Slight twitching contractions then begin to display themselves, which, however, do not affect the whole bell, but occur partially. The tonic spasm continues progressively to increase in severity, and gives the outline of the margin a very irregular form; the twitching contractions become weaker and less frequent, till at last they altogether die away. Irritability, however, still continues for a time—a nip with the forceps being followed by a bout of rhythmical contractions. Death occurs in several hours in strong and irregular systole.

If the exposure to sea water has only lasted two minutes, a similar series of phenomena are presented, except that the spontaneous twitching movements supervene in much less time than twenty minutes. But an exposure of even one minute may determine a fatal result a few hours after the Medusa has been restored to fresh water.

Contact with sea water causes an opalescence and essential disintegration of the tissues, which precisely resemble the effects of fresh water upon the marine Medusæ. When immersed in sea water this Medusa floats upon the surface, owing to its smaller specific gravity.

In diluted sea water (50 per cent.) the preliminary tonic spasms do not occur, but all the other phases are the same, though extended through a longer period. In sea water still more diluted (1 in 4 or 6) there is a gradual loss of spontaneity, till all movement ceases, shortly after which irritability also disappears; manubrium and tentacles expanded. After an hour's continued exposure intense rigor mortis slowly and progressively develops itself, so that at last the bell has shrivelled almost to nothing. An exposure of a few minutes to this strength places the animal past recovery when restored

[1] Looking to the enormous number of marine species of Medusæ, it is much more probable that the freshwater species were derived from them, than that they were derived from a freshwater ancestry.

[2] For full account, see *Phil. Trans.*, vol. clxvii., pp. 744-745.

to fresh water. In still weaker mixtures (1 in 8, or 1 in 10) spontaneity persists for a long time; but the animal gradually becomes less and less energetic, till at last it will only move in a bout of feeble pulsations when irritated. In still weaker solutions (1 in 12 or 1 in 15) spontaneity continues for hours, and in solutions of from 1 in 15 to 1 in 18 the Medusa will swim about for days.

It will be seen from this account that the freshwater Medusa is even more intolerant of sea water than are the marine species of fresh water. Moreover the freshwater Medusa is beyond all comparison more intolerant of sea water than are the marine species of brine. For I have previously found that the marine species will survive many hours' immersion in a saturated solution of salt. While in such a solution they are motionless, with manubrium and tentacles relaxed, so resembling the freshwater Medusa shortly after being immersed in a mixture of 1 part sea water to 5 of fresh; but there is the great difference that while this small amount of salt is very quickly fatal to the fresh-water species, the large addition of salt exerts no permanently deleterious influence on the marine species.

We have thus altogether a curious set of cross relations. It would appear that a much less profound physiological change would be required to transmute a sea-water jelly-fish into a jelly-fish adapted to inhabit brine, than would be required to enable it to inhabit fresh water. Yet the latter is the direction in which the modification has taken place, and taken place so completely that sea water is now more poisonous to the modified species than is fresh water to the unmodified. There can be no doubt that the modification was gradual—probably brought about by the ancestors of the freshwater Medusa penetrating higher and higher through the brackish waters of estuaries into the fresh water of rivers—and it would, I think, be hard to point to a more remarkable case of profound physiological modification in adaptation to changed conditions of life. If an animal so exceedingly intolerant of fresh water as is a marine jelly-fish may yet have all its tissues changed so as to adapt them to thrive in fresh water, and even die after an exposure of one minute to their ancestral element, assuredly we can see no reason why any animal in earth or sea or anywhere else may not in time become fitted to change its element.

GEORGE J. ROMANES

NOTES

THE Fiftieth Annual Meeting of the British Association will commence on Wednesday, August 25, 1880, at Swansea. The President Elect is Andrew Crombie Ramsay, LL.D., F.R.S., Director-General of the Geological Survey of the United Kingdom and of the Museum of Practical Geology. The Vice-presidents Elect are: The Right Hon. the Earl of Jersey, the Mayor of Swansea, the Hon. Sir W. R. Grove, D.C.L., F.R.S., H. Hussey Vivian, M.P., F.G.S., L. Ll. Dillwyn, M.P., F.L.S., J. Gwyn Jeffreys, LL.D., F.R.S.; and the General Secretaries: Capt. Douglas Galton, C.B., D.C.L., F.R.S., 12, Chester Street, Grosvenor Place, London, S.W., Philip Lutley Sclater, Ph.D., F.R.S., 11, Hanover Square, London, W.; Assistant-Secretary: J. E. H. Gordon, 22, Albemarle Street, London, W.; General Treasurer: Prof. A. W. Williamson, Ph.D., LL.D., F.R.S., University College, London, W.C.; Local Secretaries: W. Morgan, Ph.D., F.C.S., and James Strick, Swansea; and Local Treasurer: R. J. Letcher, Swansea. The Sections are the following:—A.—Mathematical and Physical Science.—President: Prof. W. Grylls Adams, F.R.S. Vice-Presidents: C. W. Merrifield, F.R.S.; C. W. Siemens, D.C.L., F.R.S. Secretaries: W. E. Ayrton; J. W. L. Glaisher, F.R.S.; Oliver J. Lodge, D.Sc.; Donald McAlister, B.Sc. (Recorder). B.—Chemical Science.—President: John Henry Gilbert, Ph.D., F.R.S. Vice-Presidents: I. Lowthian Bell, F.R.S.; William Crookes, F.R.S.; W. Chandler Roberts, F.R.S. Secretaries: Harold B. Dixon, F.C.S.: Dr. W. R. Eaton-Hodgkinson; P. Phillips-Bedson, D.Sc., F.C.S.; J. M. Thomson, F.C.S. (Recorder). C.—Geology.—President H. Clifton Sorby, LL.D., F.R.S. Vice-President: Prof. Archibald Geikie, LL.D., F.R.S., L. and E., Warington W. Smyth, F.R.S. Secretaries: W. Topley, F.G.S. (Recorder); W. Whitaker, F.G.S. D.—Biology.—President: A. C. L. G. Günther, M.D., F.R.S. Vice-Presidents: F. M. Balfour, F.R.S.; Prof. Newton, F.R.S.; F. W. Rudler, F.G.S. Secretaries: G. W. Bloxam, F.L.S. (Recorder); Prof. M'Nab, M.D. (Recorder); John Priestley; Howard Saunders, F.Z.S. E.—Geography.—President: Lieut.-General Sir John Henry Lefroy, C.B., K.C.M.G., F.R.S. Vice-Presidents:—Sir Henry Barkly, G.C.M.G., K.C.B., F.R.S.; Admiral Sir Erasmus Ommanney, C.B., F.R.S.; Lieut.-General Sir H. E. L. Thuillier, C.S.I., R.A., F.R.S. Secretaries: H. W. Bates, Assist.-Sec. R.G.S., F.L.S.; C. E. D. Black; E. C. Rye, Librarian R.G.S., F.Z.S. (Recorder). F.—Economic Science and Statistics.—President: George Woodyatt Hastings, M.P. Vice-Presidents: James Heywood, F.R.S.; William Newmarch, F.R.S.; Henry Richard, M.P. Secretaries: Noel A. Humphreys, F.S.S.; Constantine Molloy (Recorder). G.—Mechanical Science.—President: James Abernethy, C.E. Vice-Presidents: Prof. Osborne Reynolds, F.R.S.; Prof. James Stuart. Secretaries: A. T. Atchison (Recorder); H. Trueman Wood. The first general meeting will be held on Wednesday, August 25, at 8 p.m, precisely, when Prof. G. J. Allman, M.D., LL.D., F.R.S., L. & E., Pres. L.S., will resign the chair, and A. C. Ramsay, LL.D., F.R.S., V.P.G.S., Director-General of the Geological Survey of the United Kingdom, and of the Museum of Practical Geology, President-Elect, will assume the presidency and deliver an address. On Thursday evening, August 26, at 8 p.m., a *soirée;* on Friday evening, August 27, at 8.30 p.m., a discourse by Prof. W. Boyd Dawkins, F.R.S., on "Primæval Man"; on Monday evening, August 30, at 8.30 p.m., a discourse by Francis Galton, M.A., F.R.S., on "Mental Imagery"; on Tuesday evening, August 31, at 8 p.m., a *soirée;* on Wednesday, September 1, the concluding general meeting will be held at 2.30 p.m. On Saturday evening, August 28, Henry Seebohm, F.Z.S., will deliver a lecture to the operative classes on "The North-East Passage"; tickets can be purchased of the local secretaries. A room will be provided for the reception of apparatus and specimens illustrative of papers communicated to the sections. Excursions to places of interest in the neighbourhood of Swansea will be made on Thursday, September 2, and short excursions on the afternoon of Saturday, August 28.

