THURSDAY, MARCH 12, 1885

THE SNAKE-DANCE OF THE MOQUIS OF ARIZONA

The Snake-Dance of the Moquis of Arizona; being a Narrative of a Journey from Santa Fé, New Mexico, to the Villages of the Moqui Indians of Arizona, &c. By John G. Bourke, Captain Third U.S. Cavalry. (London: Sampson Low and Co., 1884.)

THE Pueblo Indians of New Mexico and Arizona have this general name from living in towns (Spanish *pueblo*, from Latin *populus*). Near a river, or oftener on the top of a steep-cliffed *mesa* or table-rock, may be seen these picturesque communal settlements, with their close rows of flat-roofed dwellings, walled with stone and mud, rising in terrace above terrace reached by wooden outside ladders, the whole forming a fortification strong enough to resist a sudden attack of the Apaches or Navajos of the plains, whose ravages in old times led the ancestors of the present Moqui, Zuñi, and other Pueblo tribes to resort to their peculiar architecture. Though these peoples were brought more or less under Spanish rule from the sixteenth century, and had to conform more or less to the Roman Catholic Church, the general barrenness and inaccessibility of their region saved them from being Europeanised to the obliteration of the native culture, like the nations of Mexico proper. In the Pueblos the archaic system of society, framed on maternal descent and exogamy, is still in full vigour, while the complex native religion seems almost as perfectly preserved as if the missionaries had never made the Indians wear silver crosses to their necklaces and march in procession to church on Corpus Christi. Thus it has come to pass that now, when the country has become United States territory, and the traveller bound for San Francisco passes close under the mud-walls of Laguna, there is made accessible to anthropologists a remarkable phase of barbaric society among a mild and intelligent people, where its study can be followed into the minutest detail. A few years ago, Mr. Cushing's papers in the *Century Magazine*, describing his life in Zuñi, excited wide interest. Now we have another instalment of Pueblo literature from Capt. Bourke, the officer selected by Gen. Sheridan to examine the manners and customs of the Indians of the South-Western Territories, and who in August 1881 went with a party to see one of the great rites of the Moqui religion, never before witnessed by a white man.

On his way to the Moqui towns, Capt. Bourke paid a visit to the Pueblo of Santo Domingo. Here the Indians profess to be Catholics, but (as the cura of the parish last year admitted to the writer of the present notice) they keep their old religion too. This comes out in the description of the festival Capt. Bourke's party were present at, where the procession-dance was performed by men with bodies painted pink and white, and wearing only the cotton kilt of their forefathers, while the women's headdresses were thin wooden tablets of Zuñi make, cut in the step-pattern which in Pueblo art conventionally represents the rain-clouds, for the coming of which to fertilise their arid country the ceremonies of Pueblo religion are one unceasing prayer. The clowns had the same prominent position as in the Zuñi dances sketched by Cushing; naked all but the old Mexican *maxtli* around their loins, and painted all over in black and white stripes, with tortoise-shells rattling at their knees, and their hair tied in with corn-shucks, they pranced hither and thither among the dancers. The whole purpose of the dance has been so far changed that it has become a procession bearing offerings to the shrine of St. Dominic, but even here the clowns are allowed their old licence, and chaff the Saint himself quite familiarly. There seem to have been more secret rites which the visitors were not allowed to see; indeed, when Capt. Bourke and Mr. Moran attempted to descend, note-book in hand, by the ladder through the sky-hole into one of the *estufas*—that is, the large cellar-chambers which serve as temples and council-houses—they were seized and ignominiously "fired out" by the yelling crowd below. A few days later, however, when they reached the rocky *mesa* on which stand the three Moqui Pueblos of Suchongnewy, Hualpi, and Hano or Tegua, to visit which was the object of their journey, Capt. Bourke found his way so well prepared by Mr. Cushing, that he was allowed the utmost liberty in examining everything connected with the snake dance, the great event around which all social and religious life naturally centred at the time.

A few days before, the young men had been out to the north, west, south, and east to collect snakes, and in one of the *estufas* Capt. Bourke found the whole catch stowed away in three great earthenware *ollas*. Next day the reptiles were to be seen turned out in a writhing mass, while two very old men lying on the ground were "herding" them: whenever a snake tried to wriggle away, they sat up, and with their eagle-feather wands gently brushed it till it turned back to the heap. These snakes were of several kinds, but mostly rattlesnakes, and youths came down the ladder from time to time bringing others, up to five feet long, wriggling in their hands. When the time approached for the ceremony, the visitors were politely got away to sit on a terrace-roof, where they could command a view of the procession, close to the sacred rock in the *plaza* or square, near which was planted in the ground a cottonwood sapling, apparently as a symbolic sacred tree; between the two stood a miniature conical lodge covered with buffalo hide, imitating in shape the *tepi* of the Sioux, and strongly suggesting a past time when the ancestors of the Pueblos may have lived as roving hunters on the prairie. The house-tops were crowded with women and naked children waiting for the procession. A noise of whirring and rattling, and there came forth from the arcade an old man sprinkling water on the ground, another carrying a basket of the sacred meal, men and boys with rattles, and another old man bearing a ceremonial bow, and whirling around his head a flat slip of wood fastened to a cord, in which we may recognise the "bull-roarer" known alike to the sacred rites of Australians, Kafirs, and ancient Greeks. Then came a party of dancers with their bodies painted green-black and faces blackened down to the upper lip and pipe-clayed below, with kilts of painted cotton, coyote-skins hanging behind, rattles clanking at their knees, and eagle-feather wands in their hands. There was chanting, stamping, and a circuit made around the sacred rock, with the pantomimic dance of planting corn; after which the women and girls, gay in blankets of scarlet and white, carried around their baskets and scattered corn-meal. The dancers' party filed off through the arcade, but soon returned marching two and two, the left-hand men carrying snakes, some in their hands, some in their mouths or actually between their teeth, while the right-hand men, toward whom the snakes' heads were kept turned, tickled them with the feather-wands. Slowly the dancers tramped round the *plaza*, raising their knees to waist-height, the snakes writhing and squirming to get free till their bearers dropped them on the ground at the east corner, and the squaws half-smothered them in showers of the sacred meal. They were picked up by men and boys and passed on to safe keeping in a receptacle lined with buffalo-skins in the sacred lodge. Again and again the dancers came round with more snakes held in their teeth, even two at a time by one daring performer, till all, above a hundred, had been carried round, when they were passed out again, placed within a circle of meal in front of the sacred rock, smothered in meal again, prayed over by the chief priest, then caught up in handfuls by the dancers, who rushed with them to the eastern crest of the precipice and down the break-neck trails to the foot, where they released the reptiles to the four quarters of the globe.

