THURSDAY, MAY 15, 1873

A VOICE FROM CAMBRIDGE

II.

THE questions raised by the Cambridge Memorial to which we referred last week are so important that no excuse is necessary for recurring to them. In the first place it may be remarked that the answer of Mr. Gladstone to the Cambridge memorialists, is quite such as any reasonable man might have looked for. University reform is not at present a political question in the vulgar sense of that word. The heart of the masses is not stirred by proposals concerning the tenure of fellowships. The religious element, or rather the sectarian element, has now been largely eliminated from the matter; there remains scarcely anything at stake save the interests of learning and science; and these, as we know, are things of very little value in the eyes of the present Government.

The more one looks at the matter the more it is difficult to see what good the Cambridge Reformers expected to result from their respectable document. No fault can be found with the propositions of the memorial so far as they go. They are just such sound steady-going sober proposals as would naturally come from a body of quiet moderate officials who, on the whole, content with the general state of things, desired to see some practical amendments introduced, but dreaded to agitate, had a wholesome fear of radical changes, and above all, were not clear about the broad features of the necessities which have to be met, or of the changes which have to be brought about.

Until the public mind, to say nothing of the University mind, has gained some clear definite notions about the functions of a University, all attempts at reform must be partial or complete failures.

The prevalent theories concerning the office of a University may be put in three categories.

The first regards the University as an ecclesiastical nursery. This was the original view, but now-a-days is passing out of mind, though tenaciously clung to by some resident members at either University. It only needs to be mentioned to be dismissed.

The second looks upon Oxford and Cambridge as places where the young Tartars of modern English society are covered with a varnish of "culture," and polished into gentlemen. Dr. Lyon Playfair said in the House the other day that the Scotch University taught a man how to make a thousand a year, the English University how to spend it; and in saying this he simply put into forcible language the ideas which are prevalent among many members of the Universities. They distinctly and emphatically discard the idea that it is the duty of the University to equip a man for the struggle for a livelihood, to train him for business, for the arts, for the professions. Their token is "culture," not culture in the sense of higher learning, but in the sense of personal varnish, in the sense of a mental equipment which does not pay, and which is of no use to the owner in practical life, which is a luxury and not a need, a sort of evening dress of the mind, which may be ornamental under the artificial lights of society, but is ill suited for every-day work. Now this sort of culture is not much sought after; for by hard-headed fathers whose sons have to get or to keep their living by their own exertions, it is sought for less and less year by year. The advocates of the view we are dealing with see this very clearly, and accordingly they contend, very logically, that since the world does not care greatly for this kind of culture, and will not send its sons to a University for that only, some other inducements must be provided. And these are found in the prize fellowships, more especially in the non-resident fellowships. A lad of parts whose friends would not send him to Oxford simply to gain that liberal education, "which softens the character and prevents its being strong," goes there because by show of possessing that culture which he despises or even hates, he gains a good round sum of money which it is worth his while to waste three or four years in getting.

The third view, which at present has but few advocates, teaches that the University is a place where anyone and everyone may be trained for any and every respectable path of life, and where at the same time all the interests of higher learning and science are cared for. The advocates of this view say, Do not bribe men by fellowships to come to a University from which they will go carrying with them a very little learning, and that for the most part useless, and an artificial culture of doubtful value. Make it worth their while to come to the University, teach them there what they want to be taught, train them there as they desire to be trained, and there will be no need to bribe them with fellowships. They will then come to Oxford and to Cambridge as they are now going to Owens College, to London, to Newcastle, and to Germany. Take care at the same time that the teaching be not narrow and professional, broaden it with the diligent nurture of higher learning and science, and then there will be every hope of seeing true culture and useful education going hand in hand. Let the youth of the University have the opportunity of seeing the master-minds of the age at their work, so that they may be inspired by them to the highest reaches of thought.

It appears to us that many of those who signed the Cambridge memorial had no clear ideas as to which of the above views they adhered; and hence the uncertain sound of their trumpet. Apparently the document was so loose that supporters of all three views signed it conscientiously; no wonder it fell without effect.

It is unnecessary for us to say that the third view we have mentioned is one which we ourselves support. The real difficulty lies in this, how to change the old Universities to suit these new views, how to ring out the old ecclesiasticism and false culture and ring in useful training with high science and deep active learning and research. The difficulty of this task cannot be exaggerated. Long years of misrule have left suckers of jobbery, like bindweed in an old garden, which come up refreshed with every stirring of the soil. There is a mass of powerful conservatism which has to be striven against. There is a careless public and a still more careless Government which has to be roused. There are plenty of difficulties in the way. If the memorialists really have the reform of the old universities at heart, they will cease to memorialise feebly a feeble administration, and search dili-

gently for some broad scheme of reform which may be introduced without danger, which will render all fellowships unnecessary, which will at once provide for the professional student and the original investigator, and that in such a way that an ignorant Parliament shall have no excuse for tampering with it. And if they do this quickly, they may do it before the Association for Academical Organisation has begun to stretch its limbs.

LONGMANS' TEXT-BOOKS OF SCIENCE

Electricity and Magnetism. By Fleeming Jenkin, F.R.SS. L. and E., M.I.C.E., Professor of Engineering in the University of Edinburgh. (London : Longmans and Co., 1873.)

THE author of this text-book tells us with great truth that at the present time there are two sciences of electricity—one that of the lecture-room and the popular treatise; the other that of the testing-office and the engineer's specification. The first deals with sparks and shocks which are seen and felt, the other with currents and resistances to be measured and calculated. The popularity of the one science depends on human curiosity ; the diffusion of the other is a result of the demand for electricians as telegraph engineers.

The text-book before us, which is the work of an engineer eminent in telegraphy, is designed to teach the practical science of electricity and magnetism, by setting before the student as early as possible the measurable quantities of the science, and giving him complete instructions for actually measuring them.

"The difference between the electricity of the schools and of the testing office has been mainly brought about by the absolute necessity in practice for definite measurement. The lecturer is content to say, under such and such circumstances, a current flows or a resistance is increased. The practical electrician must know how much resistance, or he knows nothing ; the difference is analogous to that between quantitative and qualitative analysis."

It is not without great effort that a science can pass out of one stage of its existence into another. To abandon one hypothesis in order to embrace another is comparatively easy, but to surrender our belief in a mysterious agent, making itself visible in brilliant experiments, and probably capable of accounting for whatever cannot be otherwise explained ; and to accept the notion of electricity as a measurable commodity, which may be supplied at a potential of so many Volts at so much a Farad, is a transformation not to be effected without a pang.

It is true that in the last century Henry Cavendish led the way in the science of electrical measurement, and Coulomb invented experimental methods of great precision. But these were men whose scientific ardour far surpassed that of ordinary mortals, and for a long time their results remained dormant on the shelves of libraries. Then came Poisson and the mathematicians, who raised the science of electricity to a height of analytical splendour, where it was even more inaccessible than before to the uninitiated.

And now that electrical knowledge has acquired a commercial value, and must be supplied to the telegraphic world in whatever form it can be obtained, we are perhaps in some danger of forgetting the debt we owe to those mathematicians who, from the mass of their uninterpretable symbolical expressions, picked out such terms as "potential," "electromotive force" and "capacity," representing qualities which we now know to be capable of direct measurement, and which we are beginning to be able to explain to persons not trained in high mathematics.

Prof. Jenkin has, we think, made great progress in the important work of reducing the cardinal conceptions of electromagnetism to their most intelligible form, and presenting them to the student in their true connection.

The distinction between free electricity and latent, bound, combined, or dissimulated electricity, which occurs so frequently, especially in continental works on electricity, is not, so far as we can see, even alluded to in these pages ; so that the student who takes Prof. Jenkin as his sole guide will not have his mind infected with a set of notions which did much harm in their day. On the other hand, terms which are really scientific—the use of which has led to a clearer understanding of the subject—are carefully defined and rendered familiar by well-chosen illustrations.

Thus we find that men of the most profound scientific acquirements were labouring forty years ago to discover the relation between the nature of a wire and the strength of the current induced in it. By the introduction of the term "electromotive force" to denote that which produces or tends to produce a current, the phenomena can now be explained to the mere beginner by saying that the electromotive force is determined by the alterations of the state of the circuit in the field, and is independent of the nature of the wire, while the current produced is measured by the electromotive force divided by the resistance of the circuit. To impress on the mind of the student terms which lead him in the right track, and to keep out of his sight those which have only led our predecessors, if not ourselves, astray, is an aim which Prof. Jenkin seems to have kept always in view.

To the critical student of text-books in general, there may appear to be a certain want of order and method in the first part of this treatise, the different facts being all thrown into the student's mind at once, to be defined and arranged in the chapters which follow. But when we consider the multiplicity of the connexions among the parts of electrical science, and the supreme importance of never losing sight of electrical science as a whole, while engaged in the study of each of its branches, we shall see that this little book, though it may appear at first a mighty maze, is not without a plan, and though it may be difficult to determine in which chapter we are to look for any particular statement, we have an excellent index at the end to which we may refer.

The descriptions of scientific and telegraphic instruments have all the completeness and more than the conciseness which we should look for from a practical engineer, and in a small compass contain a great deal not to be found in other books. The preface contains an outline of the whole subject, traced in a style so vigorous, that we feel convinced that the author could, with a little pains bestowed here and there, increase the force of his reasoning by several "Volts," and at the same time diminish by

an "Ohm" or two the apparent stiffness of some of the paragraphs, so as to render the book more suitable to the capacities of the "Microfarads" of the present day.

ZOOLOGICAL MYTHOLOGY

Zoological Mythology; or, the Legends of Animals. By Angelo De Gubernatis, Professor of Sanskrit and Comparative Literature in the Istituto di Studii Superiori e di Perfezionamento at Florence. 2 vols. (London: Trübner and Co., 1872.)

THE claims which these volumes make to our consideration as students of Nature is that their stories of birds, beasts, and fishes are treated as being Natural History, not indeed in an ordinary, but in an extraordinary sense. It is asserted that they are descriptions in mythical language of the great phenomena of the earth and sky. To no small extent this assertion is indisputably true. In ancient poetry or story, it often happens that the teller of a myth incidentally lets us know what his underlying meaning is. Thus many a passage from the Veda shows that the minds of that poetic race of herdsmen, the ancient Aryans, were so moulded to the dominant ideas of the pasture and the stall, that they saw throughout all heaven and earth the analogues of their beloved herds. The winds chasing the clouds seem, to their fancy, bulls rushing among the cows. The sky is a beneficent cow, giving rain for milk. Indra, the Heaven-god, is a bull of bulls, whose horns are the thunderbolts, who smites in storm the mountain cavern where the cloud-cows are imprisoned, and sets them free. The sun may be fancied a herdsman, as in this ancient Vedic riddle: "I have seen a shepherd who never set down his foot, and yet went and disappeared on the roads; and who, taking the same and yet different roads, goes round and round amidst the worlds." Horses, too, as we moderns know by the classic chariot of the sun, figure in mythic astronomy. Prof. De Gubernatis gives us the beautiful little Russian nature-tale of the maiden Basiliça, who, on her way to the old witch's house, sees a black horseman all in black on a black horse, and then night falls; then she sees a white horseman on a white horse, and day dawns; then a red horseman on a red horse, and the sun rises. The story has been told already in England, but deserves telling again for its absolute certainty of meaning, which hardly requires the old witch's explanation that the black, white, and red horsemen are mythic personifications of night, day, and sun. If, then, we meet with stories very like unquestionable nature-myths, there is a strong case for the mythologists who say these stories are also nature-myths, whose original meaning has been forgotten, so that they have fallen into the state of mere fanciful tales. Thus, in an Esthonian story quoted by our author, this same notion appears of the three horsemen who are personifications of the great periods of light and darkness. The hero comes to deliver the princess from the glass mountain where she sleeps, and he comes dressed first in bronze colour on a bronze-coloured horse, next in silver on a silver-coloured horse, and lastly in golden garb on a golden horse. This certainly looks like a story suggested by the victorious noonday sun coming at last with glowing rays to accomplish the task he had failed to perform in darkness or twilight, to deliver the Spring from the icy fortress of Winter, or, as our nursery tale has it, to awaken the Sleeping Beauty in the Palace where the spell of Winter has bound her and hers in numbness and silence. *Valeat quantum.*

The scientific study of mythology will be advanced by the collection of mythic episodes made with extraordinary earning by Prof. De Gubernatis. It is a museum of material, and a good many of the author's rationalisations of old legends seem plausible. For instance, he adds new versions to the group of tales (to which belong "Tom Thumb" and "Little Red Ridinghood") in which the night is dramatised as a wolf or other monster, which swallows and afterwards releases the hero who represents the sun or day. He goes on to interpret in the same way the stories where the hero is shut up in the sack or chest and cast into the water, but comes safe to land after all, as the sun, shrouded in the shades of evening, crosses the ocean and reappears at morning. The value of such interpretations as these depends, of course, on careful comparison of evidence. Unhappily, however, the general method of the book is unscientific. The author has no strict logic in him. His argument is substantially this: natural phenomena often suggest to tale-tellers or poets ideas which they shape into cock-and-bull stories; therefore, the way to interpret cock-and-bull stories in general is to guess at some natural phenomena which may have suggested them. The consequence of such a principle of interpretation is a network of tangled guesses, which often only mystify the legends they pretend to explain. The ease with which such a method can be applied, and the worthlessness of its results when it is applied, are shown in the author's treatment of common proverbs. As a rule, proverbs really require no explanation; their origin is intelligible at a glance, as it always was; we feel we might have made them ourselves, if we had been clever enough, and proverb-making had been still in fashion. Not so our author. "The black cow gives white milk" means to him that the night produces the dawn, or the moon, or the Milky Way (we are allowed to take our choice which we like best). "Though the cow's tail waggles, it does not fall," seems to us to require no recondite explanation; but to Prof. De Gubernatis it connects itself with a whole fabric of speculations about the night-monster running after the dawn-cow's tail to clutch it. On the whole, we can hardly better characterise the work before us, in its combination of curious material and absurd argument, than by quoting the following piece of amazing nonsense, ending in a parenthesis with a little fact which will be new to most of our readers, and which shows that modern Italy has so kept up old classic customs, that the proverb "Ab ovo usque ad mala" still explains itself, just as we might now say, "From soup to dessert":—

"The hen of the fable and the fairy tales, which lays golden eggs, is the mythical hen (the earth or the sky) which gives birth every day to the sun. The golden egg is the beginning of life in Orphic and Hindoo cosmogony; by the golden egg the world begins to move, and movement is the principle of good. The golden egg brings forth the luminous, laborious, and beneficent day. Hence it is an excellent augury to begin with the egg, which represents the principle of good, whence the equivocal Latin proverb, 'Ad ovo ad malum,' which signified 'From good to evil,' but which properly meant 'From

the egg to the apple,' the Latins being accustomed to begin their dinners with hard-boiled eggs, and to end them with apples (a custom which is still preserved among numerous Italian families)."

It is clear that a theorist who can thus turn the practical sense of his own dinner-table into mythological nonsense about sky-hens and sun-eggs, is no fit guide to students of Comparative Mythology. But his book will be useful to those who can profit by his learning and ingenuity, without being misled by his fantastic extravagance.

OUR BOOK SHELF

The Year-Book of Facts in Science and Art: exhibiting the most important discoveries and improvements of the past year in mechanics and the useful arts, &c. By John Timbs. (London: Lockwood and Co., 1873.)

WE are glad to notice in Mr. Timbs's annual volume an improvement in some of the points in which last year we called attention to very serious deficiencies. There is a more copious reference to the original authorities, though this is still too frequently withheld, and the statements thus deprived of all scientific value; and the references are in general to more trustworthy sources. There is also a sensible diminution in the number of glaring errors of the press, which have been so conspicuous a feature in earlier volumes. The compilation shows, as does everything from the hand of the same editor, unwearied industry; but with all that a lack of the power of distinguishing the worthless from the really valuable. Many of the paragraphs belong unquestionably to the former category, and it is difficult to see what purpose they serve except that of "padding." On the other hand some really important discoveries or applications of the year are altogether unnoticed. Considerable further improvement will be necessary before "Timbs's Year-book" becomes either an adequate or a trustworthy record of the scientific events of the year. The portrait of Dr. Carpenter given by way of frontispiece is exceedingly good.