WE regret to announce the death of M. J. M. Gaugain, the eminent French electrician, at the age of seventy years. We shall give some account of his life and work next week.

THE Committee for the erection of a statue to Gauss have just issued a note, from which we learn that on the 27th instant (11.30 A.M.) the statue—modelled, as we have previously announced, by Prof. Schafer of Berlin, and cast by Prof. Howaldt—is to be unveiled. The Committee will be happy to have the names of any English mathematicians or gentlemen who may be willing, or who intend, to take part in the festivities which are to accompany the ceremony of unveiling. Applications should be addressed at once to the Landsyndicus Otto, Gauss Monument Committee, Braunschweig (Brunswick).

A CORRESPONDENT, J. H. S., sends us the following notice of Dr. E. L. Moss, who has shared the fate of the *Atalanta*:—"It seems to have escaped the notice of the scientific world the loss it has sustained in the ill-fated *Atalanta*. Dr. Edward L.

Moss, one of the officers on board that vessel, besides being a surgeon of renown in the navy, was also, in the best sense of that phrase, a scientific man. His papers read before the British Association, and his remarks at sectional meetings over a large range of natural history subjects (I remember such particularly at the last Plymouth meeting) will be fresh in the minds of many. He was one who, always observing and storing up facts, at whatever part of the world he might be, could clearly and systematically arrange them, and also employ them if required with convincing force. Such opportunities for observation were many and various. His profession, and the high estimation in which he was held by the naval authorities making him a picked man for any special service. By no means his least accomplishment was the masterly way in which he wielded brush and pen. In the Arctic Expedition of 1875-76 he served on board H.M.S. *Alert*, and to the astonishment of every one brought back with him from that expedition a number of most beautiful finished water-colour paintings and sketches in black and white. These were all made on the spot in those far-off regions, and are, I believe, the only examples in colour, painted from nature, of those dreary, cold solitudes, and consequently were the first intimation to the majority of people of the gorgeous effects of colour to be seen there. I remember him telling me about the trouble it was to keep his pigments fluid and the devices he had to resort to to effect that result. Many of these paintings and drawings (in facsimile), with a vivid and most interesting descriptive narrative, were published in his book, 'Shores of the Polar Sea.'"

MR. W. A. FORBES, B.A., the Prosector to the Zoological Society, is leaving England by the mail steamer to-day for a short visit to the province of Pernambuco, Brazil. One of the chief objects of his visit will be to obtain specimens in spirit of the various Neotropical Mesomyodian *Passeres*, as well as of *Bucconidæ* and other birds. During his absence all communications relating to animals in the Gardens, &c., should be addressed to Mr. J. J. Lister, B.A., who has undertaken Mr. Forbes's prosectorial duties during the absence of the latter.

THE numerous friends of the late Prof. A. H. Garrod will be glad to hear that a "Garrod Memorial Fund" has been set on foot, with the object of reprinting, in a complete and separate form, all his published papers, both physiological and zoological. We hope to be able to announce further particulars shortly.

AMONGST the peculiar institutions of Paris are the street astronomers, who exhibit through their telescopes the moon, sun-spots, comets' tails, and other celestial objects, according to circumstances. Their charges vary from 1*d.* in the suburbs to 5*d.* on the Place de la Concorde or the Place Vendôme, where the instruments are not unworthy of a regular observatory. At the last monthly meeting of the scientific journalists M. Flammarion read an address sent to him by the corporation of these itinerant teachers of the marvels of the heavens. They state that from the beginning of the publication of the "Astronomie Populaire" the number of their customers has more than doubled.

THE establishment in Paris of a system of pneumatic clocks has not put a stop to the experiments for transmitting the observatory time by electricity not only to the several public clocks of Paris, but all over France, taking advantage of the telegraphic wires. A commission has been appointed by the Municipal Council of Paris to select between the several systems which have been proposed on competition.

AMONG the statues which have been exhibited in the *Salon* at the Palais de l'Industrie, Paris, two large monuments, to commemorate Denis Papin at Blois and Leverrier at Paris, have largely attracted public notice. The astronomer is represented erect, wearing his usual dress, and supporting in his left hand a celestial sphere; the right is pointing to the heavens.

THE U.S. Congress, we learn from the *Electrician*, has voted the sum of 15,000 dollars for a statue of the late Prof. Joseph Henry, to be placed in the grounds of the Smithsonian Institution.

THE *Colonies* draws attention to the establishment of a "School of Agriculture" at Canterbury, New Zealand, with the object of affording students the opportunity of acquiring a thorough knowledge of the science and practice of agriculture. The institution, which is under the direction of Mr. W. E. Ivey, M.R.A.C., F.C.S., is situated near Lincoln, about twelve miles from the city of Christchurch; and in addition to the school buildings—comprising lecture theatre, library, museum, chemical laboratory, &c.—has attached to it a farm of 500 acres of land of various qualities, from rich swamp pasture land to light and comparatively thin soil overlying shingle. A portion of the farm is devoted to experimental purposes to test the value of different methods of cultivation, the effect of manures on various crops, the qualities of indigenous and exotic grasses, and the suitability and comparative worth of new varieties of cereals, roots, fodder, and other plants. The students will be required to take part in the regular daily practical work of the farm, to acquire a practical knowledge of ploughing and every other kind of farm work, the use of implements and machinery, the management of stock, and the making of cheese and butter. They will also receive practical instruction in agricultural chemistry in the laboratory. Land surveying and levelling will be undertaken at suitable times for practice in the use of instruments, in measuring land, in harvest and other piece work, and for taking levels for drainage purposes. Lectures and instruction will be given to various subjects connected with agriculture, chemistry, botany, entomology, veterinary medicine, &c. Under the present rules candidates for admission as resident students are required to pass a preliminary examination; and must be between the ages of fifteen and nineteen.