The question how this extraordinary performance is managed may be in part answered. The idea of its being a mere trick may be set aside, as the snakes have not their fangs drawn, and indeed it is mentioned that the youths, though they handle the creatures recklessly while stretched at length, call in the aid of the old men as soon as a rattlesnake begins to coil ready to strike. It may be suspected, however, that the snakes have been made to bite cloths or such things before the dance, so as to reduce their poison and make them less dangerous. It is plain that the wands with the eagle-feathers are highly effective in keeping the snakes back by fanning and tickling. We are not told exactly how they act, but the Moquis believe that the snakes dread their enemy, the eagle, whose mode of attack, they say, is to tap the serpent gently with one of his wings, and exasperate it into making a spring. When the snake has lunged out all its force and struck nothing but feathers, its strength is gone, and it lies uncoiled on the ground, where the eagle seizes it in his talons and flies off with it. There may be in this story a hint of the actual purpose of the feather-wand. Through want of knowledge of the Moqui dialects, Capt. Bourke's party did not get much information on the spot as to the origin and purpose of the snake-dance, but this want was in some measure supplied at Zuñi, where Nanahe, a Moqui by birth but a Zuñi by adoption, gave an explicit account in the Zuñi language, which Mr. Cushing translated. The care and preparation of the dance, Nanahe said, belong to a secret order first established in the Grand Cañon of the Rattlesnakes, and the Moqui ancestors migrating eastward brought it with them. At first all members of the order were of the Rattlesnake gens, but as time passed, that clan became numerous and mixed with the other clans. To keep the order from getting too big, no members were taken in unless belonging (that is, by descent through the mother) to the Rattlesnake gens, or unless when a member dies his son is taken in, as was Nanahe's own case; but a man would not come in merely by inheritance if he had not the proper qualities, and on the other hand a man of brave heart and good character would be likely to be admitted, although neither his mother nor his father was a Rattlesnake. "From the Moqui villages the order spread to other villages, but the headquarters remained among the Moquis. If a man was bold and courageous, and had a stout heart, and led just such a life as the order told him, and obeyed its orders, he could carry snakes in his mouth and they couldn't hurt him; but if he did not conform his conduct to such requirements, a bite from one of the snakes would be as fatal to him as to any one else." Here we seem to see the main point of the whole rite—that the snake-dance is primarily a ceremony of the Snake clan, to which the living snakes are considered to stand in the relation of patrons or kinsfolk. The present reviewer thinks this Nanahe was one of the Moquis he saw at Zuñi last year, who put his crossed fingers in his mouth to show how two snakes are held at once, describing also how, by chewing a mouthful of clay, a better grip is got of the slippery reptiles. We may fairly trust his account given here of the ceremonies of the order, the use of the four medicine-roots, the bathing and fasting, the smoking of the sacred pipe, and the ceremony with which the young men, when they catch a snake, seize it behind the head, hold it up toward the sun in their left hand and stroke it lengthwise with the right, praying to their father, the Sun, "Father, make him to be tame; make him that nothing shall happen that he bring evil unto me. Verily, make him to be tame"; then addressing the rattlesnake, "Father, be good unto me, for here I make my prayers."

Capt. Bourke quotes from *Harper's Weekly*, March 25, 1882, a description of a snake-procession in Central America considerably resembling that of the Moquis. This illustrated newspaper is not readily met with in England, but it would be worth knowing what authority there is for the account. If trustworthy, it would add another fact to the list of Central American or Mexican analogies in the Pueblo culture. Among these are the manufacture and ornamentation of the Pueblo pottery, excellently described by Col. Stevenson in the second *Report* of the Bureau of Ethnology; also the use of the *metate* or stone corn-crusher (perversely printed *metale* in this book). The description of a Moqui marriage, quoted from a Mormon bishop, which consisted in bathing the couple and then tying them together by the ends of their new cotton garments, bears an almost perfect resemblance to the well-known Aztec marriage ceremony. On the whole the new evidence which comes in as to the Pueblo Indians conforms to the judgment which Buschmann long ago formed on such scanty vocabularies as had been made of their languages. These languages he classed in the Sonoran family, not belonging to the Aztec family, but showing strong traces of Aztec intercourse and influence.

EDWARD B. TYLOR

SCIENTIFIC ROMANCES[1]

Scientific Romances. No. 1. "What is the Fourth Dimension?" By C. H. Hinton, B.A. (London: W. Swan Sonnenschein, 1884.)

THE subject discussed in this short but carefully worked out pamphlet of 32 pages, seems to be coming to the front once more. Helmholtz, in his classical paper on "The Origin and Meaning of Geometrical Axioms" (*Mind*, No. 3, July 1876), clearly states our position with regard to its representation: "As all our means of sense-perception extend only to space of three dimensions, and a fourth is not merely a modification of what we have, but something perfectly new, we find ourselves, by reason of our bodily organisation, quite unable to represent a fourth dimension."

In this article, as also in the excellent paper on "Measurement," contributed by Dr. Ball to the "Encyclopædia Britannica" (vol. xv.), many references are given to writers who have touched upon this point, but our present author has made a contribution to the subject which is independent of these writers, and puts it clearly before his readers. There are many backward glances to the inferior spaces, and here and there we find slight points of contact between our author and him of "Flatland," which show that the two were thinking of the same matter, possibly at the same time.

"By supposing away certain limitations of the fundamental conditions of existence as we know it, a state of being can be conceived with powers far transcending our own. When this is made clear it will not be out of place to investigate what relations would subsist between our mode of existence and that which will be seen to be a possible one." From a simple illustration it is shown that in our space there are three independent directions, and only three (as Helmholtz says, by the motion of a surface, a surface or a solid is described, but by the movement of a solid a solid and nothing else is described). Why should there be this limitation? He then discusses the cases of the inferior beings, which we put thus: it would be as surprising for a Flatlander to be lifted out of his closed pentagonal house and put outside as it would be to an ordinary human being "if he were suddenly to find himself outside a room in which he had been, without having passed through the window, doors, chimney, or any opening in the walls, ceiling, or floor."

The upshot of the first chapter is that beings can be conceived as living in a more limited space than ours.

A straight line by a movement at right angles to itself begets a square, but the Linelander can only conceive of movement in its straight line. The square in the same way can be made to move so as to beget a cube, yet the Flatlander has no idea of movement perpendicular to its plane. Now proceed similarly with the cube: "We must suppose the whole figure as it exists to be moved in some direction entirely different from any direction within it, and not made up of any combination of the directions in it. What is this? It is the fourth direction."