Das Leben der Erde. Blicke in ihre Geschichte, nebst Darstellung der wichtigsten und interessantesten Frazen ihres Natur-und Kulturlebens. Ein Volksbuch von A. Hummel. (Leipzig: Verlag von Friedrich Fleischer, 1872).

Physikalische und chemische Unterhaltungen. Ein Volksbuch von Dr. Otto Ule und A. Hummel. (Leipzig: Verlag von Friedrich Fleischer, 1873.)

TILL the publication of Hummel's "Leben der Erde" there were scarcely any popular scientific works published in Germany, which may seem strange, seeing that that country has claimed, probably with justice, the intellectual leadership of the world for many years past. It is possible there is less need for popularising the results of science in Germany than in England and France, seeing that the German system of education is so thorough and comprehensive. Germans also have a greater tendency to go about everything in a systematic way; and this is shown with great force and clearness by Mr. Matthew Arnold to be especially the case in their educational organisation, which discourages the acquirement of knowledge in an irregular and haphazard way. In this country again, as well as in France, "the people" generally make their first acquaintance with subjects in which the German people are grounded when at school, long after they have left school from popular scientific treatises. These two works are constructed on somewhat the same plan as the well-known French works of Flammarion, Guillemin, and Reclus, and appear to us to be well and often eloquently written, and so far as we have been able to test them, are accurate and wonderfully full. In the second the authors aim at giving every-day illustrations of physical and chemical laws, and at showing their practical and economical bearings. They divide it into four sections:—1. General phenomena of motion as applied to solid, liquid, and æriform bodies. 2. Sound, light, and heat. 3. Magnetic and electric phenomena. 4. Chemical phenomena. Hummel's *Leben der Erde*, we should think, would be the more popular of the two, both from the subjects treated of, the greater picturesqueness of language, and the greater abundance and attractiveness of the illustrations, some of which are very fine, though on the whole, not so well executed as such illustrations generally are in corresponding English and French works. He endeavours to show the relation of the earth to other heavenly bodies, gives its geological history, describes its physical geography, including the phenomena of land, water, and air, and concludes with a very eloquent account of the organic life of the earth. On the whole, both works seem to us very creditable to their authors.

LETTERS TO THE EDITOR

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

Agassiz and Forbes

THE letter from Mr. Alexander Agassiz, published in last week's NATURE, revives an attack which was made by Agassiz and Desor more than thirty years ago. It was then promptly met. (See Forbes's "Historical Remarks on the first Discovery of the real Structure of Glacial Ice," Edin. New Phil. Journal, 1843.) I possess correspondence which abundantly shows that the scientific world (English and Foreign) was thoroughly satisfied with the answer given by Forbes. Much of this correspondence can, if necessary, be published. But the reply given at the time, and which I am confident will satisfy any unprejudiced person, may be found *in extenso* in Appendix B to the "Life and Letters of James David Forbes" (Macmillan and Co., 1873). No answer was ever attempted by Mr. Agassiz to the paper in question, and the facts it contains could not have been allowed to pass by him unchallenged, had they not been accurately given. Mr. Alexander Agassiz may never have read the original paper. The date of his letter shows that he cannot have seen the reprint in the Life of Forbes.

This impeachment of Forbes's character by Mr. Agassiz (made, I willingly grant, with the best motives, and in ignorance of the details of the case) demands an explanation. I am aware that few would give credence to imputations of dishonesty in Forbes's character; but the matter is also of historical interest, and deserves an historical examination. I will therefore, with your permission, lay before the readers of NATURE next week the facts from which they shall judge whether the assertions in Mr. Agassiz's letter are supported by the evidence, or not.

Blackheath, May 10 GEORGE FORBES

Venomous Caterpillars

IN Mr. A. Murray's paper on venomous caterpillars in NATURE of May 1, I observe that in discussing the distinction between the terms poison and venom, he says in reference to the action of snake poison:—"It is said that you may swallow the venom of the rattlesnake with impunity, and I imagine you may, if it does not get absorbed through the mucous membrane; but Dr. Fayrer's experience, lately published, of the effects of the semi-swallowing, which occurs in extracting the venom from a poisoned wound would rather seem to show that such extremely virulent venom would penetrate the mucous membrane and act as if actually introduced by a wound, his throat having become dangerously ulcerated from sucking the poison from the wound of a man bitten by a cobra."

If Mr. Murray will refer to my investigations on this subject, he will find that snake poison produces the same effect when applied to a mucous membrane, and introduced into the stomach, the eye, the intestine, or applied to the exposed surface of a muscle or peritoneum, though not so rapidly as when injected directly into the vascular system. The idea that it may be swallowed with impunity being quite incorrect. But I must

disclaim (having no title to it) the experience he assigns to me in reference to the dangerously ulcerated throat, never having made myself a martyr to science by so experimenting in *propria persona*. I have no doubt, however, as I have elsewhere stated, that this method of treating a cobra bite would not be devoid of danger to the operator.

As to venomous caterpillars. There is one much dreaded by sportsmen in the Himalayan Terai. It is said to be apt to fall from the trees on to persons passing or resting beneath their branches, and causes great irritation of the parts with which it comes in contact, amounting, I have been told, in some cases to erysipelatous inflammation. It is a moderate-sized, dark-coloured, hairy caterpillar, and known (I believe) in those parts of the Terai where I have been, as the *komla*. I have never seen it, but during my tiger-shooting expeditions into the Terai, it was always one of the probable inconveniences to be looked for in a camp in the tree jungle. I have heard many stories of the painful and irritating effects of contact with this creature, whose hairs are said to cause those results not only by breaking into but by also inoculating some irritating secretion into the skin.

London, May 4 J. FAYRER

I HAVE just read with interest your report of the paper on "Venomous Caterpillars," which appeared in your last. Towards the end of the report Mr. A. Murray refers to a hairy caterpillar which he received from Brazil, and remarks that "if the caterpillars have a special venom, then, as in the nettle, there should be a gland at the base of each hair, which should be hollow." I think I know the caterpillar to which he refers, and if I am right, its hairs are not exactly venomous, but produce a considerable amount of irritation in the skin. When in Brazil in 1859, I collected some of these caterpillars. They are very similar in appearance to the larvæ of the British Arctia, but when their hairs are examined under a microscope, they are found to consist of a series of barbed points, the point of each succeeding barb fitting into the divergence of the preceding barbs; at least, that is my recollection, for I have not examined them since then, and cannot find any specimens to do so now. The caterpillar is called in Maranham, "largata de fogo," that is, "fire caterpillar." After these hairs have afforded their protection to the caterpillar during its life, it carefully removes them from its body and weaves them in its cocoon, so that the pupa is thus as safe from intruders as the larva itself was. When a child, I recollect that Maranham was occasionally visited by great numbers of a particular kind of moth, the dust of whose wings produced a very great irritation on the skin, the least touch of one being sufficient to render you miserable for the rest of the evening. I perfectly remember a drove of these putting a quick temination to a small dance at home, as you may easily conjecture that ladies in evening costume are not well protected against such visitors. When in Maranham in 1859, I heard that these moths had not been seen there for many years. I believe their visits were during the rainy season. Some of the British Bombices, *B. quercus*, for example, and some of other genera, are said to possess irritable hair. But in *B. quercus* the hairs are not barbed, and, not being an entomologist, I can give no information respecting the others. HENRY S. WILSON

Anatomical School, Cambridge, May 5

On some Errors of Statement concerning Organ-pipes in Recent Treatises on Natural Philosophy

THAT our best teachers of science, both in their books and lectures make statements which are erroneous in fact, and inferences which are misleading whenever they touch upon the subject of wind instruments is not a little surprising, considering that intellects so highly trained hold in aversion any approach to inexactness, and the strangeness of it is that the errors arise through an ancient human custom, now supposed obsolete among philosophers, of "speaking without knowledge."

The evidence, if tendered, would fill some few pages of this paper, and if names were appended to the quotations the list would include authors most esteemed and honoured.

To cite two instances among many—and they are from works of unquestioned value and authority, and supposed to bring down sciences to the latest date—in the recently completed translation by Prof. Everett of Prof. Privat-Deschanel's "Natural Philosophy," the following passage occurs in explanation of the organ-pipe:—"The air from the bellows arrives through the conical tube at the lower end, and before entering the main body of the pipe has to pass through a narrow slit, in issuing from which it impinges on the thin end of the wedge placed directly opposite, called the lip. This lip is itself capable of vibrating in unison with any note lying within a wide range, and the note which is actually emitted is determined by the resonance of the column of air in the pipe." In another equally valuable work, the "Physics," by Prof. Ganot, translated by Prof. Atkinson, this description is given respecting the free-reed—"the tongue which vibrates alternately before and behind the aperture, merely grazing the edges as seen in the harmonium, concertina, &c., such a reed is called a free reed." Four professors responsible for statements so perversely at variance with facts that it is not possible either writer can have even attempted to ascertain, still less to demonstrate that the facts are as asserted. Practical experience affirms that the lip of the organ-pipe does not vibrate; press it with your hand or hold it in a vice to deaden the assumed vibration, and you will not alter one iota of the pitch of the sounding note: that the free-reed does not in its vibration "merely graze the frame;" it would be fatal to its proper speech if it did, and its vibrations would be checked in a jarring rattle. The facts are too simple to need argument; all that was required was observation.

When Ganot, describing a metal free reed, affirms as a law that when the force of air is increased the pitch of the reed rises, his statement is inexact, for it depends entirely on the accident of taking up a reed more or less rigid in proportion to scale, whether the experimentalist shall prove his assertion or prove the reverse. In the harmonium, of a set of five octaves of reeds, half will go more or less sharp, and half will go more or less flat, as the force of wind is increased, a fact which, if more generally known, might induce players to mitigate some of the insufferable harshness and jangling inflicted on listeners. That "a sharp edge" is essential to the functions of the flue organ-pipe is one of the commonest errors entertained by philosophers, and it forms the groundwork for whole pages of false theory. In treatise after treatise it is stated "the air is driven against the sharp edge," "is split upon the sharp edge, and by concussion caused to proceed intermittingly," "the air strikes the sharp edge," "is divided," "is lacerated," "strikes against the upper lip, and a shock is produced which causes the air to issue in an intermittent manner." Another equally common misstatement, and important because so strongly influencing theory, is that "a closed pipe gives a note an octave in pitch lower than an open pipe of the same length; the length of a closed organ-pipe is one-fourth that of the sonorous wave it produces in the air." Proved facts give different results. At my hand this morning there stood a sounding-pipe perfect in finish, its lip quite blunt, by measurement at the edge half an inch in thickness; and whole ranks of pipes were there in various grades of conformation, showing that the sharp edge was immaterial to the functions of a speaking-pipe. Sometimes the chamfering of the lip is desirable, sometimes not, and the builder decides according to the quality and character of each stop. The art in "voicing" a pipe consists in so directing the stream of air that it shall avoid striking the lip, and shall smoothly glide past without shock or noise, or concussion; you get no tone until it does. Actual experiment will show that a closed pipe gives a note only a major seventh below the note it gives as an open pipe, not an octave below; indeed, in the higher range of pipes it will be a whole tone short of the octave, to sound which the pipe would need to be made considerably longer. As having some significance in connection with this, it may be mentioned that there is in an open pipe, whilst sounding, a centre of equilibrium of pressure; it does not occur, as supposed, at the true half of the length, but somewhat below that division; as evidence, take the Flute Harmonique, when desiring to strike the node, it will always be found below the half. Further, as to length. If the open diapason pipe beside me, giving as fine a tone (CCC) as musician can desire, measures 14 ft. 10 in. in length, and its corresponding sound-wave claims 16 ft. or nearer 17 ft., the wide divergence merits better investigation than it has hitherto received. The experiments of Regnault and Seebeck are highly important to this question, but do not reach the conditions pressing for explanation in a speaking organ-pipe. To attempt to demonstrate the laws of organ-pipes with a tuning-fork is as inconclusive as sending galvanic electricity through a dead body and calling the movement life.

There is little difficulty in understanding how it happens that errors respecting wind instruments arise and are perpetuated. Experimental philosophers are occupied with the weightier matters of science, are rarely musicians or familiar with wind instru-

ments; of the trouble and anxiety their caprices give at home and in the workshop they have no knowledge. The organ-pipe is brought into the lecture-room, it is caused to prove what is wanted, more is not looked for; it comes like a beauty in a ballroom, dressed up to play a part and be amiable and gracious: the practical man knows that organ-pipes are very like human beings, of whom Goethe says, "We do not learn to know people when they come to us; to learn their real peculiarities we must go to them."

April 18 HERMANN SMITH

Rock Inscriptions of Brazil

BEING unable to attend the reading of Mr. Whitfield's paper, at the Anthropological Institute, April 22, the following observations are offered.

The rock inscriptions of Brazil are worthy of attention, because they appear to belong to a vast series, to which Mentone affords a large contribution. The suggestion that in the very earliest epochs tally records existed, lends interest to the investigation. It appears probable that military tallies of the levy of men preceded the registers in the historical period of the tribute of men, arms, and money by provinces, such as we find in Herodotus with regard to Persia.

In reference to the possible general connection of such inscriptions as these with the eastern world, it may be observed that Brazil has participated in at least two great migrations.

The Kiriri and Sabuyah of Bahia are allied by language to the ancient Pygmean or Negrito stock. This race is everywhere very low, and cannot have produced even these inscriptions.

The greater part of Brazil is covered by the Guarani or Tupi (Agua) languages allied to the Agau of the Nile region, the Avkhass of Caucasia, &c. It is worth inquiry whether the Mentone inscriptions may not belong to this epoch.

HYDE CLARKE

Abnormal Coloration in Fish

SEEING Mr. W. S. Kent's letter on this subject in NATURE of the 8th inst., a similar instance was recalled to my memory. About three weeks ago I observed in a fishmonger's shop a plaice, nearly one third of the under side of whose body (at the tail) had the usual colour and orange spots of the upper. In this specimen the spots were more numerous and brilliant than usual. The line of demarcation was irregular, but abrupt. The circumstance struck me because I have seen great numbers of Pleuronectidæ, but never one marked thus. The fishmonger told me that he had never seen a like specimen.

ARTHUR NICOLS

Phosphorescence in Wood

FROM the description given by your correspondent, Richard M. Barrington (vol. vii. p. 464) of phosphorescence in coniferous wood, I should imagine it to be extremely probable that the pieces of Scotch fir in question were infested with the spawn of *Polyporus annosus* Fr., a fungus very common on the Coniferæ. The mycelium of this plant (as well as the perfect fungus) is well known to be at times highly phosphorescent, and in the *Gardener's Chronicle* for September 28, 1872, I have figured the perfect state of it as seen so commonly in a luminous condition in the coal mines of Glamorganshire. In these deep pits the spawn of this fungus ramifies about the old shoreing timber, and is so highly phosphorescent as to be clearly seen from a distance of twenty yards. Many other fungi with their mycelia are known to be at times phosphorescent, as *Polyporus sulfureus* Fr. and *Corticium cæruleum* Fr., both common on decaying wood.

In the *Gardener's Chronicle* for September 21, 1872, the Rev. M. J. Berkeley has published a remarkable case of phosphorescence in logs of larch. Here the most luminous parts were where the mycelium was most developed, and the wood gave out such a blaze of white light that although the pieces were wrapped in five folds of paper, yet the light shone through as if the specimens were exposed. The phosphorescence appears to accompany the decomposition of the wood on which the fungi at the same time prey.

W. G. SMITH

Coincidence of the Spectrum Lines of Iron, Calcium, and Titanium

IN Prof. Young's letter published in NATURE, vol. vii., p. 17, some coincidences of the lines of different substances which "are too many and too close to be all the result of accident" are referred to, those of iron with calcium and titanium being especially cited. Two explanations are offered, first that "the metals operated upon by the observers who first mapped out the spectra were not absolutely pure," and second, that "there is some such similarity between the molecules of the different metals as renders them susceptible of certain synchronous periods of vibration."

If we are driven to this second explanation the received inductions of spectrum analysis and the deductions of celestial chemistry based upon them are shaken at their foundation, for if more than one known terrestrial element can display identical lines in the spectrum, the suggestion that other unknown celestial elements may do the same is freely opened. It is therefore very desirable that the spectroscopist should receive all the aid which the studies of chemical specialists can afford him towards the solution of this problem.