FROM the reply of Earl Spencer last Thursday in the House of Lords to a question as to the teaching of agricultural science by the Science and Art Department, we are glad to find that at least the "utility" of science is beginning to be recognised in high places. "There was no more important matter," the Earl said, "than the application of science to the art of agriculture. Great attention had of late years been very properly called to the great aid which science gave to the various classes of manufacturers and producers; and that principle applied with quite as great force to agriculture as to any other art. That was especially the case at the present moment, when the country was inquiring narrowly into the whole of our agricultural system. If science could enable our agriculturists to produce more from the land than they had hitherto done it would add another to the many useful things it had been the means of accomplishing. It had been decided," the Earl went on to state, "by the department, in consequence of the pressure for accommodation for science classes and for instruction in various branches, not to have a special class for agricultural science this year, seeing that botany, geology, and chemistry, which were so intimately connected with agriculture, were taught separately. Since he had come into office, however, the department had decided that a class for agriculture should be held in August next."

THE Midland Union of Natural History Societies held its third annual meeting at Northampton on Thursday and Friday last, 17th and 18th inst., under the presidency of Sir Herewald Wake, Bart. The Union consists of twenty-four societies in the central counties, and numbers nearly 3,000 members. Its object is to encourage natural history studies, and to make local students residing far apart known to each other. So far its

success has been most marked. At Birmingham in 1878, at Leicester last year, and at Northampton this year, it has brought together naturalists from Nottingham, Burton, Leicester, Bedford, Peterborough, Hereford, Welshpool, Shrewsbury, Cheltenham, Stroud, Birmingham, and other places, and has afforded opportunities for intercourse between many who were previously strangers. The presidential address was brief, but interesting and suggestive. Lord Lilford took part in the proceedings, and read an admirable paper on ornithological topics. He exhibited nearly 200 specimens of birds taken chiefly in North Northamptonshire, the bulk of which he presented to the Northamptonshire Naturalists Society, of which he is president. The report of the council gave an outline of work done by the various societies in the Union during the past twelve months. In the evening an interesting scientific *conversazione* was provided in the Town Hall, and was largely attended. On Friday the members divided into two parties, one of which explored the geology of the district under the guidance of Mr. Hull; the other, led by Mr. Scriven, visited Castle Ashby, the seat of the Marquis of Northampton, and devoted the bulk of their time to botanising in Yardley Chase, &c. The meeting was in every way a success. The next year's meeting will be held at Cheltenham, and Dr. T. Wright, F.R.S., is the president elect.

M. Daubrée, director of the French School of Mines, has published an essay on Descartes, in which he summarises the services rendered by that philosopher to science. He reminds his readers that Descartes advocated the theory of an igneous origin for the earth, and he enters into a lengthened discussion of the objections which may be raised against the theory of actual causes, as advocated by Lyell.

The City and Guilds of London Institute for the Advancement of Technical Education has definitively accepted from Her Majesty's Commissioners for the Exhibition of 1851 a site for the Central Institution in Exhibition Road. The site is 300 feet long, and is between the temporary French and Belgian Courts. The advantages of this site are its proximity to the museums and libraries, and science and art schools of South Kensington. The central institution, when erected, will be used for the training of teachers, and will provide the highest technical instruction to students who have already obtained such a knowledge of the elements of science as is furnished by the School of Mines and other scientific institutions.

Reports continue to appear of the unusual quantity of drift ice met with in the North Atlantic by vessels sailing between this country and America. Do not these "numerous fields of ice" met with indicate an unusually early and extensive break-up of the Arctic ice-sheet, and extreme meteorological conditions in the Polar area?

Mr. Frank Buckland has been awarded a gold medal and a decorated diploma of honour by the authorities of the Berlin International Fishery Exhibition.

Père Marc Dechevrens, the Director of the Zikawei Observatory, near Shanghai, has lately published an important essay on the disastrous typhoon of July 31, 1879, accompanied by remarks on other typhoons in the autumn of the same year.

By recent intelligence from New South Wales we learn that very rich silver lodes, with a large quantity of gold, had been discovered at the Nambucca River, and that gold had also been found near Moama, on the Murray.

In his just published Consular Report from Saigon, Mr. Tremlett furnishes some further notes respecting *hwang-nao*, to which we have referred on a previous occasion. It is said to be a bush, and to present something of the appearance of ivy; it is only found in mountains of lime tone formation. It is said to cure the bite of the most venomous serpents, and has been successfully employed in curing cancer and principally leprosy, in the treatment of which it has never given other than satisfactory results. The native physicians, Mr. Tremlett remarks, distinguish thirty-six kinds of leprosy, the most common attacking the feet and hands; it is considered to be hereditary, and is usually contracted by children at the age of puberty. After some generations it has been noticed to confine itself to either the male or the female members of the family; the disease is considered contagious, which only would account for the large number of lepers in Tongking.

In the last aëronautical ascent which was made at Rouen on Monday, June 13, by M. Jovis, M. Desmaret, one of the aëronauts, tried with success to take photographs of the land below. About fifteen different views were taken by him, and are wonderfully executed. The car had a hole in the centre, and the photographic apparatus was supplied with a patent obturator working in one-hundredth of a second. The photographs were of course taken by instantaneous process.

We notice some interesting geological researches by M. Kontkevitch on the eastern slopes of the Oural Mountains. They will be an important addition to the well-known map of the western slope published some years ago by Prof. Möller.

We have received the tenth volume of the *Memoirs* of the St. Petersburg Society of Naturalists, which contains, besides the minutes of meetings of the Society, a series of interesting papers:—A *résumé* of our knowledge on the Silurian in the Governments of St. Petersburg and Esthonia, by Prof. Friedrich Schmidt; on the ornithological fauna of the marshes of the district Uman (province Kieff), by G. Th. Göbel; a monograph on the sponges of the White Sea, by K. S. Merejkovsky; on the algæ of the Gulf of Finland, by Chr. Gobi; ornithological observations on the province of Ryazan, by P. Pavloff; on the birds of the tracts between the Amou and Kouvan-djarma Rivers, by M. Boutleroff; on the structure of the eye-like spots in certain fishes, by MM. Ousoff; and a flora of the Phanerogams of the Government of Tver, by A. A. Bakounin.

In the *Sessional Proceedings* of June 4 of the National Association for the Promotion of Social Science will be found an extremely interesting discussion of the subject of educational pressure among girls, by various ladies connected with well-known girls' schools, and others.

The additions to the Zoological Society's Gardens during the past week include two Rhesus Monkeys (*Macacus erythræus*) from India, presented respectively by Mr. W. Connell, and Mr. George L. Amlot; a Quica Opossum (*Didelphys quica*) from Demerara, presented by Capt. E. Ball; an Azara's Fox (*Canis azaræ*) from South America, presented by Mr. Edward Cooper; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mrs. M. A. Brown; two Common Gulls (*Larus canus*), European, presented by Mr. J. Castell; a Dominican Gull (*Larus dominicanus, jv.* ?) from New Zealand, presented by Capt. R. Bower; a ——— Buzzard (*Buteo sp. inc.*) from Tasmania, presented by Capt. J. Seaborne; a Salt Water Terrapin (*Clemmys terrapin*) from North America, presented by Mr. A. D. Bartlett; a Common Ocelot (*Felis pardalis*) from Demerara, a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Weeper Capuchin (*Cebus capucinus*) from Brazil, an Australian Crane (*Grus australasiana*) from Australia, deposited; two Virginian Deer (*Cariacus virginianus*) from North America, four Beautiful Finches (*Estrelda bella*) from Australia, purchased; a Leonine Monkey (*Macacus leoninus*) from Arracan, a Slow Loris (*Nycticebus tardigradus*) from Malacca, two Bay Bamboo Rats (*Rhizomys badius*) from India, two Sumatran