Arguing from the analogy we know, we arrive at the following results: The line has 2 points, the square 4 (angular) points, the cube 8 points, the foursquare (Mr. Hinton's name for the fourth dimension figure) 16 points; in the respective cases the lines are 1, 4, 12, and $2 \times 12 + 8$, *i.e.* 32; the plane surfaces are 0, 1, 6, and $2 \times 6 + 12$, *i.e.* 24. We get then the foursquare with 16 points, 32 lines, 24 surfaces, and bounded by 8 cubes; to us, if it were resting in "space," it would look like a cube. Of course there are other details. We pass on to Chapter III., in which are discussed the relations which beings in four dimensions would have with us. To us, of course, they would have the appearances of beings in space (as to a Flatlander a sphere appears to be a circle). "Why, then, should not the four dimensional beings be ourselves, and our successive states the passing of them through the three-dimensional space to which our consciousness is confined?" This is discussed in some detail and illustrated by means of threads. We confess to not quite following our author in his conclusion: "It is needless to say that all the considerations that have been brought forward in regard to the possibility of the production of a system satisfying the conditions of materiality by the passing of threads through a fluid plane, holds (*sic*) good with regard to a four-dimensional existence passing through a three-dimensional space. Each part of the ampler existence which passed through our space would seem perfectly limited to us. We should have no indication of the permanence of its existence. Were such a thought adopted, we should have to imagine some stupendous whole, wherein all that has ever come into being or will come, co-exists, which, passing slowly on, leaves in this flickering consciousness of ours, limited to a narrow space and a single moment, a tumultuous record of changes and vicissitudes that are but to us (*sic*). Change and movement seem as if they were all that existed. But the appearance of them would be due merely to the momentary passing through our consciousness of ever-existing realities."

The concluding chapter leads up from the inferior dimensions, and shows how, in four dimensions, the "box trick" might be effected. Some interesting illustrations from liquids and gases follow, and then, on the hypothesis of there being a fourth dimension, two possible alternatives are discussed. "If we are in three dimensions only, while there are really four dimensions, then we must be relatively to those beings who exist in four dimensions as lines and planes are in relation to us. That is, we must be mere abstractions. In this case we must exist only in the mind of the being that conceives us, and our experience must be merely the thoughts of his mind—a result which has apparently been arrived at, on independent grounds, by an idealist philosopher. The other alternative is that we have a four-dimensional existence. In this case our proportions in it must be infinitely minute, or we should be conscious of them. If such be the case, it would probably be in the ultimate particles of matter that we should discover the fourth dimension, for in the ultimate particles the sizes in the three dimensions are very minute, and the magnitudes in all four dimensions would be comparable."

We have said enough to show that the "Romance" is a curious one, and not without interest to many of our readers, to whom we commend it.

[1] For some remarks on the subject of this article, by Mr. G. F. Rodwell, we refer the reader to NATURE, vol. viii. pp. 8, 9.

LETTERS TO THE EDITOR

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

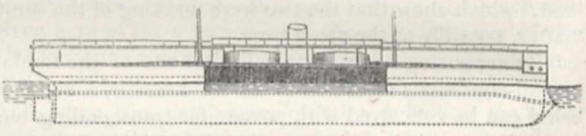
[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Relative Efficiency of War Ships

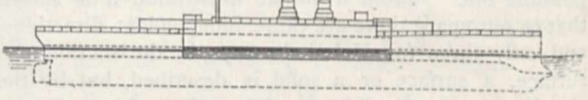
I HAVE a complaint to make against certain of the statements made in the article upon "The Relative Efficiency of War Ships," which appeared in your number for February 26. It is incorrect to declare that I advocated before the Committee on Naval Designs, in 1871, the system of construction upon which the ships of the *Admiral* class are built. The *Ajax*, *Agamemnon*, *Colossus*, and *Edinburgh* are designed upon a citadel system which I originally devised and advocated under certain limitations; but I deny, and always have denied, that any of those ships conformed to the fundamental and indispensable condition which I laid down as part of my system: viz. that the armoured citadel should be of ample dimensions to command the whole structure, keeping it afloat and upright, notwithstanding any amount of injury to the unarmoured ends. As this system has been violated in all the four ships above-mentioned, it is most unfair and improper to state that even those vessels are constructed upon a system which I advocated. But as regards the ships of the *Admiral* class they do not at all conform to the system which I advised, and the writer of the article in question could only have supposed them to do so from a serious misapprehension of the ships themselves. The article stated that the central part of all the ships in question, including the *Admiral* class, are "plated completely around with very thick armour, which extends from the upper deck to several feet below the water-line." This is a very incorrect description of the *Admiral* class, the armour in which does not rise to the upper deck at all, but is stopped in the form of a shallow belt rising but a foot or two, or possibly slightly more, above the water's surface. I repudiate with indignation the statement that such a system of construction as this, in association with the long unarmoured ends of the *Admiral* class, was ever recommended by me. For this reason I complain likewise of the statement in your article to the effect that my recent letter to the *Times* is but a continuation of the old and well-remembered *Inflexible* debate. So far is this from being so, that I distinctly pointed out in that letter that the cutting down of the armour to a mere belt of short length separated the ships of the *Admiral* class from the others, and imported "a new and terrible cause of danger." Another statement of which I complain, and which I desire to have corrected, is to the effect that I "refused to give evidence" before the *Inflexible* Committee. Were this true, it would constitute, in my judgment, a most serious ground of complaint against me, but it is not true. The *Inflexible* Report and its Appendices clearly exhibit the fact that within two days of the appointment of the Committee, and on the very day on which my evidence was asked for by the Committee, I handed in to that body a most elaborate mass of evidence, occupying no less than eighteen columns of the *Inflexible* Report, and illustrated by two sheets of drawings, this evidence setting forth in great detail my views of the subject, and the grounds of my dissatisfaction with such ships. It is true that four months later I was asked by telegram to attend the Committee, but asked to be excused on the ground that I objected to take part in the dilatory proceedings of the Committee, which I regarded as frustrating the objects with which it was demanded by Parliament. My full evidence was, however, already before the Committee, and had been for several months.

The above are the points of which I complain, and wish to have corrected. I do not ask as a matter of right, but I desire to have stated, that the long explanation which was given in the article in question for the purpose of showing that mere displacement is not, under all circumstances, a measure of the power of a ship, was, in my opinion, wholly unnecessary—at any rate, in so far as either Mr. Barnaby or myself was concerned. Both Mr. Barnaby and myself knew perfectly well that displacement is but a very rough measure of the power of ships, and no measure at all when ships of wholly different classes, and kinds, and dates, and systems are closely compared together. The only use that I made of the principle in my letter was to accept it for the moment as a rough basis of comparison between the ten latest French and the ten latest English ships, and I consider that for that purpose it was a good enough principle to indicate the inferiority of the English ships. But the acceptance of the principle for that purpose in no way precluded me from going further and showing that this rough comparison did not by any means bring to light other elements of grave inferiority, and even of danger, in the English vessels.