I may venture to speak to the instances quoted by Prof. Young. First as regards calcium and iron. In making analyses of a large number of brands of pig iron I found that they all contained calcium, but in very variable proportions, and endeavoured by observing their properties, and by further examination of finished iron, to learn how the presence of calcium affected the quality of iron, but failed to solve this problem. In the course of these investigations, I found that the finished iron, like the pig, presented considerable variations as regards the quantity of calcium contained in it, *but I never found a sample of iron or steel quite free from some trace of calcium.* As I was operating for the most part on superior qualities of iron which had been submitted to the utmost practicable degree of commercial purification, this experience renders it extremely probable that Prof. Young's first explanation is the correct one, so far as iron and calcium are concerned.

The want of any chemical reagent by which minute traces of titanium can be detected in the presence of large quantities of iron, or of a means of completely separating these metals, places a serious difficulty in the way of directly answering the question whether iron is usually associated with traces of titanium; but there are indirect evidences of its very common existence in ordinary iron. The most decided of these is afforded by the common, almost universal, occurrence of the beautiful copper-coloured crystals of cyano-nitride of titanium in the hearth bottoms of blast-furnaces. In many cases their concretions form large masses, where the ores that have been used are not supposed to be titaniferous.

Metallic iron obtains impurities, not only from its ore, but also from the fuel and flux used in reduction, and besides these from the furnace or crucible in which it has subsequently been fused or raised to its welding point. The difficulty of completely purifying iron is so great that many such coincidences as those referred to may be expected *a priori*.

W. MATTIEU WILLIAMS

Musical Stones

WHEN roaming over the hills and rocks in the neighbourhood of Kendal, which are composed chiefly of mountain limestone, I have often found what we call here "musical stones." They are generally thin flat weather-beaten stones, of different sizes and peculiar shapes, which when struck with a piece of iron or another stone, produce a distinct musical tone, instead of the dull heavy leaden sound of any ordinary stone. The sound of these stones is, in general, very much alike, but I know gentlemen who possess sets of eight stones which are said to produce, when struck, a distinct octave. Being only an amateur geologist, I am unable to account for this fact, and would be glad if any of your numerous readers would take the trouble to explain to me, through the medium of your columns, the peculiar composition of the stone in question, and the distinct qualifications necessary to form a musical stone.

RICHARD J. NELSON

Acquired Habits in Plants

IN NATURE of May 1, p. 7, which I chance not to have seen till now, Mr. Babbington puts a question on the subject of my climbing specimen of violet which I fear I am not botanist enough to answer.

I described it as a "dog" violet simply because it bore leaves and flowers on the same stem, which in my simplicity I supposed was enough to settle its species. But though the subdivisions of *V. canina* be new to me, a word or two of remark and description may elucidate the required point to other eyes. I would add that the specimen, such as it is, is very much at Mr. Babbington's service should he care to see it. It is still recognisable, no doubt, though it suffered considerably from having no better protection for some hours than a fly-book.

In the first place it was not growing in a moist situation or one to account for luxuriance. Though near the river, it was many feet above the water, and was on the further side of a small high road. In this position it had, as I before mentioned, attained a height of two feet and a half, and the flower which first attracted my eye was almost on a level with my waist. The plant had climbed through the hedge like a vetch or a fumitory. On comparing it with the most robust specimens of *V. canina* which I can find this spring, the following points of resemblance and of divergence present themselves. The stem of mine is channelled in the ordinary way, and the leaves tolerably like in shape though rather more pointed. On the other hand, the leaf-stalks and peduncles are in mine much shorter, the upper leaves being almost senile. The position of the bracts is similar, but instead of the conspicuous stipules of *V. canina*, mine has those parts so small as almost to escape notice. Again, while the stem of *V. canina* does not in my experience branch, the stem of mine has, in two places, thrown off a small branch bearing leaves and flowers. Also there was not, as far as I remember, any trace of any shoot from the root except the one stem, while *V. canina*, as ordinarily found, sends up a greater and a lesser flowering stem and a bunch of leaves besides.

I hope that these particulars will shed more light on the subject than I can myself. J. G.

St. Asaph, May 10

JOHN STUART MILL

BORN MAY 20, 1806; DIED MAY 8, 1873

THOUGH it has not been the custom among specialists to regard Mr. John Stuart Mill as a scientific man, yet we venture to say that he has not left behind him in this country any man who has done more for the general advancement of science. Before Mr. Mill's time men found their way to great discoveries, and succeeded in proving to each other that what they had discovered was scientific truth. But they could tell each other very little about the method of scientific investigation. Indeed Whately, the then greatest authority in logic, pronounced a theory of induction impossible. Mr. Mill, however, did formulate the canons of induction, and in so doing he lit a lamp which will for ever burn a steady guiding light in the path of the scientific inquirer. And the value of this light need be regarded as none the less even if we consider that its chief service lies in guiding us past the snares and pit-falls of error, and the entrances to those mazes and endless labyrinths of unreality in which so many powerful intellects have toiled and spent their strength for nought; nay, worse than in vain, for their brilliant struggles have fascinated thousands and drawn them from the sober highway of truth, which alone is the road to usefulness—to happiness. The vast and still growing influence that Mr. Mill has exerted in this direction is fully recognised by those who regret it most, because they believe that Truth may be reached by other and nobler paths. We are content to note the fact that among the great men of our day no one has done so much as he, to widen the domain of science and to subdue to its methods all subjects of human interest. Choosing for the field of his more serious labours several of the most difficult subjects of research, those that had most eluded the grasp of the understanding, he has enriched the world with works that will long remain monuments of science. His "Logic" is our text-book of the science of evidence. His "Political Economy" is our text-book of the science of wealth. And if there is a scientific work on politics it is Mr. Mill's "Representative Government." One feature of Mr. Mill's character deserves special notice in this connection. He had the true scientific temper, a disinterested love of truth, in a degree not to be surpassed. If it could be shown that in any particular his teaching was unsound, and none were ever able to do this so well as his own disciples, the men whom he had trained to think, no one was more glad that error had been detected than was Mr. Mill himself. It will be enough to remind our readers of one notable example of this. When Mr. Thornton showed that the universally accepted doctrine of the wage-fund was a huge fallacy, Mr. Mill came forward with alacrity to acknowledge that he in common with all other political economists had fallen into a grave error, and that Mr. Thornton had made a most valuable contribution to economic science. If all scientific men could as completely subordinate their personal vanity to the pursuit of truth, progress would be more rapid than at present. The daily papers have already made the reader familiar with the many-sided richness and beauty of Mr. Mill's character. He was an object of loving admiration to all who had the happiness to enjoy his personal acquaintance. The world, while it mourns his loss, does not, cannot know how great and how good a man has been taken away; and still less does it know how ill it can afford to lose such a man.

MINERS' RULES IN THE SEVENTEENTH CENTURY

ON looking over a packet of old papers I have found some documents, of which I enclose copies, written by a German miner, named Brandshagen, who was employed by my ancestor, Sir Philip Egerton, to superintend the attempt to work copper in the New Red Sandstone strata of Cheshire in the year 1697. As the *rules* for miners of that age afford so strong a contrast to the *unruly* behaviour of that class at the present day, they may perhaps interest some of the readers of NATURE. P. DE M. GREY-EGERTON

Worthy & most honourable Sir,—

Your worship give most humbly thanks for employment meself and my countrymen about your Worship mines, which I have enjoyed now above 4 weekes, & not to be att all further unacquainted unto your Worship, I could not forbeare to give a true & plain account of what I have observed in this time about these mines, as good as my smal understanding in y^e^ English linguage would permit, & if it was in any way acceptable then my wishes & desires where fullfilled. I have this time also endeavored to blow up y^e^ rocks by guns powder, as the best way to kill them, butt in y^e^ first time I found y^e^ elements as aire & water where against my designe, y^e^ last I have conquered, & I hope I shall doe so y^e^ other next time when I have occasion for it. I found also some other smal things which would not so soon agree with my hands, for there are many years past, that I did work under ground with my owne hands, butt all these things are now disceased, onely that I was lately too covetous & would have more rocks blown up then my powder was able to; what other blasts for effect have done, your Worship can be informed of it by Mr. Smith. I shall endeavour all what is in my power to serve your Worship with that understanding I have about mines to which I have employed meself now above 15 year, in spending a great deal of money as well for learning as travelling in many places in Europe where good mines where, to come to any perfection in this art. I have received now my things for examination of y^e^ oare, which I will doe as soon as possibly I can come to it in this desolate place, where nothing in y^e^ world is to be had for any commodities what soever it may be, & whilst we are strangers here, & must buy all things for ready, it is impossible to life of what your Worship has allowed unto us & there-

fore I doubt not your Worship will make a distinction between workmen & workmen, with which I recommend me into your Worship' favour allways remaining

Your Worship most humble Servant,

J. A. BRANDSHAGEN

Bickerton, Sept. y^e^ 24th, 1697

For the Right Honourable S^r^ Phillipp Egerton, Knt., these.

Rules for all Workmen in general

One of every Workmen he may be of what sort he will shall come half an hour before y^e^ duely time & give a certain number of strucks with a hammer on an Iron plate, erected to this purpose, to give a Signe to y^e^ other workmen to come att work, half an hour after he shall doe so att a second time by an other number of strucks & shall streike no more then y^e^ duely strucks by forfeiting 2*d.*, he has y^e^ same signes to give all day when y^e^ miners shall come out & goe under ground again, & this shall doe one workmen after an other from day to day, & he who has done y^e^ businesse this day shall remember to his follower that he has to doe y^e^ same next day, & he that wilfully neglected these remembrance shall be punished together with him that shall doe this businesse next day (if he neglect it) for he himself must be carefull about y^e^ time & day to doe this, & he that shall give y^e^ signs too late, has forfeited 6*d.*, & he that shall not doe it att all shall loose all his wages, due to him, & by consent of y^e^ mines Lords shall be turned of from y^e^ work.

In y^e^ morning before y^e^ last struck is done on y^e^ Iron plate every workman belonging to y^e^ mines must appeare to y^e^ appointed place near y^e^ work, or he has forfeited 2*d.*, & he that comes half-an-hour after, 2*d.* more, & so following for every half-an-hour 2*d.*, & this is understood of all times when y^e^ signe is given.

When they are together they may doe a short prayer that God may give his blessing to their work, that it may raise to y^e^ honour & glory of him, & to y^e^ benefit & blessinesse of y^e^ mines Lords & their whole familie.

After this every one must goe to his post, & diligently performe to what y^e^ steward shall order him, in doing y^e^ contrary he shall be duely punished, & he who shall leave y^e^ work within y^e^ duely hours & before y^e^ signe is given, shall loose 6*d.* or for every half-an-hour 2*d.* as y^e^ steward shall think fitt, & he that is found neglectfull shall every time have forfeited 2*d.*

When it is pay-day, every workmen before he gett money must shew to y^e^ steward his tools & other things what is trusted in his hand by y^e^ lost of all his wages, & if there should want any of such things, he must leave so much money of his wages as it is worthy in y^e^ stewards hand, till he restores y^e^ same.

He that hindered one an other in his work it may be in what way it will, either by ill words, quarreling or in other ways, must duely be punished as y^e^ steward thinks fitt, because every one must be quiet with his work; have they any thing one against an other they may bring it before y^e^ steward, or cleare their things after y^e^ work is done att an other place.

No body shall be permitted without leave of y^e^ steward to take any oare away for a shewing piece, or under any other pretext, butt he may y^e^ same aske from y^e^ steward & be content with that he gives him, and if any should doe y^e^ contrary, he is so heigh to punish as y^e^ steward shall think sufficient.

No body shall bring any person or persons not belonging to y^e^ mines, either under ground or at any other place where y^e^ oares or other things are, without permission of y^e^ steward, & that by y^e^ penalty of one shilling.

Every man must be in a Christian-like beheaviour, and he that speekes blasphemes, or gives scandales, or does other things near y^e^ mines with which God is offended, shall every time be punished with 4*d.* or more according to his crime.

When it is pay-day every one must be of a modest behaviour against ye steward, and must not murmer against him when his wages is decurted for punishement, butt must bring his complaints (if he has any against it) before y^e^ mines Lord, if neverthelesse that he has gotten his wages, he must not goe from y^e^ steward away, till y^e^ whole payment is done, & can give witnesse that every one has received his due.

No workmen shall make more holy days in y^e^ year besides y^e^ Sunday, then y^e^ Lords of y^e^ mines shall allow them, or shall be punished as one that leaves y^e^ work for a whole day.

He that turned y^e^ hour glasse in a wrong way shall loose one shilling.

*SUPPRESSION OF SCENT IN PHEASANTS**

THE pheasant, from nesting on the ground, is peculiarly exposed to the attacks of four-footed or ground vermin, and the escape of any of the sitting birds and their eggs from foxes, polecats, hedgehogs, &c., appears at first sight almost impossible. This escape is attributed by many, possibly by the majority, of sportsmen to the alleged fact that in the birds when sitting the scent which is given out by the animal at other times is suppressed; in proof of this statement is adduced the fact that dogs, even those with the keenest powers of smell, will pass within a few feet, or even a less distance, of a sitting pheasant without evincing the slightest cognizance of her proximity, provided she is concealed from sight. By others this circumstance is denied, they reason *à priori* that it is impossible for an animal to suppress the secretions and exhalations natural to it—secretion not being a voluntary act. I believe, however, that the peculiar specific odour of the bird is suppressed during incubation, not, however, as a voluntary act, but in a manner which is capable of being accounted for physiologically. The suppression of the scent during incubation is necessary to the safety of the birds, and essential to the continuance of the species. I believe this suppression is due to what may be termed vicarious secretion. In other words, the odoriferous particles which are usually exhaled by the skin are, during such time as the bird is sitting, excreted into the intestinal canal, most probably into the cæcum or the cloaca. The proof of this is accessible to every one; the excreta of a common fowl or pheasant, when the bird is not sitting, have, when first discharged, no odour akin to the smell of the bird itself. On the other hand, the excreta of a sitting hen have a most remarkable odour of the fowl, but highly intensified. We are all acquainted with this smell as increased by heat during roasting; and practical poultry keepers must have remarked that the excreta discharged by a hen on leaving the nest have an odour totally unlike those discharged at any other time, involuntarily recalling the smell of a roasted fowl, highly and disagreeably intensified. I believe the explanation of the whole matter to be as follows: the suppression of the natural scent is essential to the safety of the bird during incubation; that at such time vicarious secretion of the odoriferous particles takes place into the intestinal canal, so that the bird becomes scentless, and in this manner her safety and that of her eggs is secured. This explanation would probably apply equally to partridges and other birds nesting on the ground.

The absence of scent in the sitting pheasant is most probably the explanation of the fact that foxes and pheasants are capable of being reared in the same preserves; at the same time the keepers are usually desirous of making assurance doubly sure, by scaring the foxes from the neighbourhood of the nests by some strong and offensive substance.

* From Mr. Tegetmeier's forthcoming work on "Pheasants for the Covert and the Aviary."

THE NEW PROFESSOR OF ENGINEERING AT GLASGOW

IT has already been announced in NATURE that the Crown authorities have appointed Prof. James Thomson, C.E., LL.D., to succeed the late Prof. W. J. M. Rankine in the Glasgow Chair of Engineering and Mechanics; and as that gentleman has been deemed worthy to occupy the Chair that was long filled by a man of world-wide eminence, it may not be undesirable to give a brief sketch of his professional and scientific career.

Prof. Thomson is the elder brother of Sir William Thomson, and son of Dr. James Thomson, a former Professor of Mathematics in the University of Glasgow. The early part of his education was obtained in the Royal Belfast Academical Institution, and he completed his studies in Glasgow, where he obtained the degree of M.A. in 1840, with honourable distinction in Mathematics and Natural Philosophy. During the year 1841—42, he was a student in the class of Civil Engineering and Mechanics under Prof. Lewis D. B. Gordon, C.E., Rankine's predecessor, and even then he was distinguished for his accurate mathematical and physical knowledge, and for his ready appreciation of the principles of applied mechanics. He afterwards became an industrious pupil in the Horseley Iron Works and Manufactory, near Tipton, in South Staffordshire, and subsequently he entered the service of Mr. (now Sir) William Fairbairn, in whose workshops on the Isle of Dogs and in Manchester he had the benefit of assisting to execute engineering works of the greatest magnitude, and of great variety. After prosecuting his profession for several years in England and Scotland, he ultimately settled down in Belfast as a civil engineer.

When the Professorship of Civil Engineering in Queen's College, Belfast, became vacant in the year 1857, Mr. Thomson obtained the appointment. He has now occupied that position for a period of fifteen years.