Wild Dogs (*Canis rutilans*) from Sumatra, a Javan Adjutant (*Leptoptilus javanicus*) from Java, received in exchange; a Wapiti Deer (*Cervus canadensis*), an Axis Deer (*Cervus axis*), born in the Gardens; three Siamese Pheasants (*Euplocamus prælatus*), two Horned Tragopans (*Ceriornis satyra*), two Peacock Pheasants (*Polyplectron chinquis*), four Mandarin Ducks (*Aix galericulata*), four Variegated Sheldrakes (*Tadorna variegata*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

KEPLER'S NOVA OF 1604.—The vicinity of this object is now favourably situate for observation in the evenings, and it is well worth while to keep a close watch upon one or two small stars near the position deduced for Kepler's object by Prof. Schönfeld from the observations of David Fabricius, which he considered preferable to those of Kepler and his pupils, given in his celebrated work, "De Stella nova in pede Serpentarii," more especially upon a star of the twelfth magnitude, or fainter, observed by Prof. Winnecke in 1875, which is close upon the place of a star of the tenth magnitude inserted on Chacornac's chart, but not afterwards found of this degree of brightness, and which is still more significant, almost exactly in the position of Kepler's object assigned by the observations of Fabricius. The most convenient reference-star in this neighbourhood is one meridionally observed by Argelander, No. 16872 of Oeltzen's Catalogue, a bright ninth magnitude, the position of which for the beginning of the present year is in R.A. 17h. 23m. 52·2s., N.P.D. 111° 23′ 22″; Schönfeld's place of Nova 1604 for the same epoch is in R.A. 17h. 23m. 26·9s., N.P.D. 111° 22′ 32″; Winnecke's star precedes Argelander's 33·2s., in 2″·7 less N.P.D. There is a somewhat brighter star preceding Argelander's 18·8s. with 1″·6 greater N.P.D., which, after several years' observation, has not exhibited any sensible fluctuation of magnitude. Attention should be chiefly directed to Winnecke's object, and it would be desirable to know its present magnitude, which some reader of this column may have the opportunity of putting upon record; we would, however, suggest its *frequent* observation.

There is no reason to suppose, notwithstanding the name of "temporary stars" which has been attached to them, that either Tycho Brahe's famous star of 1572, Kepler's of 1604, or the less conspicuous star discovered by Anthelm in 1670, have died out; on the contrary, in all three cases there are now small stars close upon the best positions which we can assign to the objects of those years, in which some fluctuations of brightness have been remarked after very careful observation.

WESTPHAL'S COMET (1852 IV).—In Mr. Chamber's useful manual of astronomy there is an oversight with respect to the orbit of the comet discovered by Westphal at Göttingen in June, 1852, the elliptic character of which was first made apparent by the computations of Mr. Marth towards the end of the same year. Elements derived from the earlier calculations are given in place of the definitive orbit deduced by Dr. Axel-Möller or the similar very completely-investigated orbit by the discoverer; hence the comet is credited with a period of revolution which is certainly ten years in excess of that belonging to the ellipse in which it was moving during its appearance in 1852. Dr. Axel-Möller's orbit is as follows:—

Perihelion passage, 1852, October 12·76278 G.M.T.

Longitude of perihelion	43 14 8	Mean equinox,
,, ascending node ...	346 9 49	1852·0
Inclination	40 54 28	
Angle of excentricity	66 42 8·36	
Log. semi-axis major	1·1855845	

Motion—direct.

With these elements we find:—

Semi-axis major	15·3315
,, minor	6·0637
Excentricity	0·9184625
Aphelion distance	29·4129
Perihelion distance	1·2501
Revolution	60·031 years

It is easy to see by what action the comet has been at some past time in all probability fixed in this orbit till similar perturbation recurs. In a true anomaly of 126° 30′ after perihelion or in ecliptical longitude 168° 52′, the comet is distant from the orbit of Jupiter only 0·36 of the earth's mean distance from the sun, and so close an approach of the two bodies would almost certainly result in the impression upon the comet of an orbit, materially differing from that in which it moved previously; this we know has occurred in several instances since the motions of comets have been rigorously investigated, a notable case being that of Brorsen's comet, which is now moving in an orbit into which it was thrown by its encounter with Jupiter in May, 1842.

GEOGRAPHICAL NOTES

IN yesterday's *Times* is a letter from Mr. Thorndike Rice, giving details of the programme of the expedition to Central America, under the leadership of M. Charnay, for the exploration of the ancient monuments there, and to which we referred some time ago. Casts will be taken of all important bas-reliefs and inscriptions, part of which will be deposited in the Smithsonian Institution, and part sent to Paris. Details of the work of the expedition will be published from time to time in the *North American Review*.

CONSIDERABLE attention is still attracted in Australia to the supposed existence in recent years of a survivor of Leichhardt's great exploring expedition, which disappeared in 1848. Numerous lengthy communications have been published by the Colonial press, which tend to confirm the belief that an aged European, not improbably Classen, as we have before mentioned, was living with the blacks near the Queensland border until some four years ago. A man has also come forward at Sydney and made a curious statement to the effect that he was a sailor on board a steamer which was sent by the South Australian Government in 1867 to take cargo to the Roper River, Gulf of Carpentaria, and that on landing some ten miles to the south of the mouth of that river he met natives who told him that three days journey up the river there was an old white man with a very long beard. The position mentioned would, it is thought, be very near the Elsey, where it has been before suggested that something might be found out about the fate of Leichhardt's party. It is to be regretted that the different persons who have contributed items of information did not come forward sooner with their contributions, however small, towards the solution of this mystery, as it might have been cleared up ere this.

THE s.s. *Eira*, recently launched, left Peterhead on Saturday morning for the Arctic regions on a voyage of discovery. She has a crew of some twenty-five, and carries a photographer, the same who accompanied Capt. Nares, and a doctor. The steamer has been coaled and provisioned for two years, but her return is expected before that time.

THE Ontario correspondent of the *Colonies and India* states that the construction of the long-talked-of railway across the island of Newfoundland has at length been decided upon; it will be 350 miles long, and will be of great benefit to the island.

IN his report on the department of maps, charts, &c., at the British Museum, Mr. Major notes the undermentioned interesting additions during the past year:—A large English chart on parchment of the coasts of Brazil and Africa of the early date of 1647, bearing the legend, "made by Nicholas Comberford, dwelling neare to the West end of the Schoole House, at the XX signe of the Plat in Radcliffe, anno 1647." Also two illuminated and gilt MS. maps on parchment, the one of the coasts of Florida, New Spain, and Africa (1688), and the other of the West Indies (1698). These are by José da Costa Miranda. Another valuable acquisition is an important plan of Paris in seventy-two sheets, constructed by Varniquet, and finished in 1791, after thirty years' labour.

THE new number of the Belgian Geographical Society's *Bulletin* opens with a paper on the geography of Lake Tanganyika, which was prepared by Lieut.-Col. Adan for the committee of the International African Association; it is illustrated by an interesting reproduction on one sheet of various maps, exhibiting the views of cartographers on the shape of the lake. The other papers are by Dr. Litton Forbes on the Island of Rotumah, and by M. A. J. Wauters on the African elephant.