In the accompanying diagram the great difference between the *Inflexible* or *Agamemnon* class and the ships of the *Admiral* class is clearly illustrated. In both figures that part of the armour which is above the water is shown in full black, the part below the water being indicated by dotted lines. A glance at the diagram is sufficient to make it readily understood that the



Agamemnon



Collingwood

Agamemnon, whose side armour rises several feet above the water, can be inclined to a considerable angle before her armour is brought under the water, whereas a very slight inclination only is necessary to bring the extremely shallow armour of the *Collingwood* under the water. In the case of the *Agamemnon*, therefore, the armour she possesses affords her a considerable amount of resistance to capsizing, while the resistance thereto derived by the *Collingwood* from her armour is almost *nil*. The same remark applies, of course, to the buoyancy of the armoured out-of-water parts of the two ships, the *Collingwood* having but a small fractional part of that which the *Agamemnon* possesses.

E. J. REED

[We give insertion to this communication from Sir Edward Reed with great pleasure, because one of the chief objects we sought in our article was to support his view that the stability of the ships of the *Admiral* class under the conditions which might be expected to occur in a naval engagement was open to grave question, and to reassert that further scientific experiments should be made.

We regret that the fundamental difference, so far as *fighting* stability is concerned, between ships of the *Inflexible* and *Admiral* type, which is now brought out so well by Sir E. J. Reed's diagrams, was not emphasized in the article so strongly as it should have been.—ED.]

How Thought Presents Itself among the Phenomena of Nature

IN your paper of the 5th you give a short abstract of a recent lecture at the Royal Institution by Mr. G. Johnstone Stoney, on the question "How Thought presents itself among the Phenomena of Nature." In this abstract I observe an assertion which is quite new to me, and, I must add, quite unintelligible. It occurs in the first paragraph. The assertion seems to be that there is an absolute distinction between molar and molecular motion, inasmuch as that, in the case of molecular motion there is no authority for the conviction that there must be some "thing" to be moved. The conception of motion involves the conception of matter as a necessary or inseparable concomitant—although the abstract idea of motion may, in a sense, be separately entertained. Is there any difference in this respect between molar and molecular motion? A molecule is a group of atoms, and an atom is only conceivable as an ultimate particle of matter. I hope that some further explanation may be given upon this point, which is one of the highest interest and importance, both as a matter of physical and of metaphysical speculation.

Inverary, March 8 ARGYLL

The Compound Vision and Morphology of the Eye in Insects

MR. SYDNEY HICKSON, in your issue of February 12 (p. 341), makes certain statements concerning my paper in the *Transactions* of the Linnean Society on this subject. I will not follow Mr. Hickson through his entire article, as I conceive it is sufficiently refuted by my paper itself. He says: "It would be tedious to bring evidence of this kind to confirm a theory which is already fully established." I would ask Mr. Hickson if any-one can explain the vision of the compound eye intelligibly on the received theory? I would also remind your readers that Prof. Huxley, writing of the crayfish in 1880, accepted the view with extreme caution; he said, "The exact mode of connection of the nerve fibres with the visual rods is not certainly made out;" that Claparède never accepted it, and Max Schultze admitted that there were grave physical difficulties in the way of its acceptance.

Mr. Hickson is very anxious, apparently, to deny me what I never claimed—*i.e.* the discovery of a layer of definite structure beneath the basilar membrane. What I do c'aim is the discovery of the nature of its elements. I deny, in my paper, that the optic nerve passes through these structures, and I deny that these consist of a fine reticulum of nerve-fibres. These are questions of fact and observation, not of theory or deduction. If I am wrong, I am wrong. But the way to test my work is by working out the eye as I have worked it out. I have spent nearly ten years in this work, and I do not expect to have my views generally accepted for another ten years.

The absence of pigment and retinal purple is a secondary question. I do not know, nor does any one know, whether there be retinal purple or not in this layer. I admit that pigment is absent in the retina (my retina) of some insects and crustaceans, and I have recorded the fact. I am not yet convinced that we can say vision is impossible without it. Albinos have vision undoubtedly in the absence of retinal pigment. He would be a bold man who asserted that vision could not be effected without pigment in the retinal region. The colourless collodion film of the photographer is affected; why not retinal rods? Here, again, it is a question of fact, not theory.

The presence of pigment proves nothing with regard to the function of the great rods, any more than it shows that the iris of a vertebrate is sensitive to light.

The absence of my retinal layer in Periplaneta and Nepa is imaginary on the part of my critic, for I have examined it carefully in both, and I figure the elements from the former. I maintain that the same structures exist in all the crustacea, although they are short and more difficult to demonstrate.

Again, in the morphological question my views are not fairly stated by Mr. Hickson. I admit his facts, but deny his deductions. The hypodermis forms the dioptric structures, as the epidermis of the vertebrate forms the lens; my contention is that the retina in the insect, like the same structure in the Vertebrata, is developed as an outgrowth from the nervous system.

BENJAMIN THOMPSON LOWNE

65, Cambridge Gardens, Notting Hill, W., February 23

I DO not wish to undertake a lengthy controversy with Mr. Lowne on the question of the retina of insects, but I cannot refrain from making a few remarks on the letter you publish above.

I am afraid Mr. Lowne has misunderstood my criticism when he asks me "If any one can explain the vision of the compound eye intelligibly on the received theory?" My criticism was not meant for any theory of pure optics, but for the theory that the retinulæ are not the true nerve-end cells.

Mr. Lowne's statement that albinos are devoid of retinal pigment is not strictly accurate, for Kühne pointed out, and any one can see for himself, that all albino rabbits and other vertebrates possess a true retina purple. Moreover, the rods of Cephalopods and of Pecten, which seem to be devoid of pigment in spirit specimens, possess, as Hensen has pointed out, a true retina purple. In fact, I know of no exception to the rule I laid down—namely, that optic nerve-end cells are pigmented, and I should be glad if any of your readers could point out any exceptions to it.

Mr. Lowne's reiterated statement that the optic nerve fibrils do not end in the retinulæ is, as I said, contrary to my own observations. I have submitted my preparations to several eminent naturalists, who agree with me in my account of their distribution. I shall be happy to submit them to any others who may feel interested in this matter.

The other statements in my notice which Mr. Lowne controverts I will not refer to again here, as they will be fully explained and illustrated in my forthcoming paper in the *Quarterly Journal of Microscopical Science*, the proof-sheets of which I have now in hand. SYDNEY J. HICKSON

Anatomical Department, Museum, Oxford, February 25

Civilisation and Eyesight

IN connection with Lord Rayleigh's letter in NATURE, p. 340, on the above subject, I venture to hope that the following may be of interest:—

In the "Expression of the Emotions" the late Mr. Darwin quotes some observations—if I recollect correctly—by Gratiolet tending to show that, under the influence of *fear*, the pupils of animals' eyes dilate. Observations extending over some years have convinced me that fear is undoubtedly capable of thus causing dilation of the pupils (see Dr. Hack Tuke, "Influence of the Mind on the Body"); and in general literature, such as travels, novels, &c., I have met with many instances in which the eyes of both men and animals under this condition have been so described by the writers.