Besides attending to the duties of his class, Prof. Thomson carried on an extensive practice as a consulting engineer, both at home and abroad, chiefly in connection with water supply, irrigation, the drainage of sugar plantations in Demerara and Jamaica, and other swampy lands, and in designing machinery for the same, and in other hydraulic works. One of his earliest inventions was the well-known Vortex Turbine, which affords an admirable example of an unusual combination of great scientific knowledge and practical skill in the same person. This application of mechanical principles is one of the most successful means of turning water power to advantage that has hitherto been placed at the service of the engineering profession. Many examples of the Vortex Wheel are now in successful operation in various parts of the world, and the invention was deemed to be so important that the Privy Council renewed the patent when the ordinary period of fourteen years had expired. Another of his useful inventions is the Jet Pump and Intermittent Reservoir for the drainage of swampy lands.

Among Prof. Thomson's inquiries in the domain of pure physics a prominent place must be given to those which he instituted regarding the lowering of the freezing temperature of water by pressure. This he determined by theoretical considerations entirely, and the result announced by Prof. James Thomson was afterwards exactly confirmed by the experiments instituted by his distinguished brother. The "arrival by theory without the aid of experiment at so extraordinary a physical fact, calls to my mind most forcibly," says Joule, "the discovery of Neptune by Adams and Leverrier, and is one great step towards the position to which we may eventually hope science to attain, when a perfect acquaintance with theoretical principles will enable us to dispense with the appeal to experiment so necessary, in most cases, at the present time." This discovery and its experimental verification immediately suggested a perfect solution of the problem of the descent of glaciers, and it has since led to many kindred discoveries in pure science. Like his predecessor, Prof. Thomson has extensively contributed to the advancement of science through the medium of the British Association. On five separate occasions he has been selected as the Secretary of the Mechanical Section of that body, and he has been a number of times specially deputed to make reports and conduct experimental researches for the solution of questions in practical engineering. The tendency of Prof. Thomson's mind may be, to some extent, judged of by the character of the papers on physical, mathematical, and mechanical subjects which he has published or communicated to various scientific bodies. They are nearly forty in number, and are published in full or abstract in the *Cambridge and Dublin Mathematical Journal*, the *Edinburgh New Philosophical Journal*, the Transactions of the Royal Societies of London and Edinburgh, the Proceedings of the British Association, and the Transactions of the Institution of Engineers in Scotland.

Prof. Thomson's honorary degree of LL.D. was obtained from the University of Glasgow about two years ago. His formal induction by the Senatus of the University took place last month, and his professional duties in his *alma mater* will commence in the ensuing winter session.

JOHN MAYER

THE FERTILISATION OF THE WILD PANSY

AMONG the accurate and acute observations of C. C. Sprengel towards the close of last century,* which have received but scant attention from his successors, even down to our own day, was one on the subject of the colouring of variegated flowers. This botanist, with an insight into the mutual relationships of animal and vegetable life far in advance of his age, suggests that this colouring may serve as a guide to insects in seeking for the honey which serves for their food, and the search for which is so powerful an agent in the conveyance of the pollen, and the consequent fertilisation of the flower. Sprengel pointed out that in almost all variegated flowers the variegation follows a regular pattern, and that when it consists of streaks or stripes, these streaks almost invariably point to the nectary, or the receptacle of the sweet secretions which form the food of insects, in whatever part of the flower it may be situated. With this idea as a starting point, an interesting line of inquiry may be carried out as to the connection between the presence of scent and the absence of variegation in flowers. It will be found as a general rule, though not without exceptions—and it would be very interesting to attempt to trace the reason of these exceptions—that those flowers which possess a powerful odour are (in the native state) self- or whole-coloured, while brilliantly variegated flowers are, as a rule, scentless. On the hypothesis that each of these properties has for its object the attraction to the flower of the insect necessary for the fertilisation of its seeds, it is easy to be seen that the presence of both in the same flower is needless; and hence we find that Nature is in the habit of husbanding her resources, and not supplying needlessly to the same flower two different provisions for securing the same end.

Having had an opportunity during the present spring of observing the structure, with reference to the phenomena of fertilisation, of the flower of the common Wild Pansy (*Viola tricolor* sub-sp. *arvensis* of Hooker's "Student's Flora") I have thought a description of it might be of interest to the readers of NATURE, and especially to anyone who is able to contrast the phenomena in the variegated and scentless pansy with those in the scented and almost whole-coloured sweet violet.

The corolla of the wild pansy consists of five petals

* Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen: von Christian Konrad Sprengel. Berlin, 1793.

(Figs. 1, 2), the two upper ones of which, *a*, *b*, have no colouring, the two lateral petals *c*, *d*, have each one conspicuous broad streak, and are furnished near the base with a tuft of hairs; while the lowest, *e*, has a number of streaks, usually either 5 or 7, and is also provided with a tuft of hairs near the base; this petal is prolonged below into a spur. All the streaks, on both the lateral and the lowest petal, point exactly towards the centre of the flower *f*, where are the stamens and pistil. The stamens (Figs. 3, 4, 5) are also five in number; the filaments, *a*, are very short; the anthers, *b*, form a circle surrounding the pistil, closely applied to it, and also closely touching one another at their edges; each anther has the connective, *c*, prolonged above into an orange-coloured appendage; and these also, somewhat overlapping one another, form a complete ring round the pistil. Two of the stamens are prolonged below into remarkable kneed appendages, both of which project down into the spur of the lower petal, partially filling it up. The pistil (Figs. 6, 7) consists of a nearly globular ovary, *a*, an irregularly curved style, *b*, much narrower below, and furnished in front with a remarkable wedge-shaped black line, *c*, and of a single stigma, *d*, hooded in shape, the viscid stigmatic surface of which is contained in a deep cavity near its summit. In the open flower, this stigma (*e*, Fig. 3) has a most grotesque resemblance to a monkey's or old man's face. The anthers open laterally and rather within, for the discharge of the pollen, so that it falls naturally on the lower part

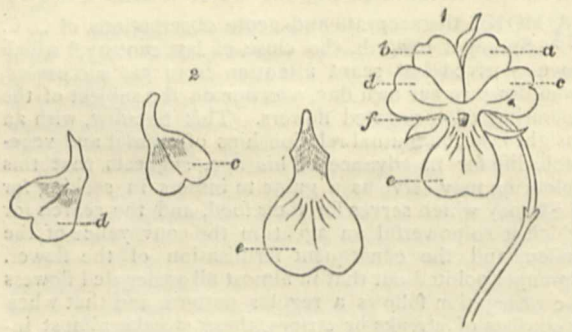

FIG. 1.—1, Flower of *Viola arvensis* *a*, *b*, upper petals; *c*, *d*, lateral petals *e*, lower petal; *f*, centre of flower. 2, The petals separated; *c*, *d*, lateral petals; *e*, lower petal.

of the style, which they completely invest, and it is difficult to see how, without artificial means, any of it will reach the stigma; the flower is also distinctly protandrous, the stigmatic cavity not being fully matured till the flower has been some time open and the pollen fully discharged. The "nectary," or part specially devoted to the secretion of the honey, is the termination of the two appendages of the stamens which project into the spur of the corolla (indicated at *f*, Figs. 3 and 5). When the sweet juice is collected here in sufficient quantities, it drops down into the bottom of the spur, to which all access of rain is prevented by the hairs that fringe the petals around the entrance of the passage to the spur.

With regard to the fertilisation of the violets, which, as has been mentioned, can obviously scarcely take place without foreign aid, Sprengel gives a long and very full description of the manner in which the sweet violet is visited by bees and humble bees, the insertion of whose proboscis into the spur of the corolla, and then its withdrawal, will necessarily remove some of the pollen, and bring it into contact with the stigma either of the same or of a different flower. It seems hence to have been assumed rather than observed that the wild pansy is fertilised in the same manner; although Sprengel states that he has not usually seen this species visited by bees, and Müller's observations* are by no means decided. My own

* Die Befruchtung der Blumen durch Insekten und die gegenseitigen Anpassungen beider; von Dr. Hermann Müller. Leipzig, 1873.

view is that the wild pansy is fertilised chiefly, if not entirely, by very minute insects of the Thrips kind. During a long observation one morning this spring of a field in which these flowers were very abundant, I never once saw them visited by a humble-bee or other large species, and the only insect observed to frequent them was a little species of Thrips, and these only in small numbers, which I attribute to the circumstance that my only opportunity was the first warm sunny morning after a long period of cold weather, when but few insects had yet left their winter retreats. Sprengel indeed says that the wild pansy is greatly frequented by Thrips, although he believes the fertilisation to be effected by bees.

If this view be correct, the markings of the flower furnish the insect with a most remarkable series of guide-posts (or, as Sprengel terms it, "Saftmaal") to the nectar which serves as its food. The streakings on the lateral and lower petals form a sure guide, as soon as the little visitor reaches the flower, all converging (as shown in Fig. 1) to the centre of the flower and summit of the ring formed by the connectives of the anthers. Here even a minute Thrips can with difficulty force its way between the style and the closely adjacent ring of anthers, the deep orange tips of which would naturally attract it; but here it meets with a most curious and valuable assistance

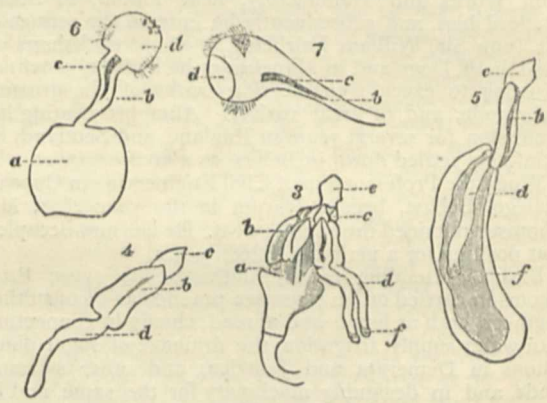

FIG. 2.—3, Pistil and stamens; *a*, filaments; *b*, anthers; *c*, connectives; *d*, appendages to lower stamens; *e*, stigma; *f*, honey-glands. 4, Lower stamen (enlarged); *b*, anther; *c*, connective; *d*, appendage. 5, The same, seen within the spur of the corolla. 6, Pistil; *a*, ovary; *b*, style; *c*, wedge-shaped streak; *d*, stigma. 7, The same, seen laterally at a later stage.

in the wedge-shaped streak on the front side of the style (as seen at *c* in Figs. 6 and 7), the broad upper end of which is distinctly visible above the anther-ring, tapering downwards to a sharp point near the bottom of the style, where the insect would be at once landed on the upper part of the kneed appendages, along which it has now simply to descend until it reaches the nectar, the object of its journey. The style is much narrower towards the base than above, and hence there is room for a considerable accumulation of pollen here, as it escapes from the anthers. The insect must necessarily carry away a considerable quantity of the pollen in its descent and ascent of the style; whether for the purpose of pollenising the stigma of the same or of a different flower is not at first sight clear. The heteracmy of the flower (*i.e.* the male and female organs being mature at different periods) favours the idea of cross-fertilisation, which may very well happen from the active little Thrips visiting many flowers in the course of a day. The ovules of the wild pansy are indeed abundantly fertilised, much more generally, in fact, than those of the sweet violet, the mature capsules of which frequently result from the unopened, self-fertilised, "cleistogenous" flowers, which have not, as far as I am aware, been observed in the pansy.

ALFRED W. BENNETT

NOTES FROM THE "CHALLENGER"*

II.

ON Sunday, March 2, we saw the first patches of gulf-weed drifting past the ship, and flying-fish were abundant. Our position at noon was lat. 22° 30′ N., long. 42° 6′ W., Sombrero Island distant 1,224 miles. At night the phosphorescence of the sea was particularly brilliant, the surface scintillating with bright flashes from the small crustaceans, while large cylinders and globes of lambent light, proceeding probably from *Pyrosoma* and some of the Medusæ, glowed out and slowly disappeared in the wake of the vessel at a depth of a few feet.

The next morning we sounded at 7 A.M. in 2,025 fathoms with No. 1 line, the "Hydra" machine and 3 cwt., a slip water-bottle, and one thermometer; a stop-cock water-bottle was bent on at 925 fathoms from the bottom. The corrected bottom temperature was 1°·9 C., the temperature of the surface being 22°·8 C. During the morning the naturalists were out in a boat with the towing-net, and they brought back a number of fine examples of *Porpita*, several of *Glaucus atlanticus*, some shells of *Spirula* bearing groups of small stalked cirripeds, and many large radiolarians. One of the Spirula shells was covered with a beautiful stalked infusorian.

We proceeded in the evening under all plain sail. The soundings on the chart in advance of us seemed to indicate an extensive rise, with a depth of water averaging not much more than 1,700 fathoms, and it was determined to dredge again on the following day.

On the morning of March 4 we sounded in lat. 21° 38′ N., long. 44° 39′ W., in 1,900 fathoms, with No. 1 line, the "Hydra" and 3 cwt., the slip water-drop, and a thermometer. The bottom was grey ooze, as on the day before, and the bottom temperature 1°·9 C. The dredge was put over at 8 A.M. It was intended to attach a "Hydra" tube with disengaging weight a little below the bottom of the dredge; the weight slipped, however, close to the surface, and the dredge was lowered in the ordinary way with 1½ cwt. 500 fathoms in advance. The dredge came up about 4 o'clock with a small quantity of ooze containing some red clay, a large proportion of calcareous débris, and many foraminifera, chiefly *Orbulina* and *Rotalia*.

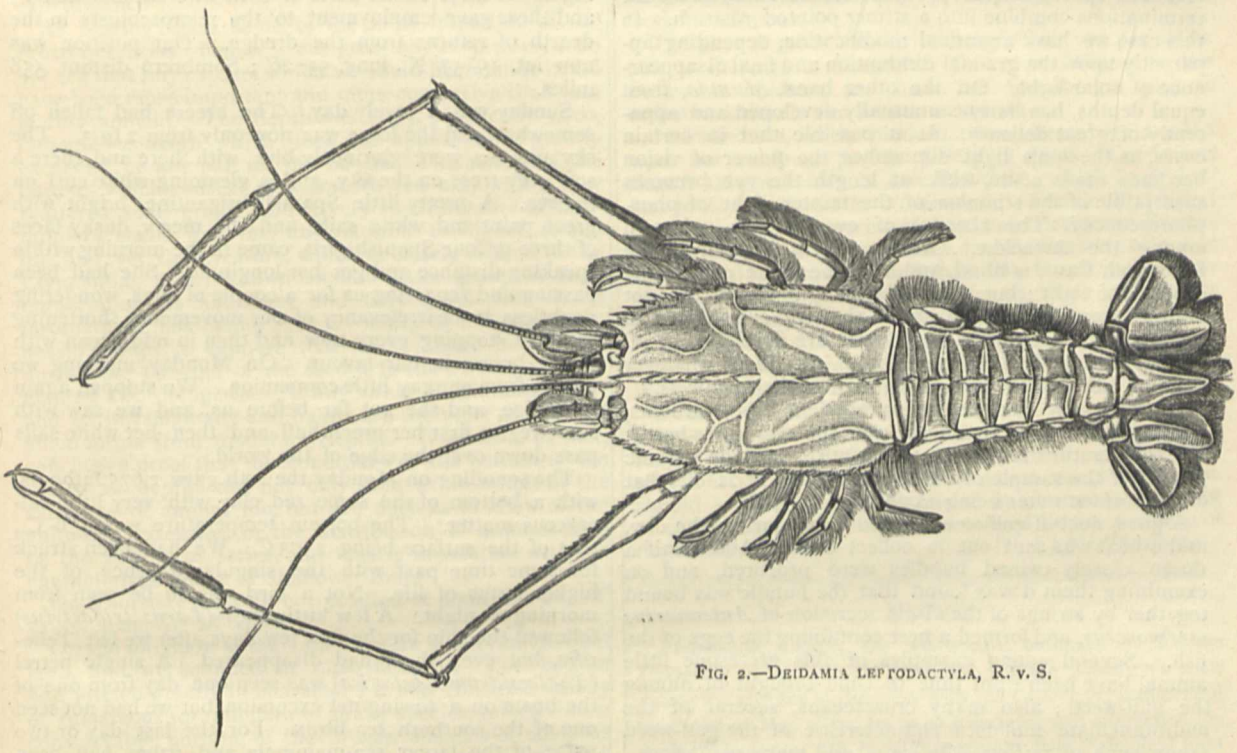

FIG. 2.—DEIDAMIA LEPTODACTYLA, R. v. S.