SIR JOHN LUBBOCK ON THE HABITS OF ANTS

IN a further contribution of his observations towards elucidating the economy and habits of these insects, laid before the last meeting of the Linnean Society (June 17), Sir John commenced

by relating his fresh experiments on their powers of communication. Among others a dead blue-bottle fly was pinned down, and after vain efforts at removal the selected ant hied home, and emerged with friends who slowly, and evidently incredulously, followed their guide. The latter starting off at a great pace distanced them, and they returned, again, however, to be informed, come out and at length be coaxed to the prey. In the several experiments with different species of ants and under varied circumstances, these seem to indicate the possession by ants of something approaching language. It is impossible to doubt that the friends were brought out by the first ant, and as she returned empty handed to the nest the others cannot have been induced to follow merely by observing her proceedings. Hence the conclusion that they possess the power of requesting their friends to come and help them. For other experiments testing the recognition of relations, although the old ants had absolutely never seen the young ones until the moment, some days after arriving at maturity, they were introduced into the nest, yet in all cases they were undoubtedly recognised as belonging to the community. It would seem, therefore, to be established that the recognition of ants is not personal and individual, and that their harmony is not due to the fact that each ant is acquainted with every other member of the community. It would further appear from the fact that they recognise their friends even when intoxicated, and that they know the young born in their own nest, even when they have been brought out of the chrysalis by strangers, indicating, therefore, that the recognition is not effected by means of any sign or password. With regard to workers breeding, the additional evidence tends to confirm previously-advanced views, that when workers lay eggs males are always the issue of these. Without entering into details of instances it may broadly be affirmed that in the queenless nests males have been produced, and in not a single case has a worker laid eggs which have produced a female, either a queen or a worker. On the contrary, in nests possessing a queen, workers have been abundantly produced. The inference to these curious physiological facts leads to the presumption that, as in the case of bees, so also in ants, some special food is required to develop the female embryo into a queen. In Sir John's nests, while from accidents and other causes many ants are lost during the summer months, in winter, nevertheless, there are few deaths. As to the age attained, specimens of *Formica fusca* and *F. sanguinea*, still lively, are now four and others five years old at least. The behaviour to strange queens often results in their being ruthlessly killed; yet as communities are known to have existed for years, queens must occasionally have been adopted. With the view of trying how far dislike and passion might be assuaged by a formal temporary acquaintance a queen of *F. fusca* was introduced into a queenless nest, but protected by a wire cage, and after some days the latter removed, but the queen was at once attacked. Mr. McCook, nevertheless, relates an instance of a fertile queen of *Cremastogaster lineolata* having been adopted by a colony of the same species.

Such difference in conduct, Sir John suggests, may be due to his own ants having been living in a republic; for it is affirmed that bees long without a queen are strongly averse to adopt or accept another. Furthermore, if a few ants from a strange nest are put along with a queen they do not attack her, and if other ants are by degrees added the throne is ultimately secured. In pursuance of experiments to test the sense of direction, some ants were trained to go for their food over a wooden bridge made up of segments. Having got accustomed to the way, afterwards when an ant was in the act of crossing, a segment was suddenly reversed in direction, evidently to the ant's discomfiture; she then either turned round, or, after traversing the bridge, would return. When, however, similar pieces of wood were placed between nest and food, and the ant at the middle piece, those at the ends being transposed, the ant was not disconcerted. In other instances a circular paper disk was placed on a paper bridge, and when the ant was on the disk this was revolved, but the ant turned round with the paper. A hat-box with holes of entrance and exit pierced at opposite sides was planted across the line to the food; when the ant had entered and the box turned round, the ant likewise wheeled about, evidently retaining her sense of direction. Again, with the insect *en route*, when the disk or box with the ant within was merely shifted to the opposite side of the food without being turned round, the ant did not turn round, but continued in what ought to have been the direction to the food, and evidently was surprised at the result on arrival at the spot where the food had previously been. To ascertain whether ants make sounds audible to one another, the use of the telephone was resorted to, but the results were negative. These experiments may not be conclusive, for the plate of the telephone may be too stiff to be set in vibration by any sounds which the ants produced. As opposed to the opinion expressed by M. Dewitz, Sir J. Lubbock regards the ancestral ant as having been aculeate, and that the rudimentary condition of the sting in *Formica* is due to atrophy, perhaps attributable to disuse. A ground plan of the nest of *Lasius niger* is now given by Sir John, which exhibits an intricate, narrow, and winding entrance-passage; the main nest cavity is further supported by pillars, and here and there by islands; protected recesses obtain, evidently strategical retreats in times of danger. Studying the relations and treatment of the aphides, or plant-lice of the ants, Sir John clearly demonstrates that not only are the aphides kept and protected in the ants' nests, but the eggs of *Aphis* laid outside on the leaf-stalks of its food-plant in October, when exposed to risks of weather, are carefully brought by the ants into their nests, and afterwards tended by them during the long winter months until March, when the young ones are again brought out and placed on the young vegetable shoots. This proves prudential motives, for though our native ants may not lay up such great supplies of winter stores of food as do some of those found abroad, they thus nevertheless take the means to enable them to procure food during the following summer. The fact of European ants not generally laying up abundant stores may be due to the nature of their food. Insects and small animals form portions of their food, and these cannot always be kept fresh. They may also not have learnt the art of building vessels for their honey, probably because their young are not kept in cells like those of the honey bee, and their pupæ do not construct cocoons like those of the humble bee. Relatively to their size our English ants nevertheless store proportionally; for if the little brown garden ant be watched milking their aphides, a marked abdominal distension is observable. The paper concludes by the history and technical description of a new species of Australian honey ant. This corroborates Westmael's strange account of the Mexican species; certain individual ants being told off as receptacles for food, in short they become literally animated honey pots.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE committee of management of the Royal Agricultural College, Cirencester, have just established two scholarships of 25*l.* and 10*l.* respectively, to be open to all students of the college, and to be awarded three times every year in accordance with the results of the sessional examinations. The first award will take place after the Christmas examination of the present year. The vellum certificates and book prizes, and the gold medals, will be continued as heretofore.

THE first session of the representative Conseil Superieure de l'Instruction Publique of France was closed on June 17, by an address pronounced by M. Jules Ferry. The result of the deliberations has been to raise the standard of *Baccalaureat*, the first step in French classical honours; the time allotted to Greek and Latin in the course of studies has been curtailed at the expense of themes and versification, and allotted either to science or to living languages. The work of the next session will be to organise the scientific instruction. Sharp discussions are expected between the delegates who wish to organise a special course of instruction for sciences, and those who stick to the old scheme of making the preparation for the Government schools a supplement to classical instruction.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 5.—On tones generated by a limited number of impulses, by W. Kohlrausch.—On torsion, by E. Warburg.—On stationary vibrations of a heavy fluid, by G. Kirchhoff. On the propagation of electricity by current water, and allied phenomena (continued), by E. Dorn.—On the new relation discovered by Dr. Kerr between light and electricity, by W. C. Röntgen.—On some new researches on the mean length of path of molecules, by R. Clausius.—Researches on heat-conduction in liquids, by H. F. Weber.—Researches on the height of the atmosphere and the constitution of gaseous celestial bodies (continued), by A. Ritter.—On ultra-violet rays (con-

tinued), by J. L. Schönn.—On a new simple condensation-hygrometer, by A. Matem.—On a general proposition of Herr Clausius in reference to electric induction, by G. J. Legebeke.—On an optical illusion in looking at geometrical figures, by W. Holtz.—Reflection and refraction of light on spherical surfaces, supposing finite angle of incidence, by F. Lippich.