Is dilation of the pupil under the influence of fear to be explained on the assumption that the increased aperture of the eye enables a more effective scrutiny of the object causing terror, and has thus been of service in the struggle for existence?

An answer to this question is not easy to give, for, although dilation of the pupil under the influence of fear may have originally been of direct service to an animal, yet this condition may in time have come to be associated with other emotions in which it is not so easy to trace any such direct benefit.

Observations upon the subject are by no means easy (varying light, for instance, varies the aperture of the eye), but in the course of my observations I became much inclined to believe that other strong mental emotions besides fear (*e.g.*, joy or pleasure) may be capable of giving rise to dilated pupils.

Charlotte Brontë, in "Jane Eyre," is one of the only writers who associates a dilated pupil with other emotions than fear. Here is the sentence:—"Pain, shame, ire, impatience, disgust, detestation, seemed momentarily to hold a quivering conflict in the *large pupil dilating* under his ebon brow."

It is to be feared that the experimental investigation of eyesight with artificially contracted or dilated pupils is scarcely practicable, for drugs, such as atropine or eserine, act not only on the pupil, but also on the power of accommodation for distance. J. W. CLARK

Liverpool, February 21

P.S.—I see Dr. M. Foster, in his "Text-Book of Physiology," mentions the dilation or contraction of the pupil which attends the adjustment of the eye for distant or near objects respectively, and also its dilation "as an effect of emotions." It thus seems highly probable that strong and very different mental emotions may give rise to dilated pupil. Dr. Herdman has suggested to me, as an explanation of this, that an intens excitation of one brain centre may possibly act in the same way as a direct inhibitory impulse by partially paralysing an adjacent centre.

The Forms of Leaves

THERE are several points in Sir John Lubbock's lecture (NATURE, February 26, p. 398) which seem to invite some little criticism. That "the size of the leaf . . . is regulated mainly with reference to the thickness of the stem" seems somewhat self-evident, as a large leaf must have a large stem to carry it, as, *e.g.*, may be seen by comparing the slender shoot of a Deodar with a cabbage-stalk; but he adds: "The size once determined exercises much influence on the form." This is a *deduction* which seems to require *verification*. Sir John gives the area of a beech-leaf as about 3 square inches, but the form remains the same whatever the size. Size rather depends on vigorous growth, as in the following instances: *Populus alba* leaves on a vigorous basal shoot were 6½ × 3½ inches, the diameter of the shoot being ⅛ inch; on the upper branches of the same tree many leaves were only 1½ to 2½ inches long, the diameter of the shoot being also ⅛ inch. Similarly growing oak leaves of the same shape were 6 × 3 inches and 2 × ¾ inches respectively. An *Aucuba japonica* bore rounded leaves on a basal shoot 4 × 3¼ inches, but those on the stem were 4 × 1 inch. In this case, as in other plants with (normally) dimorphic leaves, as ivy, it is difficult to see what connection there is between size and form. Indeed leaves of every degree of superficial area can be found amongst the lobed ones on the climbing stem of ivy, and the entire ones of the flowering branch. Sir John adds that "the form of the inner edge [of the beech] . . . decides that of the outer one." He does not seem to have verified this deduction. The two edges are symmetrical in this leaf, but they are not so in the elm and lime. How will the inner edge explain the cause of their obliquity? If, however, the *buds* of the lime be examined, a more probable cause (as it seems to me) will be discovered in the conditions of development. He describes the *Eucalyptus*, when young, as having "horizontal leaves, which in older ones are replaced by scimitar-shaped phyllodes." Bentham and Hooker say of *Eucalyptus*: "Folia in arbore juniore sæpe opposita, in adulto pleraque alterna," but makes no mention of phyllodes. Speaking of evergreen leaves, he says: "Glossy leaves have a tendency to throw [snow] off, and thus escape, hence evergreen leaves are very generally smooth and glossy." This sentence appears to imply that such leaves are glossy in anticipation of snow! a deduction which certainly requires verification. Again: "Evergreen leaves often have special protection . . . by thorns and spines. Of this the holly is a familiar illustration; and it was pointed out that in old plants above the range of browsing quadrupeds, the leaves tend to lose their spines and become unarmed." The inference the reader draws from this is that when the holly grows out of reach of browsing animals it has no necessity to produce prickly leaves, and so changes them accordingly, thereby implying that unarmed leaves were in some way preferable. This is another instance of deductive reasoning which requires verification, for it seems to be attributing to the holly a very unexpected process of ratiocination! But it is not at all usual for hollies to do this. I have several from six to nearly twenty feet high, and not one has borne an unarmed leaf. Though my cows do not touch a holly hedge, yet one young bush lately planted has taken their fancy, and they have bitten it all to pieces. On the other hand one bush (in the garden), a variety with unarmed foliage, occasionally throws out a branch with prickly leaves, though the cows are not admitted where it grows.

"Fleshy leaves were principally found in hot and dry countries, where this peculiarity [*sic*] had the advantage of offering a smaller surface, and therefore exposing the plant less to the loss of water by evaporation." Surely the usual explanation, that it is the thick cuticle which prevents rapid exhalation is a better reason than Sir John's deduction from the small size of the leaves? Speaking of aquatic plants, he says that the submerged "cut up" leaves of such plants presents a greater extent of surface;" and adds that "such leaves would be unable to support even their own weight, much less to resist any force, such as that of the wind.." I should be glad to know if he has verified the first statement by actual measurements; for an *à priori* assumption leads one to fancy that a complete leaf would have a greater surface than one represented by its ribs and veins only. With regard to the second and third statements a "natural experiment" completely refutes his deduction, for I know a place where a small pond dried up last summer, and a large portion of the ground was covered with a dense velvet-like carpet, composed of the *erect* filiform branchlets of the "cut-up" leaves of *Ranunculus aquatilis*, which had become modified by their new medium, and perfectly adapted to enjoy an aërial existence.