Warped in the hempen tangle there was a fine specimen of a handsome decapod crustacean, having all the principal characters of the family Astacidæ, but differing from all the typical decapods in the total absence of eye-stalks and eyes. Dr. v. Willemoes-Suhm has given this interesting deep-sea form such a preliminary examination as is possible in the absence of books of reference. I quote from his notes. *Deidamia leptodactyla*, n.g. and sp. (Fig. 2). The specimen, which is a male, is 120 mm. in total length and 33 mm. in width across the base of the cephalo-thorax, which is 60 mm. in length. Three rows of spines, one in the middle line and one on each side, run along the cephalo-thorax, which is divided by a transverse sulcus into an anterior and a posterior part, the former occupied by a central gastric and lateral hepatic regions, and the latter by a central cardiac and latent bronchial regions. The abdomen, which consists as usual of seven segments, has the central series of spines of the cephalo-thorax continued along the middle line. The sixth segment bears the caudal appendages, and in the seventh, the telson, we find the excretory opening. The lateral borders of the body, and all the appendages with the exception of the first pair of ambulatory legs, are edged with a close and very beautiful fringe of a whitish-yellow colour.

There are two pairs, the normal number, of antennæ, then come mandibles, then maxillæ; three pairs of maxillipeds, five pairs of ambulatory legs, and five pairs of swimmerets. As most of the appendages differ from those usually met with in the Astacidæ only in detail, I need here only mention that the anterior antennæ have two pairs of flagella, one of which is very long, longer than the external flagellum of the external pair.

The form of the first pair of ambulatory legs is singularly elegant. They are 155 mm. in length—considerably longer than the body; they are very slender, and end in a pair of very slender denticulated chelæ, with a close,

* Continued from p 30.

velvet-like line of hairs along their inner edges. The rest of the ambulatory legs are much shorter, and all bear chelæ, a character which will demand a certain relaxation of the diagnosis of the Astacidæ if *Deidamia* is to be placed in that family.

The specimen captured being a male, the first pair of swimmerets are somewhat modified. The four other pairs of swimmerets, which are 33 mm. in length, bear each two narrow swimming processes richly fringed with hair, and a short flagellum.

The absence of eyes in many deep-sea animals and their full development in others is very remarkable. I have mentioned ("The Depths of the Sea," p. 176), the case of one of the stalk-eyed crustaceans, *Ethusa granulata*, in which well-developed eyes are present in examples from shallow water. In deeper water, from 110 to 370 fathoms, eye-stalks are present, but the animal is apparently blind, the eyes being replaced by rounded calcareous terminations to the stalks. In examples from 500 to 700 fathoms in another locality, the eye-stalks have lost their special character, have become fixed, and their terminations combine into a strong pointed rostrum. In this case we have a gradual modification, depending apparently upon the gradual diminution and final disappearance of solar light. On the other hand, *Munida*, from equal depths, has its eyes unusually developed and apparently of great delicacy. Is it possible that in certain cases, as the sun's light diminishes, the power of vision becomes more acute, while at length the eye becomes susceptible of the stimulus of the fainter light of phosphorescence? The absence of eyes is not unknown among the Astacidæ. *Astacus pellucidus*, from the Mammoth Cave, is blind, and from the same cause—the absence of light; but morphologically the eyes are not entirely wanting, for two small abortive eye-stalks still remain in the position in which eyes are developed in all normal decapods. In *Deidamia* no trace whatever remains either of the eyes of sight or of their pedicels.

On Thursday the 6th we sounded in 2,325 fathoms, sending down a thermometer and the slip water-bottle. The temperature registered was 1°·7 C., and the specific gravity of the sample of water was 1·02470 at 21° C., that of the surface water being 1·02556, at 23°·3 C.

A good deal of gulf-weed drifted past during the day, and a boat was sent out to collect some. About half a dozen closely twined bundles were procured, and on examining them it was found that the bundle was bound together by strings of the viscid secretion of *Antennarius marmoratus*, and formed a nest containing the eggs of the fish. Several young examples of this grotesque little animal have been from time to time brought in among the gulf-weed; also many crustaceans, several of the nudibranchiate mollusca characteristic of the gulf-weed fauna, such as *Scillæa pelagica* p., and many planarians.

The dredge came up at 4.15 P.M. with a small quantity of red mud, in which we detected only one single but perfectly fresh valve of a small lamelli-branchiate mollusk. In the mud there were also some sharks' teeth of at least two genera, and a number of very peculiar black oval bodies about an inch long, with the surface irregularly reticulated, and within; the reticulates closely and symmetrically granulated the whole appearance singularly like that of the phosphatic concretions which are so abundant in the greensand and trias. My first impression was that both the teeth and the concretions were drifted fossils, but on handing over a portion of one of the latter to Mr. Buchanan for examination, he found that it consisted of almost pure peroxide of manganese.

The character both of the exterior and interior of the nodule strongly recalled the black base of the coral which we dredged in 1,530 fathoms on the 18th of February; and on going into the matter, Mr. Buchanan found not only that the base of the coral retaining its external organic form had the composition of a lump of pyrolusite, but that the glossy black film covering the stem and branches of the coral gave also the reaction of manganese. There seemed to be little doubt that it was a case of slow substitution, for the mass of peroxide of manganese forming the root showed on fracture in some places the concentric layers and intimate structure of the original coral. The coral, where it was unaltered, had the ordinary composition, consisting chiefly of calcic carbonate. Whether the nodules dredged on March 7th are pieces of rolled coral, the ornament on their surface being due to an imperfect crystallisation of the surface layer of the peroxide of manganese, or whether they form another case of pseudomorphy, the peroxide of manganese replacing some other organism, we have not the means of determining. The whole question is a very singular one.

Some of our party, using the towing-net and collecting gulf-weed on the surface from a boat, brought in a number of things beautiful in their form and brilliancy of colouring, and many of them strangely interesting for the way in which their glassy transparency exposed the working of the most subtle parts of their internal machinery; and these gave employment to the microscopists in the dearth of returns from the dredge. Our position was now lat. 19° 57′ N., long. 53° 26′; Sombrero distant 558 miles.

Sunday was a lovely day. The breeze had fallen off somewhat, and the force was now only from 2 to 3. The sky and sea were gloriously blue, with here and there a soft grey tress on the sky, and a gleaming white curl on the sea. A pretty little Spanish brigantine, bright with green paint and white sails, and the merry, dusky faces of three or four Spanish girls, came in the morning within speaking distance and got her longitude. She had been passing and repassing us for a couple of days, wondering doubtless at the irrelevancy of our movements, shortening sail, and stopping every now and then in mid ocean with a fine breeze in our favour. On Monday morning we parted from our gay little companion. We stopped again to dredge, and she got far before us, and we saw with some regret first her green hull and then her white sails pass down over the edge of the world.

The sounding on Monday the 10th gave 2,675 fathoms, with a bottom of the same red clay with very little calcareous matter. The bottom temperature was 1°·6 C., that of the surface being 23°·3 C. We had been struck for some time past with the singular absence of the higher forms of life. Not a bird was to be seen from morning to night. A few kittiwakes (*Larus tridactylus*) followed the ship for the first few days after we left Tenerifie, but even these had disappeared. A single petrel (*Thalassidroma pelagica*) was seen one day from one of the boats on a towing-net excursion, but we had not seen one of the southern sea-birds. For the last day or two some of the larger sea-mammals and fishes had been visible. A large grampus (*Orca gladiator*) had been moving round the ship and apparently keeping up with it. Some sharks hung about, seeking what they might devour, but we had not yet succeeded in catching any of them. Lovely dolphins (*Coryphæna hippurus*) passed in their varying irridescent colouring from the shadow of the ship into the sunshine, and glided about like living patches of rainbow. Flying-fish became more abundant, evidently falling a prey to the dolphins, which are readily deceived by a rude imitation of one of them, a white spinning bait, when the ship is going rapidly through the water.

On Tuesday the 11th we pursued our course during the forenoon at the rate of from six to seven knots, with a light breeze, force 3 to 4. The dredge-line was veered to over 4,000 fathoms, nearly 5 statute miles. The dredge came up at about half-past five o'clock, full of red mud of the same character as that brought up by the sounding machine. Entangled about the mouth of the dredge and embedded in the mud were many long cases of a tube-

building annelid, evidently formed out of the gritty matter which occurs, though sparingly, in the clay. The tubes with their contents were handed over to Dr. v. Willemoes-Suhm, who found the worms to belong to the family Ammocharidæ (Claparéde and Malmgren), closely allied to the Maldania or Clymenidæ, all of which build tubes of sand or mud. The largest specimens dredged are 120 mm. in length by 2 mm. in width. The head is rounded, with a lateral mouth. There is no trace of cephalic branchiæ. The segments are not divided from one another; but the *tori uncinigeri*, which are occupied by the hair-like setæ, and the elevations bearing small *uncini*, indicate the beginning of a new segment.

There is no doubt that this annelid is closely allied to the genus *Owenia*, but it differs from it in the absence of cephalic branchiæ. Malmgren, has, however, already proposed the name of *Myriochele* for a form in which this absence of branchiæ occurs. The description of the northern form on which Malmgren's genus is founded is not at hand, so that it is impossible in the meantime to determine whether the two forms are identical or specifically distinct.

As bearing upon some of the most important of the broad questions which it is our great object to solve, I do not see that any capture which we could have made could have been more important and more conclusive than that of this annelid. The depth was 2,975, practically 3,000, fathoms—a depth which does not appear to be greatly exceeded in any part of the ocean. The nature of the bottom, which consists of a smooth red clay with a few scattered sand grains and a very small number of foraminifera shells, was very unfavourable to higher animal life, and yet this creature, which is closely related to the Clymenidæ, a well-known shallow-water group of high organisation, is abundant and fully developed. It is fortunate in possessing such attributes as to make it impossible even to suppose that it may have been taken during the passage of the dredge to the surface, or have entered the dredge-bag in any other illegitimate way; and its physiognomy and habits are the same as those of allied forms from moderate depths. It affords, in fact, conclusive proof that the conditions of the bottom of the sea to all depths are not only such as to admit of the existence of animal life, but are such as to allow of the unlimited extension of the distribution of animals high in the zoological series, and closely in relation with the characteristic faunæ of shallower zones.

On Thursday the 13th our position at noon was lat. 18° 54′ N., long. 61° 28′ W.

On the forenoon of the 14th we were still 35 miles from land, and we sounded in 1,420 fathoms. The bottom had altered greatly in character: it now consisted chiefly of calcareous foraminifera of many species, mixed with a considerable portion of the broken spicules of siliceous sponges. The bottom temperature registered was 3° C. The water-bottle was accidentally broken in taking in, so that that observation was lost. As we were now within sight of land, and all our results were evidently modified by its immediate proximity, we regarded our first deep-sea section as completed. WYVILLE THOMSON

A MODERN STERNBERGIA

AT a time when botanists of some repute are not ashamed to confess their inability to deduce satisfactory characters for the determination of plants from their internal anatomy, old workers in this field may well turn back to refresh their memories on such points, and to inquire whether their eyes may not have deceived them in the investigations of former years when microscopes were not what they now are. In doing this a few days ago in connection with the examination of a carboniferous conifer, I was surprised to find that I had overlooked or omitted to note the fact that the Balsam Fir of Canada (*Abies balsamea*), which affords the well-known Canada-balsam, has that curious structure of pith well known in Palæozoic Conifers, and which has been named *Sternbergia*. It is well seen in young twigs one or two years old, and though on a smaller scale, is very similar to that of *Dadoxylon materiarium* of the upper coal-formation of Nova Scotia and Prince Edward Island, as I have figured this in my recent report on the geology of the latter province.

This modern Sternbergia is not produced by the mere breaking of the cellular tissue transversely by elongation of the fibre; but, as I pointed out many years ago in the case of the coal-formation Sternbergiæ,* is a true organic partitioning of the pith by diaphragms of denser cells opposite the nodes, as in *Cecropia pellata*, and some species of *Ficus*, &c. The pith of the Balsam Fir is, like that of many other conifers, composed of dotted or transversely marked cells elongated vertically, and reminding one of the pseudo-vascular pith of some Lepidodendroid trees. The transverse diaphragms are composed of denser cells flattened horizontally, and they are, as in Sternbergia, accompanied by constrictions of the medullary cylinder. As in some fossil conifers, the diaphragms are not perfectly continuous.

The plan of growth of the modern fir does not permit its pith to increase in diameter. This was different in the Palæozoic conifers, in which the Sternbergia pith is sometimes nearly two inches in diameter.

In Palæozoic, as in modern times, Sternbergia piths were not confined to one family of trees. Corda has shown this structure in *Lomatophloios*, which is equivalent to *Lepidophloios* or *Ulodendron*. I have shown that it exists in several species of Lepidodendroid and Sigillaroid trees and in *Leptophleum*.† Williamson, who first established it in the Conifers, has also found it in *Dictyoxylon*. Still I have nowhere found these remarkable fossils so abundant as in the upper coal-formation, and either in the interior of calcified or silicified trunks of pine or with fragments of wood attached to them sufficient to indicate their coniferous character.

I may add, that the microscopic structure of young twigs of modern conifers presents many interesting points for comparison with fossil trees, and that in making longitudinal slices of the pith of recent specimens, care should be taken not to be misled by the mere crumpling of the celiular tissue sometimes caused by the pressure of the knife. J. W. DAWSON

NOTES

PROFESSOR CARUS, the well-known naturalist of Leipsic University, who is to fill Professor Wyville Thomson's chair during the absence of the latter with the *Challenger*, commenced his duties on May 2 last, by an able and eloquent address on the study of zoology. He is fully convinced that "the final form of our (zoological) system will be a pedigree."

THE *Challenger* arrived at Halifax on May 9, all well. She had a successful passage from Bermuda, the dredgings and soundings being very satisfactory. On the 18th inst. she will leave this port on a return voyage to Bermuda.

WITH great regret we record the death of Mr. John Stuart Mill, at the age of 67 years, on May 8, at Avignon, from a sudden attack of erysipelas, which cut him off in four days. He has been buried beside his wife at Avignon. A meeting of the friends of Mr. Mill has been convened, at Willis's Rooms, for Tuesday, 20th inst., to consider in what manner the national respect for his memory may be most fittingly testified.

A COMMITTEE for the erection of a monument to Liebig has been constituted at Munich. Councillor von Niethammer is the chairman, Prof. Von Bischoff the vice-chairman, and Professors

* Canadian Naturalist and Geologist, 1857.
† Journal of the Geological Society, May 1871.

Vollhard and Von Jolly are the secretaries. The King of Bavaria has subscribed 1,000 florins.

THE purchase for the National collection, by the Trustees of the British Museum, of Mr. A. R. Wallace's splendid collection of birds from the Malay Archipelago, will be gratifying to all who are interested in science. Mr. Wallace being so thoroughly acquainted with ornithology, and having obtained so many of the specimens himself from localities recorded by himself at the time, makes the collection much more valuable than the skins alone would have been, if they had been accumulated by a less thorough master of the subject. That such is the case, is proved by the great value of Mr. Wallace's paper on the Parrots of the Malay Archipelago, which appeared in the Proceedings of the Zoological Society, nearly ten years ago; and another on the Pigeons of the same region, published in the *Ibis*, at about the same time. It is also not to be forgotten, that the discovery of one of the most important of recent points in physical geography, namely, the situation of the line which separates Asia from Australasia, in other words, *Wallace's line*, was made in great measure from the observations by the author,—whose name is thus deservedly immortalised,—of the differences in the avifaunas of Bali and Lombock.

THOSE of our readers who are interested in University science teaching will be glad to learn that Dr. Michael Foster's course of Elementary Biology at Cambridge, which commenced last week, is attended by more than 30 students. This unexpectedly large attendance has taxed to the utmost the space at disposal. However, such arrangements have been made as will enable every student to have a fair though not large amount of space at his disposal, each set of reagents, &c., being used in common by two or three men. Nothing could illustrate more strongly the urgent need for further provision of working-room for biological students at Cambridge; as scarcely any space is now available for advanced histological, embryological, or physiological research. Dr. Foster's course this term is very similar to that given to science teachers in the summer at South Kensington, and is the first that has been held in term-time at Cambridge, a few students having gone through a like course last long vacation. It is probable that there may be a still larger attendance at future courses of this kind, as Dr. Foster announced that he should require students to have received this or similar teaching before admission to the winter courses of practical physiology. Dr. Foster is assisted in the work of practical demonstration by Mr. H. N. Martin, D.Sc., M.B. of Christ's College, Mr. C. Yule, B.A. of St. John's College, and Mr. T. W. Bridge, of Trinity College, the newly-appointed Demonstrator of Comparative Anatomy.