American Journal of Science, May.—Outlet of Lake Bonneville, by G. K. Gilbert.—Chemical and geological relations of the atmosphere, by T. Sterry Hunt.—Archæan rocks of Wahsatch Mountains, by A. Geikie.—Apatites containing manganese, by S. L. Penfield.—New meteorite in Cleberne co., Alabama, by W. E. Hidden.—On the recent formation of quartz and on silicification in California, by T. S. Hunt.—The Uranometria argentina, by H. A. Newton.—The Ivanpah, California, meteoric iron, by C. U. Shephard.—The atomic weight of antimony (preliminary notice of additional experiments), by J. P. Cooke.—Daubrée's experimental geology, by J. Lawrence Smith.—Bastnäsite and Tysonite from Colorado, by O. D. Allen and W. J. Comstock.—On argento-antimonious tartrate (silver emetic), by J. P. Cooke.—The sternum in Dinosaurian reptiles, by O. C. Marsh.—On the southern comet of February, 1880, by B. A. Gould.

Proceedings of the Boston Society of Natural History, vol. xx., part 3 (published April).—Dr. Sam. Kneeland, the mineralised phosphatic guanos of the equatorial Pacific Islands; on the frozen well at Decorah, Iowa.—Prof. Brewer, additional notes on his lists of New England birds; catalogue of humming-birds in the Society's collection (only commencement).—Prof. Shaler, on the submarine coast shelf.—Dr. Wadsworth, on danalite from the iron-mine, Bartlett, N.H.; on picrolite from a serpentine quarry in Florida, with analysis by W. H. Melville.—J. H. Huntington, on the iron ore of Bartlett, N.H.—Dr. Fewkes, on *Rhizophysa filiformis*, with a plate; on the tubes in the larger nectocalyx of *Abyla pentagona*, with a plate.—Prof. E. Morse, on the antiquities of Japan.—F. W. Putnam, on chambered mounds in Missouri; on some explorations in Tennessee, with remarks on some bones of N.E. Indians; on the ornamentation of some aboriginal American pottery.—Dr. Hagen, on a new species of Simulium with a remarkable Nympha-case—W. O. Crosby, on evidences of compression in the rocks of the Boston basin.—Dr. W. K. Brookes, development of the digestive tract in molluscs.—S. H. Scudder, probable age of Haulover Beach, Nantucket Harbour.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 27.—"On the Relation of the Urea to the Total Nitrogen of the Urine in Disease," by W. J. Russell, Ph.D., F.R.S., and Samuel West, M.B., Oxon.

In the valuable series of papers upon the excretion of urea, communicated by Prof. Parkes to the Royal Society, he showed that in health 90 per cent. of the nitrogen in the urine was eliminated in the form of urea. It seemed to us of considerable interest and importance to ascertain whether in disease this statement still held good, or whether, as indeed seemed probable, under altered conditions, nitrogen might not be excreted in some other form. With the view of determining this point, the following experiments were undertaken.

The cases upon which the observations were made fall into two groups—the first, a series taken at random from the hospital, the patients suffering from various diseases, and being under various conditions as regarded diet, muscular exertion, &c. In the second series, the patients were healthy, and placed under conditions as far as possible constant, the amount of diet being fixed, and the patients at absolute rest.

The first series, consisting of twenty-three observations, falls into several small groups. The relation of the urea-nitrogen to the total nitrogen was, in all cases, calculated out in percentage amounts (the total nitrogen being taken as 100), and the mean of each group of observations given.

The first group consists of six cases of pneumonia, and in these the urea-nitrogen represents 90 per cent. of the total nitrogen.

The second, of two cases of jaundice, with two determinations in each. The mean of the first giving 85·7 per cent.; of the second 90·2 per cent.

The third, of two cases of albuminuria, in which the mean is 86 per cent. In these observations the albumen was previously precipitated and removed. In a third case the determination was made without previously removing the albumen. In this latter, the percentage was 63·6.

The fourth group consists of a collection of cases of various kinds. One of pyæmia, one of typhoid fever, rheumatic fever, acute dysentery, pleurisy, hepatic abscess, and leucocythæmia, two of erysipelas, and two of diabetes, making eleven in all. The mean percentage of them all is 93·8.

The lowest percentage in this first series is found in the cases of albuminuria and of jaundice, a fact of interest as bearing upon the place of production of urea.

The second series consists of eighteen determinations made upon three cases, in which the diet was fixed and the patient in a condition of absolute rest.

These give a mean of 90·1 per cent. The mean of all the cases in the two series is 89·3, or, if the cases of albuminuria and jaundice be excluded, 91·3 per cent., and this agrees almost exactly with the results of Prof. Parkes' experiments, in which the mean arrived at is 91 per cent.

We may therefore assume that the urea-nitrogen may be taken as the measure of the total nitrogen, and that this may be approximately determined by adding 10 per cent. to the amount of urea-nitrogen.

This is, however, only true if the mean of a large number of observations be taken, for there is no fixed relation between, on the one hand, the amount of the urine and the amount of the solids in it, or on the other, between the amount of the various solids *inter se*.

The result, then, of our observations is to prove that the chemistry of the urine remains essentially the same in disease as in health, and that the generalisation of Prof. Parkes is true in either case. The urea may therefore be safely regarded as the measure of the total nitrogen, and as forming 90 per cent. of it.

"On the amount of Nitrogen excreted by Man at rest," by Samuel West, M.B. Oxon, and W. J. Russell, Ph.D., F.R.S.

The three patients, the subjects of this investigation, were all placed under the conditions of the most absolute rest, not being allowed to sit up in bed, or even indeed to feed themselves. Their diet was reduced till it was found that their health was suffering, and then increased until a condition was reached, which may be called one of "clinical equilibrium," when the health, so far as could be determined clinically, was perfect.

The patients were all suffering from the same affection, viz., aneurism, a disease which produces mechanical rather than constitutional symptoms, and in these cases, so long as the treatment was carried on, produced no symptoms at all, so that for all practical purposes the patients may be regarded as healthy men.

The condition of clinical equilibrium being reached, the amount of nitrogen in the food was determined by direct analysis.

In two of the cases the diet consisted of 10 ozs. of solids and 10 ozs. of liquids.

By calculation from Parkes' tables, this should yield 6·3 grms. of nitrogen. Analysis gave a somewhat higher number: in the first determination 7·07, and in the second 6·95.

In the third case the diet was 8 ozs. of solids and 8 ozs. of liquids, distributed in the same proportion. This by calculation from the preceding analysis should give about 5·6 grms. of nitrogen.

Comparing now the amount of nitrogen ingested in the food with the amount obtained from the urine, we find:—

	Nitrogen ingested.	Nitrogen in urine.
Case I.	7·0 ...	8·6
,, II.	7·0 ...	8·64
,, III.	5·6 ...	6·4

In all the cases the amount in the urine is in slight excess of that in the food, so that we may fairly regard all the nitrogen here obtained as representing tissue waste, for there was no surplus in the food to increase the amount in the urine.

We obtain as the mean of these three cases $\frac{23{\cdot}64}{3} = 7{\cdot}87$, or approximately 8 grms., which we therefore are justified in regarding as the minimum amount of nitrogen a healthy adult man excretes per diem. This is equivalent to 17 grms., or 260 grains of urea.