In offering these few criticisms for Sir John Lubbock's consideration, I would venture to remark that he seems to have followed too closely in the deductive methods of another writer on leaves, and which called forth the following remark from Prof. Lankester:—[He] "gives us hypotheses, suppositions with insufficient evidence, and deductions from the generalisation of Evolution, but he is relatively deficient in 'verification'" (NATURE, vol. xxviii. p. 171). GEORGE HENSLOW

Drayton House, Ealing

The Fall of Autumnal Foliage

MR. FRASER alludes to "the unpursued inquiry into the cause of leaves falling in autumn" (NATURE, February 26, p. 388), and I do not find it mentioned in Sach's "Text Book"; but Dr. Masters, in Henfrey's "Elementary Course of Botany," fourth edition, p. 515, speaks of "a layer of thin-walled cells being formed across the petiole," but does not say whence this layer is derived. Duchartre, however, gives a pretty full account of opinions up to 1877 ("El. de Bot.," deux. éd. p. 443), which he reduces to two, viz. Schacht's, who attributes it to a growth of periderm, and that of Mohls, who recognises a special layer which he calls *couche séparatrice*, considering the peridermic layer as being often, but not always formed. Subsequently, M. Ledgeganck

examined different plants and corroborated Schacht in regarding the periderm as the *cause prédisposante*, and cold to be the *cause efficiente*, which contracts "le tissu de la base du pétiole, spongieux, aéré, élastique à un degré beaucoup plus considérable que celui du coussinet." From my own observations on the horse-chestnut, ash, &c., it appears to be in these clearly a continuation of periderm produced by the phellogen of the branch, which invades the base of the petiole, till it meets in the middle, cutting right through the fibro-vascular bundles of the petiole. As this suberous layer dies, the leaf necessarily falls off. But as long as a leaf is in vigorous health it would seem to resist this invasion, and last longer, as do evergreens. I inclose a figure I possess of a slide showing the process in the horse-chestnut.

Drayton House, Ealing GEORGE HENSLOW

Forest-Trees in Orkney

IN NATURE of February 26 (p. 388) Mr. A. T. Fraser says that "a peculiarity of Caithness and the Orkney and Shetland Islands is that no forest-trees can be got to grow," and he proceeds to explain this by the preponderance of polarised light. As far, at least, as Orkney is concerned, I am prepared to rebut this calumny. It is true that forest-trees are not the striking feature of the Islands, but they do occur. At Binscarth, between Kirkwall and Stromness, there are willow, ash, sycamore, and Scotch fir. They require to be protected—from the wind, I presume, and not from the light—by hedges of bour-tree (elder). In the street at Kirkwall itself there is a fair-sized sycamore.

Trinity College, Cambridge JAMES CURRIE

YOUR Indian correspondent, Mr. A. T. Frazer, can hardly be acquainted with the primitive jungles of Southern India, or he would have observed that there, at one and the same time, the aspect of all the four seasons is displayed in the vegetation.

When in Coorg, in two different years, during the months of January and February, we not unfrequently drove up to Mercara, the capital, a distance of ten miles from the place where we were staying. On the way thither we saw some trees in their winter condition with perfectly bare branches, others had the tender foliage of spring, some again were in all their summer glory, and some were clothed with the most brilliant autumnal tints; this was most probably due to the great variety in the species of trees in that district. COSMOPOLITAN

A Tracing Paper Screen

As several inquiries have been made of me as to where the proper tracing paper can be obtained, perhaps I may be allowed to state that I got mine through Mr. George Smith, 26, Colebrooke Row, City Road, N., who was the first, I believe, to recommend the use of this valuable material.

CHARLES J. TAYLOR

Toppesfield Rectory, Halstead, Essex

GEOFFREY NEVILL

WE have to announce the comparatively early death of Mr. G. Nevill, which took place at Davos Platz, after a long and lingering illness, on February 10. This removes from among us another of the scanty band of English conchologists, whose ranks, only a few days before, suffered a similar loss in Mr. J. Gwyn Jeffreys. Mr. Nevill's labours have been principally confined to India, where he was for many years one of the assistant-superintendents under Dr. J. Anderson in the Indian Museum, Calcutta; his work is, therefore, better known to those who have collected in the East and written on the molluscan fauna of that part of the world. For many years he was a constant correspondent and colleague of the writer's, who can testify to the large and varied knowledge Mr. Nevill possessed of the different forms. A very large number of species were sent him by Mr. Nevill from time to time, many of which still remain to be described. Mr. Nevill was the author of many papers on his favourite study, most of which are to be found in the *Journal* of the Asiatic Society of Bengal; but perhaps his best and most useful work, particularly to those interested in distribution, was the "Hand List of Mollusca in the Indian Museum" (Part I. comprising the Pulmonata and Prosobranchia-Neurobranchia published in December, 1878, and is remarkable for the accuracy with which the localities of the different species is given, and the collections from whence they were received. He also catalogued the Ampullariacea and Valvatidæ and Paludinidæ). Unfortunately, the whole catalogue of the Gastropoda is incomplete, for his health failed him altogether in 1881. Yet he struggled on to the last with his task, even when unable to leave his room to go as usual to his office in the Museum, and was compelled eventually to give up his appointment and return to Europe. The entire arrangement of the Mollusca in the new Museum formed a part of his work when there, and it was well and admirably done. Almost his last work in the field was at Mentone, in 1878-79, where, in the post-Tertiary beds, he made a careful collection of the shells, particularly the smaller species, a list of which he published in the Zoological Society's *Proceedings*. Yet even so late as last summer, when hardly able to move from weakness and partial paralysis, he was getting together the land-shells to be obtained in the country around the Lago de Como.

Geoffrey Nevill was born at Holloway on October 5, 1843; he was the second son of Mr. Wm. Nevill, F.G.S., who resided for many years at Langham Cottage, Godalming, a gentleman who made mineralogy his study, and whose collection of meteorites was well known. As is often the case, his son inherited kindred tastes, for, when quite a boy, his attention was directed to shell-collecting both in Germany and in England. Most of the English species in the Calcutta Museum originally formed a part of this collection, and bear labels from near his early home at Godalming. He received his education at Dr. H. D. Heatley's school at Brighton, and afterwards spent some time at Bonn in the house of Dr. F. H. Troschel, Professor of Zoology, and this no doubt confirmed his early taste for natural history and directed his future career.

He was never strong, so, after entering into mercantile life in his father's house, and his health breaking down, he was ordered abroad, and he proceeded to the Cape, the Mauritius, and Bourbon, where he collected largely, and formed a valuable and rich collection. Some of the results were described in joint papers by himself and his brother, Hugh Nevill, of the Ceylon Civil Service, He went on to the Seychelles Islands in 1868, where he remained some time, still further enriching his collection, and then went on to Calcutta. At this time an appointment offered itself in the New Museum, which he took and filled for many years. Here in Calcutta during this period a little band of workers in conchology were drawn together, most of whom were employed on the different surveys of the country. Season after season, on return from the field, the results of their labours in every part of India accumulated and were examined. Ferd. Stoliczka, one of the first to be removed, was one of the most ardent workers, and all benefited from his deep, more advanced knowledge of the subject.

The survivors will recall those pleasant intellectual gatherings when they hear of Geoffrey Nevill's death, and future students and collectors of Indian Mollusca will appreciate the work he lived to perform, and which will render their work in the galleries of the museum in Calcutta more easy.