MR. JOHN ARROWSMITH, the well-known geographer, died on May 2, at the age of eighty-three years.

A GENTLEMAN writes us that he was invited by the Royal Commissioners to act as a juror at the Vienna Exhibition, but was at the same time coolly told that our Philistian Government had placed no funds at the disposal of the Commissioners wherewith to defray the necessary expenses of those who are willing to devote their valuable time and experience to the service of their country. Our readers will not be surprised at this. Other Governments have discovered that even in the most commercial, as well as in the highest light, the encouragement of science "pays." The British Government, with five millions on the right side of their account, still regard science as a beggarly Lazarus, to whom, for mere shame's sake, they are compelled to throw an occasional crumb. As our correspondent says, poor little Switzerland has devoted two and a half times the pittance our Government have allowed to defray the expenses of the Vienna Commission; while the amount expended by Austria in their department of former exhibitions was at least four times as much as we have devoted to theirs.

CAPT. F. J. OWEN EVANS, R.N., F.R.S. Chief Naval Assistant in the Hydrographic Department of the Admiralty, and in charge of the Magnetic Department, has been appointed Companion of the Most Honourable Order of the Bath.

THE publication of the eighth volume of the *Zoological Record* which, as we announced some time since, has been so long delayed through the unfortunate indisposition of one of the contributors may now be shortly expected. The ninth volume containing the zoological literature of 1872 is now in hand, the recorders being the same as in the eighth volume, with the exception of Prof. Traquair, whose place is supplied by Prof. Lütken of Copenhagen. The Editor will be glad to receive separate copies of papers published in journals (especially those which have not a very wide circulation) addressed to the care of the publisher, Mr. Van Voorst, 1, Paternoster Row, London. Such separate copies, however, to be of use, should have the original pagination indicated.

THE Society of Antiquaries of Scotland has just come into the enjoyment of an estate in Caithness, of which the reversionary interest was bequeathed to it for the purpose of founding a Lectureship of Archæology.

MR. BESSEMER intends to found a gold medal, to be given annually to any member of the Iron and Steel Institute who may have displayed literary capacity, or promoted the progress of metallurgical science by original research.

PROFESSOR NEWCOMB'S "New Tables of the Motions of Uranus," are announced as already in the press, and may be expected to be published during the approaching summer. They have been prepared and will be printed at the expense of the Smithsonian Institution. Prof. Newcomb has already, by using all known observations of Neptune, compiled the very accurate tables for computing the motions of that planet that have been used in the "American Nautical Almanac." Having thus provided for the most distant member of our system, he has now returned to Uranus, and finds that his present tables (which will complete the survey of the solar system) represent quite completely the hitherto inexplicable movements of that body.

THE Cincinnati Observatory, founded by Prof. Mitchell, is, we learn, to be removed, and established in a manner worthy of the wealth of Cincinnati. From the drawings it may be judged that the dome of the new building will be thirty-five feet in diameter in the inside. The new site was highly approved of by Prof. Abbe, who continued until lately to be the director of the observatory at Cincinnati, and was presented by John Kilgour, Esq., who also added thereto the sum of ten thousand dollars to provide for the new building.

AMONG the resolutions adopted by Congress at its last session was one authorising the President to invite the International Statistical Congress to hold its next, or ninth, session in the United States. The invitation is to be formal and cordial, and it is provided that should this be accepted the President is authorised to appoint the usual organisation commission, and to take the other preliminary and necessary steps for the meeting of this body, and for holding its session at such time as may be deemed expedient by the Statistical Congress.

A TELEGRAM announces that some of the crew of the Arctic exploring ship *Polaris*, which left New York under the command of Captain Hall in 1871, have been landed in Newfoundland. They were picked up in an open boat 40 miles from the coast of Labrador. It seems, by their statements, that in August 1872, the ship, being beset with ice, commenced landing provisions.

Suddenly the ice broke, and the men who were upon it were carried away. They drifted southward for 196 days—more than six months—and the ice, which originally was five miles in circumference, was gradually reduced to a few feet. They then took to the only remaining boat. Captain Hall, they report, died of apoplexy in November 1871. These statements have been received with distrust.

MR. LAMONT'S beautiful steam yacht *Diana*, which has been chartered by Mr. Benjamin Smith, of London, for a voyage of exploration in the Northern Seas, left Dundee on Saturday. The yacht is manned by a crew of twenty, and although there is a sailing master, Mr. Smith will have complete control. The first point of rendezvous will be Cobbe's Bay, on the north-west of Spitzbergen, where Mr. Smith expects to meet his own sailing yacht, the *Samson*, which was despatched from Hull with stores on May 1 under the command of Captain Walker, for many years connected with the Dundee whaling fleet. Every effort will subsequently be made to push as far northward as possible. During the voyage marine and land plants will be gathered and observations of the tides and currents made. The *Diana* is provisioned for a year, but the object contemplated is expected to be realised in about six months.

AT the recent meeting of the Delegates of the French Learned Societies, gold medals were awarded to the following:—M. Leymerie, for his geological studies in the Pyrenees; M. Bleicher, military surgeon, for his interesting geological observations on the central plateau of France and the environs of Montpelier; M. Guillier, for his researches on the geology and industrial products of the department of Sarthe; M. Pomel, for his investigations on the geology of the Sahara; M. Sirodot, for his work on the algæ (*Lemanea*), which grow in fresh running water. Silver medals were awarded to M. Cauvet for various observations on vegetable anatomy and physiology; to M. Verlot, for his catalogue of the vascular plants of Dauphiny; M. Gassies, for his investigations on the terrestrial and river shells of New Caledonia; to M. Villot, for his observations on the curious metamorphoses and strange migrations of certain worms found in wells and in standing water.

IN 1859, an attempt was made to start a Zoological Garden in Philadelphia, which fell to the ground during the subsequent war. A fresh company is now being formed to carry out the original intention, though on a larger scale. A site has been secured in Fairmount Park, and capital is to be obtained in the following manner:—Certificates of stock are to be issued of not less than fifty dollars each. All receipts derived from the Gardens and collections of the Society, are to be applied annually—first, to the maintenance of the establishment; secondly, to the payment of six per cent. on the stock; and third, any balance remaining to go to the gradual extention of the collection of the Society and the improvement of its grounds. Many influential citizens are supporting the project.

THE Annual Report of the Visitors of the Royal Institution shows a considerable increase in the number of members, and is otherwise very satisfactory.

THE Rev. Thomas Fowler, M.A., Fellow, Sub-Rector, and Tutor of Lincoln College, has been elected to the Professorship of Logic at Oxford, vacant by the death of Prof. Wall.

MR. HYDE CLARKE will on Tuesday, the 20th instant, read a paper at the Anthropological Institute, on "The Egyptian Colony and Language in the Caucasus."

THE Royal Cornwall Polytechnic Society, has published its list of prizes for 1873. The largest sums, varying from ten guineas to one guinea, are offered for improvements in mine ventilation, mining, boring machinery, and similar departments. Small premiums are offered for essays, local observations, and collections of Natural History, especially such as illustrate the Natural History of the county.

WE have received the "Report on the Condition of the Sea Fisheries of the South Coast of New England in 1871-2," by Prof. S. F. Baird. As the result of a thorough investigation, Prof. Baird comes to the conclusion that during the last few years there has been a decided decrease in the number of food-fishes in these waters: the decrease being mainly due to the combined action of the fish-ponds or weirs and the blue-fish, the former destroying a large percentage of the spawning fish before they have deposited their eggs, and the latter devouring immense numbers of young fish after they have passed the ordinary perils of immaturity.

FROM the "Report of the Commissioners of Fisheries of the State of New York," we learn that the rivers of that State are being plentifully stocked with useful fish, especially shad; and the Commissioners are confident that the people of the United States will in a short time rely upon restocking their waters, and not upon game laws, to keep up a full supply of fish for their markets.

WE have received the first two parts of Mr. Tegetmeier's magnificent work on "Pheasants for the Covert and the Aviary." We shall notice it fully when completed.

THE much-vexed question as to whether seals are fish or not, as regards the oil to be obtained from them, has recently come up in a practical shape between the governments of the United States and Newfoundland. The fishery treaty lately entered into between the United States and Great Britain, and about to go into actual operation in the course of the present summer, provides that *fish* oil shall be admitted free, but that other oils shall pay a duty of ten per cent. This question is one that would be very easy of solution if it were purely zoological in its character, since, as every one does or should know, the seal and porpoise, as well as the whale, are warm-blooded mammalia, having nothing in common with the fish any more than has the man who, for the time being, goes into the water for the purpose of bathing. It appears, however, to be the general practice with commercial nations to class all oils obtained from marine objects, whether cetaceans, birds, or fishes, as fish oil, and on this ground it is probable that the claim of the Newfoundland authorities to have seals recognised as fish will be accepted.

THE following additions to the Brighton Aquarium have been made during the past week:—Two young Seals (*Phoca vitulina*) from Jan-Mayen Island, Arctic Sea, presented by Mr. John Clark; two Porpoises (*Phocæna communis*), from Rye Bay, purchased; one Angler (*Lophius piscatorius*), from Cornwall; Bass (*Labrax lupus*); Gurnards (*Trigla lineata*); Grey Mullet (*Mugil capito*); Conger-eels (*Conger vulgaris*); Sand Smelts (*Atherina Presbyter*); Pollack Whiting (*Gadus pollachius*); Rocklings (*Motella mustela*); Sand Launce (*Ammodytes lancea*); one Octopus (*Octopus vulgaris*), from the French coast; two cuttle-fish (*Sepia officinalis*); Prawns (*Palæmon serratus*); Foliaceous Coralline (*Eschara foliacea*); Anemones, numerous.

THE additions to the Zoological Society's Gardens during the past week include a Chinese Water Deer (*Hydropotes inermis*), from China, presented by Mr. R. Swinhoe; four Peafowl (*Pavo cristatus*), from India, presented by Mrs. Stern; two Koodoos (*Strepsiceros kudu*), and a Pluto Monkey (*Cercopithecus pluto*), from Africa; a Weeper Capuchin (*Cebus capucinus*), from South America, deposited; three Cole Tits (*Parus ater*), from the British Isles; four Spix's Cavies (*Cavia spixii*), from Brazil; a tawny Eagle (*Aquila nævioides*), from Africa, purchased; a Markhoor (*Capra megaceros*); five Peacock Pheasants (*Polyplectron chinguis*); and five Chilian Pintails (*Dafila spinicauda*), born in the Gardens.

THE BIRTH OF CHEMISTRY

X.

The Theory of Phlogiston—Comparison with Hooke's Theory of Combustion.—Early Ideas regarding Calcination.—Stephen Hales—His Pneumatic Experiments.—Boerhaave.—Conclusion.

ABOUT the year 1669 we find the first dawnings of a theory which was proposed in order to connect together various chemical phenomena, and notably for the explanation of combustion, the common and most obvious of all chemical actions. This theory, known as the "Theory of Phlogiston," powerfully influenced chemistry for a century; indeed upon its ruins the structure of modern chemistry was raised by the labours of Lavoisier, Priestley, and Scheele. The proposers of this theory —John Joachim Becher (b. 1625, d. 1682) and George Ernest Stahl (b. 1660, d. 1734) endeavoured to trace the cause of various phenomena of chemical change to the assimilation or rejection of what they called "*materia aut principium ignis, non ipse ignis*"—not actual fire, but the principle of fire; a something not much unlike the pure, elemental, celestial fire which a few ancient and many Middle Age writers had feigned to exist. Stahl believed this *materia ignis* to be a very subtle, invisible, substance, which neither burns nor glows; its particles penetrate the most dense substances, and are agitated by a very rapid motion. When a body is burned it loses phlogiston; when a body is un-burned, if we may use such an expression, or de-oxidised, it assimilates phlogiston (φλογιστὸς, burnt). Thus if lead is heated for some length of time it is converted into a powdery substance which they called *calx of lead*, and we, *lead oxide;* the lead has lost Phlogiston, said Stahl. On the other hand, if this same calx of lead is heated with red-hot charcoal, it is deoxidised and becomes lead again. It has now assimilated the Phlogiston, which it had before lost.

But here arose a difficulty. A metal was found to be heavier after calcination than before; thus loss of Phlogiston lead to gain of weight, which was altogether anomalous, and apparently incapable of explanation. But the Phlogistians were equal to the occasion; the supporters of a pet theory will create any number of the most vague and impossible hypotheses, rather than yield up their darling to destruction: so, said they, Phlogiston is a principle of levity; it confers negative weight; it makes bodies lighter, just as bladders attached to a swimmer lighten him.

The theory was applied as generally as possible:—thus sulphuric acid is produced by burning sulphur under certain conditions of oxidation; the sulphur loses Phlogiston, and becomes heavier like the metallic calx; hence sulphuric acid is sulphur *minus* Phlogiston, while sulphur is consequently sulphuric acid *plus* Phlogiston. In fact *loss of phlogiston* was synonymous with what we call *oxidation*; and *gain of phlogiston* with *deoxidation*. The existence of Phlogiston was so utterly unsupported by experimental proof that the theory could scarcely exist without many opponents. The endurance of the most false chimerical theory is often really wonderful. The Phlogistians were attacked first in one direction, then in another, yet the theory continued to find supporters. At last, as a last resource, hydrogen gas—recently investigated by Cavendish—was said to be Phlogiston, but this was so entirely different from the Phlogiston of Stahl that the theory was now seen on all sides to be fast giving way. At length Lavoisier, a century ago, conclusively disproved the theory by means which cannot be discussed here, because they belong to the more advanced history of the science.

How the crude, unscientific, illogical theory of Phlogiston could have arisen in the face of Hooke's admirable theory of combustion, and Mayow's experiments in support of it, must always remain a mystery. It is probable that if Mayow had not died a young man, or if Hooke had found leisure to prosecute his views, the theory of Phlogiston would never have been propounded. The theory has been much over-praised. The only service which it rendered to the science was that it introduced a certain amount of order and system, which was hitherto wanting. It led to the grouping together of certain classes of facts, and, to a slight extent, to the application of similar modes of reasoning to similar chemical phenomena. And although that reasoning was altogether wrong, it seemed to indicate the means by which, with a more perfect and advanced system, chemistry might become an exact science subject to definite modes of treatment.

We have more than once spoken of calcination, which was indeed one of the most prominent operations of old chemistry. Since the examination of the process led to the proposal of just ideas concerning the materiality of the air—most often denied by ancient and middle-age writers—it may be well to glance at the early ideas regarding calcination. Here then was the dominant experiment in this direction: I take a bright lustrous metal, tin or lead, melt it, keep it in a molten state for awhile, and it is converted into powder, which weighs more than the original metal. Again I heat this same powder with charcoal, and it becomes metal again; yet nothing that can be seen has been added to the metal, or taken away from its calx. Geber defines calcination as "the pulverisation of a thing by fire, by depriving it of the humidity which consolidates its parts." He observed that the metal increases in weight during the operation, although "deprived of its humidity." Cardanus asserted that the increase of weight in the case of lead amounted to one-thirteenth the weight of the metal calcined; and he accounted for it on the supposition that all things possess a certain kind of life, a *celestial heat*, which is destroyed during calcination; hence they become heavier for the same reason that animals are heavier after death, for the celestial heat tends upwards. This idea was almost similar to that of the Phlogistians, although published more than a century before Becher wrote his *Physica Subterranea*. In

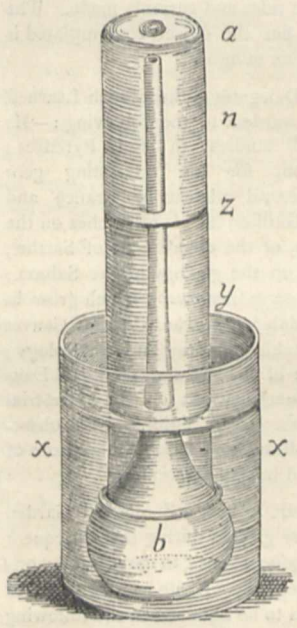

FIG. 21.