It is interesting to compare with these observations the results obtained by the other methods of the investigation above referred to.

Ranke repeated upon man the experiments which Bischoff and

Voit had conducted upon the dog, and among them are two series of observations which illustrate the subject at present under consideration.

In the first no food at all was given, and the patients were kept at rest.

In one case 8 grms. of nitrogen were passed, in a second 10, and in a third 8·6. In a fourth case the amount was as low as 6. And in another series of observations upon himself, Ranke found the amount passed in two starvation days to be 8 and 8·6 grms.

Nicholson made three estimations in the case of starving prisoners, and found as the mean of three days 8·6 grms.

Many other observers have noticed the rapid fall in the amount of nitrogen excreted during starvation.

But the short duration of these experiments makes it probable that the minimum was not reached.

We have then 8 grms. as the mean of the only reliable determination at our command of the nitrogen excreted in the urine during starvation.

Prof. Playfair attacked the question from another side, by collecting from various sources the minimum diets upon which man could live, and to which he gave the name of subsistence diets, and by calculation the amount of nitrogen contained in them. This method gave him as a mean 9 2 grms., but his patients were none of them at absolute rest, but were performing during the day a certain amount of work. Edward Smith in the same way, by calculation from the diets of the spinners during the cotton famine, found a somewhat larger amount of nitrogen (12 grms.), which agrees with the amount of nitrogen contained in Playfair's second class of small diets, but in all these cases the effect of muscular exertion is not eliminated.

Unruh gives a series of three observations upon hospital patients kept at rest and placed upon a restricted diet.

In the first, a case of cancerous obstruction, the amount of nitrogen was 8 grms. (17·5 urea). But this case is not altogether satisfactory, from the amount of wasting accompanying this disease.

The other two were cases of syphilis placed upon fever diet, and kept at rest for the sake of the experiments; the first passed 8·6 grms. (18·6 urea), the second 7·5 grms. (16·2 urea).

The mean of these three cases is 8 grms. (17·5 urea).

The general results of the various series of observations may be roughly tabulated thus:—

I. Starvation. 8 grms.
II. Non-nitrogenous food. 8 grms.
III. Subsistence diet. 9 grms.
IV. Insufficient diet. 8 grms.
V. Clinical equilibrium. 8 grms.

A remarkable coincidence, considering the variety of the methods employed and the different conditions under which the determinations were made.

We may therefore conclude that the minimum amount of nitrogen excreted by a healthy adult man is on the average 8 grms. in the twenty-four hours, this being equivalent to 17·5 grms., or to 260 grains of urea.

Geological Society, June 9.—Robert Etheridge, F.R.S., president, in the chair.—John Burn Anstis du Sautoy and Rev. John Cowley Fowler, B.A., were elected Fellows; Prof. G. Dewalque, Liége, a Foreign Member, and Prof. Leo Lesquereux, Columbus, U.S., a Foreign Correspondent of the Society.—The following communications were read:—On the occurrence of marine shells of existing species at different heights above the present level of the sea, by J. Gwyn Jeffreys, F.R.S., Treas. G.S. This paper resulted from the author's examination of the mollusca procured during the expeditions of H.M.SS. *Lightning* and *Porcupine* in the North Atlantic. He stated that he found several species of shells living only at depths of not less than between 9,000 and 10,000 feet, which species occurred in a fossil state in Calabria and Sicily at heights of more than 2,000 feet, such depths and heights together exceeding the height of Mount Etna above the present level of the Mediterranean. He then gave an account of the post-tertiary deposits in Europe, Asia, and North America, to show their various heights, and especially of the raised beach on Moel Tryfaen in Caernarvonshire, which was from 1,170 to 1,350 feet high. Some of the shells in that deposit were boreal, and did not now live in the adjacent sea. The author stated that no shells of a peculiarly northern character had been noticed in the west or south of England. He then questioned the permanence and even the antiquity of the present oceanic basins, from a consideration not only of the fauna which now inhabits the greatest depths, but also of the extent of oscillation which had prevailed everywhere since the Tertiary period. A complete list of the Moel Tryfaen fossils was given, to the number of sixty, besides three distinct varieties, of which number eleven were Arctic or northern, and the rest lived in Caernarvon Bay. All of these fossils were more or less fragmentary.—On the pre-Devonian rocks of Bohemia, by J. E. Marr, B.A., F.G.S. The author commenced with a brief notice of the pre-Cambrian rocks, which are gneisses and schistose limestone with intrusive eclogite; over these lie unconformably green grits, ashes, breccias, hornstones (étage A of Barrande), which the author considers to represent the Harlech group of Wales. Étage B is unconformable with this, but conformable with C, which contains the "primordial" fauna. D contains the colonies. E to H are Silurian, and more calcareous than those underlying them. The base of the group is unconformable with those beneath. The lithological characters of the various beds were described. The following are the associated igneous rocks:—Granite, quartz feltzite, porphyrite, mica-trap, diabase, diorite, eclogite. Of these brief descriptions were given. The author gave a comparison of the various shales with English deposits. The pre-Cambrian series much resemble the Dimetian and Pebidian of Wales, the latter being étage A; étage B, the Harlech; étage C, the Menevian, probably a deep-water deposit, as is indicated by the abnormal size of the eyes of its Trilobites; the lowest bed of étage D probably represents part of the Lingula flags of Britain. D, *a*, 1, *β*, seems to represent the Tremadoc shale of Britain, and, like it, contains pisolitic iron-ore. Representatives also of the Arenig and Bala beds are found. A slight unconformity marks the base of the Silurian. Three graptolitic zones occur. The lowest, or *Diplograptus* zone, identical with the Birkhill shales, contains thirteen species of graptolites; the next, or *Priodon* zone (four species) resembles the Brathay flags; the upper, or *Colonies* zone (five species), resembling the Upper Coldwell beds of the Lake-district. Above these follow representatives of Wenlock, Ludlow, and probably of the Passage beds. The author, with the evidence of these, discussed the "colonies" theory of M. Barrande, pointing to the non-intermixture of species, notwithstanding the irregular repetition of the zones, the non-occurrence of these colony species in intermediate beds, and other reasons. The stratigraphy and palæontology of several of these colonies were discussed in detail, showing it to be more probable that their apparent intercalation with latter faunas is due to repetition by faulting.—On the pre-Cambrian rocks of the North-Western and Central Highlands of Scotland, by Henry Hicks, M.D., F.G.S. The author, after examination, considers the rocks of the following districts to be wholly or in part pre-Cambrian:—(1) *Glen Finnan, Loch Shiel to Caledonian Canal*; (2) *Fort William and Glen Nevis*; (3) *Ballachulish, Glen Coe, and Black Mount*; (4) *Tyndrum to Callander*. The author states that the Silurian (and Cambrian) rocks flank the pre-Cambrian in lines from north-east to south-west, and overlap Ben Ledi on the south side. Thus here, as elsewhere, subsequent denudation has removed enormous masses of the more recent rocks, only here and there leaving patches of these in folds along depressions in the old pre-Cambrian floor.