REPORT OF THE COMMISSIONER OF EDUCATION IN THE UNITED STATES FOR THE YEAR 1882-83[1]

IT is impossible to read the account which the United States Bureau of Education, in the opening pages of this Report for 1882-83, gives of itself and of its labours, without being convinced of the value of the matter therein contained. A total of over 10,000 institutions of education of various kinds are in correspondence with, and supply information to, the department. An idea of the work also which falls to it may be formed from the fact that some questions addressed to it have necessitated months of research by several clerks, while the labour which its publications have entailed, as well as the value placed upon them, are shown by the fact that one of them was *asked for* by 10,000 persons of different addresses. Since all is voluntary, the Bureau claims to work the most complete system of the kind in existence. The wide compass of its survey is indicated by the very full account given, among other foreign intelligence, of the Report of the English Commission on Technical Education. Besides itself circulating through the world 20,000 copies of its Report, the office is require dto print 18,000 copies more for the use of, and distribution by, other members of the Government. Its library—where all the items of information which it is possible to collect, down to cuttings from newspapers, are gathered together and classified—is an immense work; and we can well believe that, "if this office were put in possession of a small sum annually for the purpose, it would make effective and useful displays at exhibitions, of American education . . . the most unique feature of our national life."

The report of this education generally is far more satisfactory than in other years. There has been a general increase, first in the number of scholars, even in Maine where the population has become smaller, and in New Jersey, New Hampshire, Connecticut, South Carolina,

[1] Washington Government Printing Office, 1884.

and Kansas, where schools have become fewer. Though the contrary might have been expected in an increasing country, a great complaint of the Report is the multitude of small schools which require consolidating for the sake of employing better teachers and apparatus. The suggestion is made that each State should fix a minimum of salary to be paid to any teacher; this not only must be good for the children, but would of itself urge forward the consolidation, where distance allowed it, of small schools of less than ten or twelve scholars.

In Rhode Island, and in city schools generally, the competition of factories is lamented. The deficient average attendance is imputed to the demand for cheap labour; and obligatory laws are quoted, among other things, as an antidote. It should not be forgotten that the inexorable enforcement of those laws is what is in reality the greatest kindness to poor families; for if the cheap labour of young untaught children once enters the market in the smallest quantities, it becomes impossible to gain a fair price for the work of those older and better taught. But, protected from all such unfair competition, the child's education becomes a common necessity. No doubt the difficulty is much felt in Alabama, North Carolina, Louisiana, and Mississippi, the only States whose reports are generally unsatisfactory: States where negro labour keeps down the wages of white children.

There has been an increase, again, in the number of teachers: with regard to which it is interesting to note that in three States the number of men has fallen off, while in them, and even in frontier States, that of women has increased; and an increase also in the item of teachers' salaries; even in Illinois with fewer of them, in Indiana, where the population has decreased, and in Michigan, where in past years the amount had fallen off.

The variation in different States of the expenditure on education, however, is still exemplified in the fact that Massachusetts pays fifteen times the amount per head that Alabama pays!

The educationists of Kentucky, where whites and blacks are treated alike with regard to schooling, appeal to the Peabody Trustees for advice to the Legislature. This latter body, who are gaining an influence like that of our Charity Commission, have concentrated their money upon training teachers, with successful effect over school work in the south. Another benefactor has bequeathed over 700,000 dollars to the whites of New Orleans for educational purposes.

The improvement in the organisation of systems, the greater efficiency of work, and the deeper interest felt by the people, is indicated by the public schools in some States superseding the private ones; and Gen. Eaton attributes to the influence of the superintendents (officers whom we have before quoted as combining the knowledge of our inspector with the zeal of our chairman of School Board) the two most promising general movements now going on, viz. the increase of local taxes for education in the Southern States, and the effort to abolish small independent, irresponsible districts in the older Northern States.

Still, nothing can be more depressing than that, in a community naturally the leading people of the world, a sober report of a patriotic commissioner should still find it necessary to say more than once in his Report, that a work so all-important to the future of that community as education should be marred by school commissioners persisting to license the cheapest teachers they can procure, and using the license as a means of favouring relations, political supporters, and such like; thus rendering useless the efforts of examining bodies, who have pointed out the really competent persons for this most responsible office.

We have no need to enlarge again here upon the United States difficulty, the education of the negro. The burning question of course is, Who is to pay for it? The Report speaks confidently of securing national aid, the need of which has been so strongly urged before. One gentleman gave 1,000,000 dollars towards the work, but religious denominations have so far been the great supporters of black education.

We, in England, can better enter into the labours of those who are trying to raise the street Arabs to a generally higher level. Few things ought so much to convince anxious reformers how little their improvements depend upon the form of government, as to see how the struggle of the poorest for existence is as sharp and demoralising in the large towns of the United States as it is in England. One of the leaders of the Kindergarten system lays it down that "the best energies of the faithful teacher are often required when the work of the schoolroom is over. There is much visitation to be done to look up absent children, and, where sickness invades, the teacher is often called upon to supply medical aid and other necessary help; and, where death ensues, there is sometimes no one but the Kindergarten helpers to see the little one decently buried;" and, in fact, not only to take all the duties and responsibilities off the hands of parents, but to provide an antidote to their mischievous example and teaching. Their success in many cases must lead its supporters on to the venerable yet now radical proposition, which will be most offensive to Mr. Herbert Spencer, that education from infancy should be the work of the State; and, strange as such a suggestion must seem among English homes, it is very much in harmony with modern division of labour which makes the parent less able to educate, in the full meaning of the word, a family, and the professional Kindergartens so much more so. And the same principle is to be traced in the recommendation that homes, as well as training-schools, should be found for nurses.

Both in primary and secondary schools witness is borne to the improved teaching. The importance to the former of the example of good teaching to be found in the normal schools, as well as the precept on the subject, is fully insisted upon; a difficulty often met with being the work of correcting bad teaching in the lower schools: while, on the other hand, the multiplication of teachers well trained in public normal schools is, as we have said, urged as the surest, and, in the long run, the most economical means of raising the standard of education throughout the country.

Examinations like our Oxford and Cambridge Locals, held by the regents of New York, are leading to greater uniformity in the teaching of the second-grade schools.

Perhaps the most striking thing in the Report is the important part which women are now taking in study, as well as in teaching, in the United States. The demands and attractiveness of commercial life to the young men of America, with the energy and self-reliance of its women, are leading to the result that the latter are becoming the learned class there. We have already remarked upon the large and increasing proportion of female teachers in all the elementary schools. But, moreover, while twice the number of women begin a high school course, three times as many women as men complete the fourth year. Although the increase is not large this year, there are over 40,400 women in institutions of superior instruction. At Purdue University, where practical mechanics is taught, a number of young ladies have been among the special students, and "have done the same work as the young men, and, though progressing much slower, have been nearly as successful." Educated women are now also the leaders of many philanthropic movements.