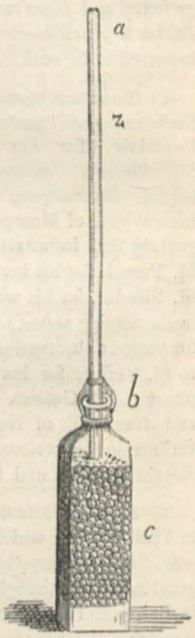

FIG. 22.

FIG. 21.—Hales' method of measuring a gas. FIG 22.—Measurement of the elastic force of the gas produced by fermenting peas.

1629 Jean Rey, a physician of Bergerac, attempted to discover the cause of increase, and attributed it to the absorption of "thickened air" (*l'air espessi*) by the metal during calcination. Lemery, as we have seen, attributed the gain to the absorption of *corpuscules de feu*. Afterwards came the nitre-air of Mayow, then a century later the increase was proved to be due to the union of the body with a constituent of the air which Lavoisier named oxygen gas; and this gas was first discovered by heating one of the calces (calx of mercury), about which so much speculation had been wasted, and so little experiment bestowed, by earlier writers.

We are drawing towards the end of our subject, but we think any account of the earlier history of chemistry would be very incomplete without a notice of the work of Dr. Stephen Hales (born 1677, died 1761). In a number of papers communicated to the Royal Society, and afterwards published in a work entitled *Statical Essays*, we find a variety of experiments by Hales, chiefly relating to pneumatic chemistry. Herein we find an account of "a specimen of an attempt to analyse the air by a great variety of chymico-statical experiments, which show in how great a proportion air is wrought into the composition of animal, vegetable, and mineral substances, and withal how readily it resumes its former elastick state, when in the dissolution of those

substances it is disengaged from them." In order to determine the quantity of air disengaged from any substance during distillation or fusion, Hales placed the substance in a retort, and luted the retort to a large receiver with a small hole, at the bottom; water was caused to occupy a known space in the receiver, and the amount of air expelled was estimated by noting the amount of water remaining in the receiver at the conclusion of the experiment, after cooling. Hales employed the following apparatus (Fig. 21) to measure the volume of air generated by any kind of fermentation, also by the reaction of one body upon another.

The substances undergoing fermentation were placed in *b*, and over the whole a vessel, *a y*, was inverted, closed below by the vessel *x x*, and containing above a certain amount of air, to the level *y*. If air were generated, the water in *a* sank (say to *y*); while if air were absorbed by the bodies in *b*, the water rose (say to *n*). Sometimes he placed different substances on pedestals in a jar of air, and ignited them, as Mayow had done, by a burning-glass, and noted the alteration in the bulk of air. He did this with phosphorus, brown paper dipped in nitre, sulphur, and other substances. If he required to act upon substances by means of a strong acid, he would place the substance in a

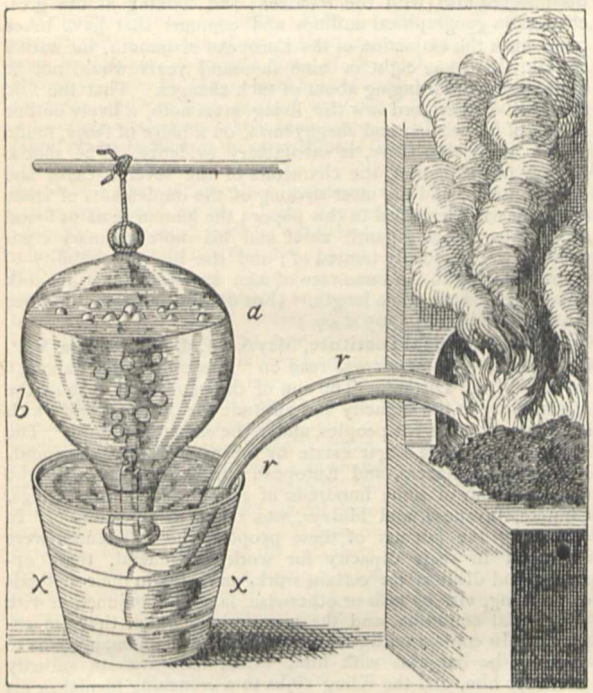

FIG. 23.—Hales' pneumatic experiments.

suitable vessel on a pedestal in a known volume of air, standing over water, and would suspend over it a phial which could be emptied by pulling a string. These devices were closely copied by Priestley and Lavoisier in their experiments upon gaseous bodies. If a substance required to be heated violently, it was placed in a bent gun-barrel, *r r* (Fig. 23), one end of which was placed in a furnace, while the other was placed under a bell jar, *a b*, full of water, inserted in the pail of water *x x*. He distilled a number of substances, apparently taken at random, and determined the amount of gas evolved, but he appears to have been at no pains to determine the nature of the gas, assuming it to be ordinary atmospheric air. Thus he distilled 1 cubic inch of lard, and collected thirty-three cubic inches of gas as the products of decomposition. Tallow, horn, sal ammoniac, oyster shells, peas, amber, camphire, and many other substances, were similarly treated.

Two grains of phosphorus ignited in a closed vessel of air, were found to absorb 28 cubic inches of air. 211 grains of nitre mixed with bone-ash yielded 90 cubic inches of gas; 54 cubic inches of water on boiling yielded 1 cubic inch of air. In order to measure the elastic force of the gas produced by fermenting peas, Hales filled a small, strong bottle, *c* (Fig. 22) with peas, filling up the interstices with water; mercury to a depth of half an inch was then poured in, and of course remained at the bottom of the vessel *c*. A long tube, *a z*, the lower end of which dipped beneath the mercury, was securely fastened into the mouth of the bottle *b*, and fixed air-tight. In a few days' time the peas were in a state of fermentation, and the generated gas had forced the mercury to ascend in the tube *a z* to a height of 80 inches, hence the gas in *c* was existing under a pressure of about 35 lbs. on the square inch.

Hales also produced gases by various reactions. Thus he poured a cubic inch of sulphuric acid on half a cubic inch of iron filings: no effect took place until he had diluted the acid with water, when forty-three cubic inches of *air* (as he calls it—in reality hydrogen gas) came off. Iron filings mixed with nitric acid, or with ammonia, or sulphur, were found to absorb air. A cubic inch of chalk treated with dilute sulphuric acid produced thirty-one cubic inches of *air* (in reality carbonic anhydride gas). If space permitted, we could say much more of Hales' works. His experiments on respiration, and on various principles of vegetation, are exceedingly ingenious, and often accurate. It has often been said that Lavoisier created modern chemistry by the introduction of the balance into chemical experiments, but here we find Hales weighing his substances, and measuring his gases, years before Lavoisier was born. Hales did not sufficiently investigate the nature of the various gases which he produced in the course of his experiments, but he assuredly paved the way for many of the after discoveries of Priestley, Cavendish, and Lavoisier.

Dr. Hermann Boerhaave, of Leyden (b. 1668, d. 1738), was a contemporary of Hales. He was the author of the first comprehensive system of chemistry:—a bulky quarto in two volumes, entitled *Elementa Chemiæ*, which appeared in 1732, and which for many years was the chemical text-book of Europe. In it he defines chemistry as "an art which teaches the manner of performing certain physical operations, whereby bodies cognizable to the senses, or capable of being rendered cognizable, and of being contained in vessels, are so changed by means of proper instruments, as to produce certain determinate effects, and at the same time discover the causes thereof for the service of various arts."

But hold! our task was to give some account of the *birth* of chemistry, while a science with such a ponderous definition as the above, is no longer infantile. The babe has grown up about us until it has assumed a tremendous individuality. The great discoveries of the fathers of modern chemistry, Lavoisier, Scheele, Priestley, Cavendish, Davy, need not be told here; they belong to the later history of chemistry. We have traced the science from its commencement in the crude metallurgical and other operations of the ancients, to the time when a comprehensive system of the science appeared. And when we think of the vast dimensions of the science of to-day, the numberless text-books in every language, the great laboratories springing up in every country, the immense amount of original research, we are carried back in spirit to those mistaken—but often grandly energetic men—who said to the disciples of their art:—

Ora!
Lege, Lege, Lege, Relege, Labora!
Et Invenies.

G. F. RODWELL

SCIENTIFIC SERIALS

Bulletin Mensuel de la Société d'Acclimatation de Paris. The April number contains much interesting information as to the work done by the Society, which besides gratuitously distributing specimens of various useful animals or plants wherever they are likely to thrive, also lends or lets to those persons, whose tastes or knowledge fit them for the charge, some of the rarer species of animal or vegetable life, thus sowing the seeds of miniature *jardins d'acclimatation* throughout the country. During the last 12 months 3 monkeys have been born at the Paris Gardens, one of them in March last. In that month 75 mammalia and 1,669 birds of various sorts were received, while the Society was able to distribute 62 mammalia and 1,731 birds. The Society aims at encouraging the reproduction of all sorts of useful animals, not merely confining its efforts to the maintenance of a stock for exhibition. An interesting account is given of an oyster breeding establishment and aquarium at Biarritz, and of the cultivation of silkworms in France generally. Our French neighbours have set us the example of cultivating

our oysters; we may learn some day to follow in their steps and turn our attention, so far as our climate will allow of it, to the "education" of silkworms. This art is becoming quite a recognised industry in France, and the success that has attended its adoption is very gratifying. Bamboos, Spanish broom (*Stipa tencaissima*), China grass or China nettles, Californian pines (*Pinus sabiniana*), are among the plants which are referred to as proper to be introduced into France.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, May 8.—Dr. Hirst, F.R.S., in the chair. Prof. Cayley communicated an extract from a letter he had received from M. Hermite "On an application of the theory of unicursal curves," and then gave accounts of the two following papers, "Plan of a curve-tracing apparatus," and "On a rational quintic correspondence of two points in a plane:" another paper entitled "Bicursal curves" (*i.e.* curves with a deficiency *one*) by the same gentleman, was taken as read.—Mr. S. Roberts read a short "Note on the Plückerian characteristics of epi- and hypo-trochoids," &c., showing that the curves were unicursal: he gave also the order and class. In connection with these curves Mr. J. L. Glaisher advocated the use of Mr. Perigal's term "bicircloids." Amongst the presents received were twenty-two memoirs, &c., by the late Prof. de Morgan, presented by Mrs. de Morgan.

Geological Society, April 30.—Joseph Prestwich, F.R.S., vice-president, in the chair.—On the Permian Breccias and Boulder-beds of Armagh, by Prof. Edward Hull, F.R.S., Director of the Geological Survey of Ireland. In this paper the author described certain breccias occurring in the vicinity of Armagh, which he referred, both on stratigraphical and physical grounds, to the Lower Permian series, considering them to be identical with the "brockram" of Cumberland, and the Breccias of Worcestershire and Shropshire. The author further referred to the extensive denudation which the Carboniferous beds have undergone in Armagh, and also alluded to the occurrence of beds of Permian age near Benburb, between Armagh and Dungannon.—Geological Notes on Griqualand West, by G. W. Stow. The geological results of a journey made by Mr G. W. Stow and Mr. F. H. S. Orpen from the Orange Free State into Griqualand West are communicated by Mr. Stow in this paper, with numerous carefully executed sections and a geological map based on the survey map prepared by Mr. Orpen for the Government. From the junction of the Riet and Modder Rivers (south of the Panneveldt Diamond-fields) to Kheis and the Schurwe Bergen, the track traversed three degrees of longitude. The return route north-east to Mount Huxley and Daniel's Kuil, and eastward to Likatlong, on the Hart or Kolang River, was nearly as long. From the Modder, first south-westward and then westward, to the junction of the Vaal and Orange, the olive shales of the *Dicynodon*- or Karoo-series, traversed frequently by igneous rocks, form the country, and are seen in some places to lie unconformably on older rocks. The shales reach to the end of the Campbell Randt, on the other side of the Orange River, and have been, it seems, formed of the débris of those old hills to a great extent. The oldest rocks of the locality are seen cropping out here and there in the gorges at the foot of the Randt, and consist of metamorphic rocks, greatly denuded, on which the massive and extensive siliceo-calcareous strata of the Great Campbell Plateau lie unconformably. These latter and the breccias of their slopes are coated thickly with enormous travertine deposits. Igneous rock-masses occur around Ongeluk, west of the Jasper range, and then bright-red jasper rocks crop up near Matsáp, succeeded to the west by the parallel quartzite range of Matsáp, and again by other bedded jaspers, which seem to lie in a synclinal of the quartzite rocks, which come up again in the Langeberg. These are succeeded by lower rocks, consisting largely of sandstone, grit, and quartzite, with more or less pervading mica, as far as the journey extended in the Schurwe Bergen, also parallel to the former ranges. The maximum thickness of the successive strata is calculated by the author at 24,000 ft.; allowing for possible reduplications, the minimum is regarded as not less than 9,000 ft. —On some Bivalve Entomostraca, chiefly Cypridinidæ, of the Carboniferous formations, by Prof. T. R. Jones, F.R.S. The larger forms of bivalved Entomostraca are not rare in the Carboniferous limestone, and some occur in certain shales of the Coal-measures.

Geologists' Association, May 2.—H. Woodward, F.R.S., president, in the chair.—On the valley of the Vézère (Perigord), its limestones, caves, and pre-historic remains, by Prof. T. Rupert Jones, F.R.S., F.G.S. The river Vézère, rising in the department of Corrèze, traversing the department Dordogne, and joining the river Dordogne near Larlat, runs from the old metamorphic rocks of the central plateau of France, through carboniferous, triassic, jurassic, and cretaceous strata. The last mentioned are chiefly limestones, nearly horizontal, presenting steep and often high cliffs, either washed by the river, or bordering its broader and older valley. The softer bands of limestone have been hollowed out along the valley by frost and water, and here and there present recesses and caves. These in several instances have been artificially enlarged, and in very many cases have afforded shelter to pre-historic people, and still retain heaps of bones and hearth-stuff, with flint implements of numerous kinds, carved bones and antlers, and occasionally human bones. The most common bones and antlers are those of reindeer, which must have abounded in southern France, whether remaining all the year round or migrating from plain to mountain and back again in their season, for the cave-folk killed them of all ages in vast numbers. The cold climate necessary for the reindeer has long passed away; the musk-ox and the hairy mammoth disappeared also with the reindeer; and looking at the great changes in geographical outlines and contours that have taken place since the extinction of the European mammoth, the author thought that some eight or nine thousand years would not be too long for the bringing about of such changes. That the Old cave folk of Périgord saw the living mammoth, a lively outline sketch of its peculiar and shaggy form, on a piece of ivory, found in the Madelaine Cave, is satisfactory evidence. The special geology of the district, the characters of the several caves and their contents, and the most striking of the implements of stone and bone were described in this paper; the human remains found at Cro-Magnon, a gigantic chief and his more ordinary companions, were specially treated of; and the high probability of their belonging to the same race of men as the older Cave-folk was discussed at some length. (For details on this subject see NATURE, vol. vii. p. 305 *et seq.*)

Anthropological Institute, May 6.—Col. A. Lane Fox, V.P. in the chair. A paper was read on "Eastern Coolie Labour," by Mr. W. L. Distant. The aim of the paper was to show the dissimilarity in the capacity and aptitude for certain work which exists among different peoples under the same conditions. The working of a large sugar estate by means of European capital, European appliances, and European superintendence, with the manual labour of some hundreds of Asiatics, including Klings, Chinese, Javanese, and Malays, was taken as an example. In describing the labours of these peoples, the differences were examined in their capacity for work in general, their aptitudes and dislikes for certain work, and also in their methods of working, viz. by task or otherwise, taken in conjunction with their social condition, and the terms under which they are engaged. In contact with the European the Chinaman seems to prosper; he bargains with him, whilst the Javanese sullenly works for him, and the Kling sinks to a crouching menial in his presence. The European seems affected in the same way; he can chat with the Chinese, tolerate the Javanese, but despises the Kling. Europern civilisation and prejudice are confronted with Eastern ignorance and prejudice. It is the need of money that has brought these different peoples together. English, Scotch, Portuguese, Klings, Javanese and Chinese are only attracted together in the hope of gain, and under this creed progress and civilisation generally remain in the hands of the strongest and richest party.—A paper by Mr. Howorth was read on "The westerly Drifting of Nomads from the fifth to the nineteenth century, Part x.: the Alans or Lesghs." Col. Lane Fox exhibited two beautifully chipped flint bracelets, four iron bracelets, and other articles found in a tomb in the valley leading to the tombs of the Kings of Thebes; also a large and finely worked flint knife from a tomb in the same neighbourhood. Lieut. S. C. Holland, R.N., exhibited a series of photographs of Ainos, and various articles of Aino manufacture.—The Rev. Dunbar I. Heath has been elected Treasurer in the place of the late Mr. Flower.