EDINBURGH

Royal Society, May 17.—Mr. D. Milne Home, vice-president, in the chair.—Mr. J. B. Haycraft, M.B., B.Sc., read a paper on a method for the quantitative estimation of urea in the blood. The method depended upon the fact that one can dialyse the fluid parts of blood into alcohol, into which the urea passes in a very pure form. The alcohol containing the urea is evaporated, the residue washed with petroleum ether, re extracted, and estimated after the method of Huefner. This method yields urea from so small a quantity of blood as 10 cc., and shows that more is present than was formerly conjectured, there being on an average 35 parts per 100,000.—Mr. Patrick Geddes, in his paper on the phenomena of variegation and cell multiplication in a species of Enteromorpha, pointed out that the development of colourless cells in this alga was by a process of budding into the intercellular spaces between the coloured cells, so that both kinds of cell-multiplication, by fission and by budding, were exemplified in the same plant.—Prof. Tait gave a communication on the accurate measurement of high pressures. For pressures up to a few tons the behaviour of nitrogen had been thoroughly investigated (at least at one temperature). By comparison with a nitrogen compression gauge, a scale could be

constructed for a pressure gauge registering by the compression of the walls of a thinnish glass cylinder containing mercury; and this scale could be applied as long as the limits of elasticity, as defined by Hooke's law, were not exceeded. To determine when these limits were being approached, a similar glass cylinder with thicker walls was to be compared with the former one, which would be the first to deviate. This second gauge, with its higher limits of elasticity, could then be used for the higher pressures; and when its indications began to deviate from Hooke's law, a third and still stronger gauge could be substituted, its constants having been determined similarly by comparison with the second gauge. And thus a series of graduated gauges could be constructed to measure extremely high pressure; and at length when the pressure was such as to crush glass, a steel gauge constructed on somewhat similar principles could be substituted, being graduated first by comparison with the strongest glass gauge. Thus accurate measurements of high pressures could be obtained up to the point at which the compressing apparatus itself would begin to give way.—Mr. D. Milne Home, as convener of the Boulder Committee, presented the sixth report, and gave a notice of its chief features.—Prof. Turner exhibited a curious collection of natural masks and skulls from New Guinea and neighbouring islands.

VIENNA

Imperial Academy of Sciences, April 15.—Observations on the deadening of torsion oscillations by internal friction, by Dr. Klemencic.—Studies on the decomposition of simple organic compounds by zinc powder; I. alcohols, by Prof. Ludwig.—On the action of some metals and metalloids on phosphorus oxychloride; and the existence of Leverrier's phosphoric oxide, by H. H. Renitzer and Goldschmidt.—On the saltness of water in the Norwegian North Sea, by Herr Tornöe.—New methods of finding mean geometric proportions, by Herr Zimels.—On the former and present position of geology and geogony, and the methods of research in these directions, by Dr. Boué.—Geological observations in Southern Calabria, by Dr. Burgenstein and Herr Nöe.—Radiant electrode-matter, by Dr. Puluj.

PARIS

Academy of Sciences, June 14.—M. Edm. Becquerel in the chair.—The following papers were read:—On papaïne; contribution to the history of soluble ferments, by M. Wurtz. Alcohol precipitates from the juice of *papaya*, a principle of variable composition, but, when purified by dialysis, approximating to albuminoid matters. Papaïne purified with subacetate of lead has the composition and characters of such matters. The rapid liquefaction of fibrine by papaïne may occur in presence of prussic, boric, or even carbolic acid (conditions excluding microbes).—Geological history of the English Channel (second part), by M. Hébert.—Craniology of African negro races; non-dolichocephalic races, by M. de Quatrefages. The ninth volume of the "Crania Ethnica" finishes the account of negro races, and enters on the yellow or Mongolic races. M. Hamy finds in Africa that not only in individuals, but in entire populations occupying considerable spaces, and in some instances extending through about four-fifths of the Continent from east to west, there is an absence of dolichocephaly. One portion of these, marked also by small stature, are sub-brachycephalic generally, but sometimes reach brachycephaly; M. Hamy calls them Negrillos. He characterises various races that have hitherto been confounded.—New experiments on the resistance of Algegerian sheep to spleen-disease, by M. Chauveau. The twelve European sheep tested all died after a single inoculation. Of forty-seven Algerian sheep, thirty-nine proved resistant after repeated inoculations.—M. Stas was elected Correspondent in Chemistry in room of the late M. Zinin.—On the value of gravity at Paris, by M. Peirce. He considers (from certain corrections) that the value hitherto given should be increased by one-ten-thousandth.—Determination of a function with only one variable, in a given interval, according to mean values of this function and of its successive derivatives in this interval, by M. Leauté.—On the resolution of the equation $x^n + y^n = z^n$, in whole numbers, by M. Lefébure.—Experimental researches on magnetic rotatory polarisation in gases, by M. Henri Becquerel. The memoir presented relates chiefly to various small corrections in his direct measurements, the most important being due to influence of magnetism on the glass closing the tubes. For the gases nitrogen, carbonic acid, protoxide of nitrogen, and olefiant gas (not for oxygen), he finds the magnetic rotations for rays of different wave lengths nearly in inverse ratio of the square of the wave-lengths as for non-magnetic solid bodies and liquids. The intimate connection of the rotation with the refractive index is shown. Oxygen, curiously, gives with red rays a rotation a very little above that with green (in the other gases the deflection is greater for green rays in the ratio of about 1·50). This may be connected with the very magnetic character of oxygen.—On the constancy of the proportion of carbonic acid in the air, by M. Schloesing. He calculates that the sea holds in reserve a quantity of CO_2 disposable for exchange with the air ten times greater than the whole quantity in the atmosphere, and much greater, *a fortiori*, than the variations of this quantity; hence a strong regulative action on the amount of aërial CO_2.—On causes which tend to warp the girders of iron bridges and means of planning these girders so as to resist warping influences, by M. Périssé.—On the transcendants which play an important part in the theory of planetary perturbations, by M. Darboux.—M. Gaugain's death was announced.—On the figure of the planet Mars, by M. Hennessy.—On the equivalence of forms, by M. Jordan.—The tensions of saturated vapours have different modes of variation according as they are emitted above or below the point of fusion, by M. De Mondesir.—Action of bromide of methyl and of iodide of methyl on monomethylamine, by MM. Duvillier and Buisine.—On the transformation of terebenthene into cymene, by M. Bruère.—Preparation of indoline and its compounds, by M. Giraud.—On the existence of a lymphatic circulation in *Pleuronectes*, by M. Jourdain. The appearances in *Platessa vulgaris*, Cuv., and *Plat. flesus*, Cuv., are described. There are vessels which convey the lymph to peripheric parts, and others which bring it to a central reservoir. Also, the lymph seems to be aërated in vessels in the branchiæ. The lymph-reservoir has no intrinsic muscles (to effect the circulation), but the fibres acting on it seem to belong to the respiratory apparatus.—On the physiological action of *Thalictrum macrocarpum*, by MM. Bochefontaine and Doassans. *Thalictrine*, the active principle of this plant (found in a certain part of the Pyrenees), acts first on the central encephalo-medullary nervous system, then on the heart, arresting the functions; it affects nervous excito-motricity, and diminishes muscular contractility. It resembles aconitine, but is not so active.—On the micrographic analysis of water, by M. Certes. He treats water with a 1·5 per cent. solution of osmic acid (1 cc. of this to 30 to 40 cc. of water); the acid kills any organisms present without deforming them; they sink to the bottom and may be examined microscopically. Some colouring reagents mixed with dilute glycerine may also be used.—On the place of formation of adventive roots of monocotyledons, by M. Mangin.

CONTENTS