Zoological Society, May 6.—Prof. Newton, F.R.S., vice-president, in the chair. The secretary read a report on the additions that had been made to the Society's menagerie during the months of March and April, 1873, and called particular attention to an example of the Broad Banded Armadillo (*Xenu-*

rus unicinctus), which was new to the Society's collection ; also to a pair of White-necked Cranes (*Grus vipio*) from Japan. No example of this fine species, so far as was known, had previously been brought alive to Europe.—Mr. Sclater exhibited some photographs of, and made some remarks on, a young specimen of the Liberian Hippopotamus (*Hippopotamus liberiensis*) which had recently been received alive by the Zoological Society of Ireland, but had died shortly after its arrival.—A communication was read from the Rev. O. P. Cambridge on some new species of Araneidea, chiefly from Oriental Siberia.—A communication was read from Mr. G. B. Sowerby, jun., on three species of land shells from Madagascar, which he proposed to call *Cyclostoma suffusum*, *C. vexillum*, and *C. perspectivum*, sps. nov.—A communication by Messrs. P. L. Sclater and O. Salvin contained notes on the range of certain species of American *Limiocolæ* in the southern part of the New World. Two distinct species of Stilts (*Himantopus*) were shown to occur in the Neotropical region—namely, *H. nigricollis* Viell., and *H. brasiliensis* Brehm.—Mr. A. H. Garrod read a memoir on the variations of the carotid arteries of birds, in continuation of the labours of Bauer, Meckel, and Nitzsch upon this subject. Mr. Garrod's observations were based principally upon specimens that had died in the Society's gardens.

Entomological Society, May 5.—Mr. H. T. Staunton, vice-president, in the chair.—Mr. Higgins exhibited a specimen of *Langia zenzeroides* (one of the Sphingidæ), from the Himalaya, bred by Major Buckley. He also exhibited a female specimen (the first that he had ever seen) of *Goliathus albosignata*, from Limpopo.—Mr. McLachlan exhibited a coloured plate of butterflies as a sample of a work on the "Natural History of Turkestan," about to be published at the expense of the Government of that place, and founded on the entomological collections made by M. Alexis Fedtscheuko during the years 1869–71. The work is to be published in the Russian language, with Latin diagnoses of the new species.—Mr. Bates pointed out a figure in the plate of *Cocandica*, a variety of *Colias nastes*, an insect belonging to Lapland, and remarked that it was an interesting fact that many species of insects belonging to Arctic regions were also found in mountainous districts much farther south, though not in the intervening plains. He mentioned also *Colias palæno*, which was found near the snow-line, in the Alps, and in Lapland.—Mr. Müller also remarked on the close connection between the Arctic and Alpine insect faunas, referring particularly to *Parnassius apollo*, which occurred in the north of Europe, but in Switzerland was confined to the Alps and the opposite Jurassian range, carefully avoiding the intervening alluvial plains, which in the glacial period had been covered with the glaciers of the Rhone, the Reuss, the Rhine, and minor tributaries. He added that if the actual stations of the species were mapped, they would all be found to exist outside, but along the moraines left by the ancient glaciers.—Dr. Sharp communicated a paper on the Staphylinidæ of Japan," principally from the collections formed by Mr. George Lewis.—A paper was read, entitled "Notes on the Ephemeridæ," by Dr. H. A. Hagen, compiled by the Rev. A. E. Eaton.

Royal Horticultural Society, May 7.—General Meeting. —Viscount Bury, M.P., having been nominated by the Council, pending the Queen's approval, to the office of president, took the chair.—The Rev. M. J. Berkeley commented upon the show. Prof. Thiselton Dyer called attention to the first appearance at the meetings of *Odontoglossum vexillarium*, a lovely orchid, with flat rose-coloured flowers, four inches across. It had flowered for the first time in the old world on April 19. The late Mr. Bowman discovered it in New Grenada, on the western slopes of the Andes. It was more nearly allied to *O. phalænopsis* than to the type generally prevailing in the genus.

Scientific Committee.—Dr. J. D. Hooker, C.B., F.R.S., in the chair.—The Rev. M. J. Berkeley exhibited a shoot of *Araucaria imbricata*, illustrating the injury suffered by this plant from the punctures of the young leaves by the prickly points of those on the other branches.—Dr. Masters exhibited a drawing of a flower of Mr. Ware's *Primula veris* var. *chlorantha*. It consisted of a mass of small leafy scales, the innermost of which were prolonged into styles and had ovules upon the edges. —Prof. Thiselton Dyer, adverting to some statements about the cultivation of fungi, stated that, according to Thore, cited by Duchartre, *Agaricus Palomet* and *Boletus edulis* are sown in the Landes by watering the soil with water in which these species had been boiled. The spores of various other species will, it is said, endure a temperature of 212° F., and those of *Peziza repanda* even, according to Schmitz, 230° F.—The Rev. M. J. Berkeley said there was no doubt that fungus spores would bear a high temperature. The development of a *Penicillium* in the interior of loaves of the *pain de munition* almost immediately after they were drawn from the oven to the temperature of which the spores must have been fully exposed, was a case in point. Specimens of *Cytinus hypocistis*, the only European species of *Rafflesiaceæ*, were shown. They had been sent from Cannes by the Hon R. Bailie Hamilton.

Institution of Civil Engineers, May 6.—Mr. T. Hawksley, president, in the chair.—The paper read was a history of the River Clyde, by Mr. James Deas, and gave an account of the various works carried out for improving it as a navigable river, and of the modes and cost of dredging and depositing followed in the deepening and widening of it. It was remarked that for no river in the kingdom had so much been done "by art and man's device" as for the Clyde above Port-Glasgow ; that the river from Glasgow, for twelve miles seaward, was nearly as much an artificial navigation as the Suez Canal. One hundred years ago the river was fordable even on foot twelve miles below Glasgow. The engineering works carried out in the Clyde, combined with the mineral resources of the district, had raised Glasgow from an insignificant provincial town, with a population in 1771 of only 35,000, to be the second city in the empire, with a population (including suburbs) of 566,150, according to the census of 1871.

Royal Microscopical Society, May 7.—Dr. Millar, V.P., in the chair.—A paper by Dr. Maddox was read, "On a parasite (believed to be a species of *Tænia*) found encysted in the neck of a sheep." The general characteristics of the cyst and the appearance of sections of it under the microscope were fully described, as were also such portions of the parasite as could be separated from the general mass, and in which the presence of immature ova was particularly noted. The circumstance of finding ova during the encysted condition of the creature was believed to be unique.—A paper was also read by Mr. W. K. Parker "On the Development of the Facial Arches of the Sturgeon," in which the formation and development of the mouth was minutely described, and the relation which it bore to that of the osseous fishes and to mammals pointed out.

PHILADELPHIA

Academy of Natural Sciences, January 14.—Dr. Ruschenberger, president, in the chair.—Prof. Cope made some observations on the structure and systematic position of the genus *Eobasileus* Cope. *Uintatherium* Leidy and *Dinoceras* Marsh were names applied to allied mammals, so that the same would probably apply to them also. Until further evidence is presented, he adheres to his original position, that these animals are true *Proboscidia*, and cannot be referred to any other order.—"On the Forms of Artificial Oxide of Zinc," by George A. Koenig, Ph.D.—"On a Boiler Incrustation from New Jersey," by George A. Koenig, Ph.D.

January 21.—Dr. Bridges in the chair.—Notice of Fossil Vertebrates from the Miocene of Virginia. Prof. Leidy directed attention to some fossils, part of a small collection recently received. They were found imbedded in blue clay containing an abundance of fossil diatomes, among which Coscinodiscus is especially conspicuous. The fossil vertebrate remains consist mainly of vertebræ and teeth of cetaceans, vertebræ of bony fishes, teeth of sharks, and spines of rays. Among them also there is a portion of a humerus of a bird, and several worn teeth of a peccary. Besides these there are specimens which may be regarded as characteristic of the following undescribed species : *Protocamelus virginiensis*, *Tautoga* (*Protautoga*) *conidens*, *Acipenser ornatus*.—Mr. Thomas Meehan offered to the Academy some facts in regard to the fertilisation of flowers which confirmed the popular view that pollen of one variety had an immediate influence on the structure of the fruit of another variety, as well as on the progeny ; and also furnished some entirely new facts in regard to the ability of a seed germ to receive impregnation from two distinct sources. Mr. Arnold of Paris, Canada, determined to observe the effect of cross fertilisation on Indian corn. He procured a very peculiar variety of which Mr. Meehan exhibited an ear, not known in the vicinity—a brown variety, with a circular dent at the apex—and raised one plant from it. The first set of flowers were permitted to be fertilised by their own pollen in order to test whether there was any reversionary tendency in the plant, or the pollen of any other variety in the vicinity. The ear now produced was the result

—every grain being like its parent. The corn plant produces two ears on each stalk. As soon as the "silk"—the pistils of this second ear—appeared, the pollen—in a "tassel"—of the common yellow flint corn was procured, set in a bottle of water tied near the developing ear, the plant's own tassel having been cut away sometime previous. After a short time this set of male flowers was removed, and a panicle of male flowers from a white variety was introduced to the same bottle in order to afford it the opportunity of operating on the same female flowers. The result was the ear now presented. The base of *each grain* was of the yellow flint corn, but the *upper half* of the white variety. The result was he thought no escape from the conclusion, not only that there was an immediate influence on the seed and the whole fruit structure by the application of strange pollen; but the still more important fact, hardly before more than suspected, that one ovule could receive and be affected by the pollen of two distinct parents, and this too after some time had elapsed between the first and second impregnation.

February 4.—Mr. Vaux, vice-president, in the chair.—The following papers were presented for publication:—"On the Lingual Dentition of certain Terrestrial Pulmonata from the United States, with remarks on their systematic value," by Thos. Bland and Wm. G. Binney; "Catalogue of the recent species of the Class Brachiopoda," by W. H. Dall, U.S.C.S.; "Descriptions of Mexican Ichneumonidæ," by E. T. Cresson. "Notices of Remains of Fishes in the Bridger Tertiary Formation of Wyoming." Prof. Leidy remarked that among the multitude of fossils which had been collected from the tertiary clays and sandstones of the Bridger Group of Wyoming, there were comparatively few pertaining to fishes. Nevertheless the remains of these are not unfrequent, but they are not so complete as one might have expected from the nature of the beds containing them. They usually occur as isolated bones, scales, and teeth, and mostly indicate fishes related with our living Gars (*Lepidosteus*) and Mud Fish (*Amia*). Many of the fragments appear to indicate the following extinct species previously undescribed:—*Lepidosteus atrox; L. simplex; L. notabilis; Amia* (*Protamia*) *uintaensis; A.* (*Protamia*) *media A.* (*Protamia*) *gracilis); Hypamia elegans; Pimelodus antiquus; Phareodus acutus.*

PARIS

Academy of Sciences, May 5.—M. de Quatrefages, president, in the chair.—The deaths of Baron Liebig, foreign associate of the Academy, and of M. Hausteen, correspondent, were announced.—The following papers were read:—On the heat produced by the reactions between water and ammonia, calcic, baric, and strontic, oxides, by M. Berthelot. The author had estimated the heat produced by the solution of dry NH_3 in water, and also on the dilution of the former solution with more water; he has found that as regards the latter case the heat is in inverse ratio to the water already combined with the ammonia. The determinations of the heat in the case of calcic, baric, and strontic oxides, was made by dissolving them in HCL, and from the result obtained the heat for their combination with water was calculated.—On the separation of potash and soda in vegetables, 5th memoir, by M Eug. Peligot. The author finds that in those cases where plants growing near the sea contain sodium salts, this fact is to be attributed to their absorption of them, through their leaves, from the spray in the air, and not from the soil.—A report on M. Bertin's memoir on the resistance opposed to rolling by the keel of a vessel, by MM. Paris, Jurien de la Gravière, and Dupuy de Lôme.—On the conditions of the integrability of simultaneous equations, &c., by M. Collet.—On the use of the meat of tuberculous animals for food; can this meat cause the development of pulmonary phthisis? by M. G. Colin. The author, from the results of thirty experiments where as many animals were fed on every kind of tuberculous flesh, answers the question in the negative. Where other experimenters have obtained opposite results, he believes that they have either experimented on animals already diseased, or have allowed portions of the tuberculous matter to find admission to the lungs of the animals in the air they breathed.—On the action of ozone on absolute alcohol: on the combination of hydrogen and cyanogen under the influence of the silent electric discharge, by M. A. Boillot.—A new observation of comet II., 1867, by M. Stephan.—On the effects produced by electricity on mercury immersed in different solutions, by M. Th. du Moncel.—On the purification of hydrochloric acid by M. Engel.—On the estimation of sugar by Barreswil's method by M. E. Feltz.—Experiments on the respiration of fish, by M. Quinquand.—Contribution to the history of microzymes and Bacteria: physiological transformation of Bacteria into microzymes and of mycrozymes into Bacteria in the digestive tube of the same animal, by MM. Béchamp and Estor.—On the remains of *Elephas priscus* found in the quaternary formation of the environs of Paris, by M. J. Reboux.

DIARY

THURSDAY, MAY 15.

ROYAL SOCIETY, at 8.30.—On the Periodicity of Rainfall in Connection with the Sun-spot Periodicity: C. Meldrum.—On the Heating of a Disc by rapid Rotation in Vacuo: B. Stewart and P. G. Tait.—On Jeypoorite: Major Ross.—Determination of the number of Electrostatic Units in the Electromagnetic Unit made in the Physical Laboratory of Glasgow University: D. McKichan.

SOCIETY OF ANTIQUARIES, at 8.30.—Remarks on some Pictures by Quintin Matsys and Holbein, in the Collection of the Earl of Radnor, at Longford Castle, lately exhibited at the Royal Academy: J. G. Nichols.

CHEMICAL SOCIETY, at 8.—On Isomerism: Dr. H. E. Armstrong.

NUMISMATIC SOCIETY, at 7.

ROYAL INSTITUTION, at 3.—Light: Prof. Tyndall.

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 9.—Limits of Certainty in Taste: Sidney Colvin.

HORTICULTURAL SOCIETY, at 3.—Lecture.

SATURDAY, MAY 17.

ROYAL INSTITUTION, at 3.—Ozone: Prof. Odling.

MONDAY, MAY 19.

LONDON INSTITUTION, at 4.—Elementary Botany: Prof. Bentley.

ASIATIC SOCIETY, at 3.—Anniversary.

VICTORIA INSTITUTE, at 8.—Anniversary.

SOCIETY OF ARTS, at 8.—Cantor Lectures. On Wines; their Production, Treatment, and Use: J. L. W. Thudichum, M.D.

TUESDAY, MAY 20.

ROYAL INSTITUTION, at 3.—Early Roman History and Architecture.

INSTITUTION OF CIVIL ENGINEERS, at 8.

STATISTICAL SOCIETY, at 7.45.

ANTHROPOLOGICAL INSTITUTE, at 8.—On the Egyptian Colony and Language in the Caucasus: Hyde Clarke.

ZOOLOGICAL SOCIETY, at 8.30.—On African Buffaloes: Sir Victor Brooke, Bart.—Remarks on varieties of the Carp: Lord Arthur Russell.—On *Lepilemur cheirgaleus*, and on the Zoological rank of the *Lemuroidea*: St. George Mivart.

WEDNESDAY, MAY 21.

METEOROLOGICAL SOCIETY, at 7.—Discussion on Proceedings of Meteorological Conference at Leipzig.—On Land and Sea Breezes: J. K. Laughton.—Notes on a a Double Rainbow observed at Kirkwall: R. H. Scott.—On some Results of Temperature Observations at Durham: J. J. Plummer.

HORTICULTURAL SOCIETY.—Exhibition of Ericas, Pelargoniums, &c.

SOCIETY OF ARTS, at 8.—Recent Processes for the Production of Gas for Illuminating Purposes: Thomas Wells.

LONDON INSTITUTION, at 7.—Fourth Musical Lecture.

THURSDAY, MAY 22.

ROYAL INSTITUTION, at 3.—Light: Prof. Tyndall.

SOCIETY OF ANTIQUARIES, at 8.30.

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