The education of the blind and the feeble-minded is urged as a matter of public economy, their cost if left uncared for amounting to much more. The same considerations have many times been urged in favour of reform schools. But they are all attempts to counteract laws of nature that all these diseased specimens shall be inexorably extirpated, and it is hard to see a satisfactory result of these efforts in the long run. A singular mischief has recently been commented upon by Prof. Graham Bell (see NATURE, No. 795), arising from the system of teaching deaf-mutes a language and literature, intelligible among themselves, but not familiar to the general public. Hence they prefer their own society, and are trying to form deaf-mute settlements which must result in hereditary transmission to the whole community of this terrible degeneracy. It will be a curious experiment if allowed to take its course.

A most healthy sign of the times is that the increase of students at the schools of science is far larger than the increase in the number of establishments. It shows a general appreciation of their work, and in an enterprising country like America will soon bring about an increase in the number of schools. Institutions are becoming more general which undertake to train students for the higher schools of science. The cost of laboratories and apparatus and the scarcity of teachers are two of their difficulties, indicating at the same time the high standard of work they aim at. We note with pleasure that the sole purpose of the Wisconsin Agricultural Experiment Station is the discovery of new truths and laws which may be of benefit to agriculture, and farming is taught there as a scientific pursuit. In the Storrs Agricultural School at Mansfield, Conn., though of less ambitious character, "students receive instruction both in the class-room and on the farm. In the class-room they study those branches of natural science which have a directly useful bearing on New England farming, such as general and agricultural chemistry, natural philosophy, farm mechanics, surveying, botany, zoology, geology, animal physiology, mineralogy, and theoretical agriculture, stock-breeding, and composition. The general principles of these sciences are taken up first, and afterwards their special applications to practical agriculture, which includes the improvement of the soil by tillage, draining, manuring, and irrigation; the culture and handling of the various field, garden, and orchard crops of New England—grass, grain, roots, vegetables, and fruits—from planting to market; the use, care, and repair of farming tools, implements, and machines; the breeding, rearing, training, and feeding and use of live stock; the best methods of dairying, the business and management of the farm in all its details. . . . The intellect being called into play, farm work is divested of its monotony and robbed of the repressive influence derived from it when viewed as mere physical labour."

It is well urged in favour of an institution like the St. Louis Manual Training School, that through the minute division of labour which necessarily attends our increased machinery, the old method of teaching a trade is rapidly and inevitably disappearing; that it is only at a technical school that the *toute ensemble* of a trade can be learned so as to be intelligently carried on and fresh inventions led to; that there is an idea afloat that it requires no education to be a mechanic, and hence the despising of both craft and craftsman, whereas the thorough understanding of both theory and practice of a skilled industry makes its owner "the peer of the statesman; and from the union of his head- and hand-work come a large part of the civilising agencies of the nineteenth century."

The English Commissioner on Technical Education reports on the efficiency of the American workman, which is mainly attributed, by all who have inquired into the subject, to the primary education acquired by them during a prolonged attendance at school, and now the idea is to be traced through all the Report upon the subject, that to teach the pupil his trade should henceforth be the work of a school; as much one part of education as the three R's the other part.

And not the work of a primary school only, but it is even urged that it should be the work of the Universities to send forth young men, fitted by technical training to lead in the development of the State; its fields, mines, quarries; its railroads and water-power; its manufactures and commerce." And already at Cornell University, as well as at Massachusetts Institute of Technology, electrical engineering is taught sufficiently extensive to prepare a man for ordinary electric work or advanced study. To Terre Haute, Ind., a small town of 26,000 inhabitants, the splendid legacy of a property bringing in 25,000 dollars a year was left for a technical school, in the starting of which great care as well as energy have been shown.

Very different, however, from these buoyant views is the record to be found also in this Report, that in Austria the higher schools for technical instruction have been decreasing for the last few years.

Nor again is science only, but art also in its more marketable shapes is becoming rapidly the work of schools. A public art school, under the direction of Mr. C. G. Leland, has been trying an experiment as to what children, nine-tenths of them from thirteen to fifteen years of age, could do in the way of art manufactures by being taught designing and art processes. Besides developing inborn talent, this school not only finds a commercial value in their productions, but insists upon what is becoming generally observed, that technical teaching, though shortening school hours for other work, by no means reduces the amount of progress made in the latter, brighter wit and interest being excited by hand-work at intervals with head-work. Elsewhere in the Report a protest is quoted from Harvard University which will be re-echoed from the breast of many an English *paterfamilias*, against athletic sports being made too much a business or profession, instead of a recreation. Besides the waste of time which, it is urged, might be given to other things, such a standard of excellence as the few attain makes the game very exclusive and confined to a small number. Of course we know the reply often made to this, viz. that the best players are also the best workers; but do not these simultaneous experiences strongly suggest that some technical art might take the place of a dangerous game, thus infusing intelligence into the former, and providing the student with a means of competency in case of reverses? Many arts are more intellectual and less laborious than football or agriculture as carried on at Rugby, England, or Rugby, Tennessee.

The unsatisfactory condition of the medical profession in the United States, which has been remarked upon in previous reports, is in this one traced back to the thinness of population a century ago; a population also of vigorous physique occupied in clearing and settling an enormous territory, and free from most of the diseases that afflict humanity of lower vitality, and under less favourable circumstances. The early colonial physician often combined other functions with those of healing: sometimes he was a minister of the Gospel, sometimes a farmer, a shopkeeper, or a mechanic. The bulk of the profession at the beginning of the century, and for many years afterwards, did not possess any medical degree. The result followed that men of natural boldness revolted against the frequent ignorance and numerous errors of such physicians, and became followers and advocates of special medical doctrines, and supported the "botanic" school of practice, that of Hahnemann—hydropathy, physiopathy, vitopathy, electropathy, or other "medical heresies." Degrees have been too easily obtainable through numerous schools competing for popularity, and offering them for little money and less work, with the natural result of their being little valued. The Report, therefore, after going largely into the subject, and deprecating the present state of things, urges fewer schools and higher degrees, which will be worth jealously guarding, to be given by State-appointed examiners only, on the attainment of a much higher standard. Since we are told that ten colleges have agreed upon a uniform entrance examination to the great help of masters preparing boys for their studies, it may be hoped that a more general union may be arrived at with regard to this standard.

Free libraries are still progressing, and so interesting are the statistics of these "universities of the people" in the United States, that Gen. Eaton promises a special publication on the subject, reprinting such parts of the great Report of 1877 as have permanent value. Several magnificent bequests and donations of books to large libraries show how naturally large private collections will gravitate to the free public library, where the locality is happily provided with one. One such, that of Dr. Toner's, containing 27,000 books and 12,000 pamphlets, was thus bequeathed to the Library of Congress. This latter institution, at the end of 1882, already contained 480,076 volumes and 160,000 pamphlets, and the forthcoming plan of a new building to keep in utilising order this rapidly growing mass is intended to embody the best appliances, arrangements, and ideas about library construction which such enormous accumulations render indispensable. An excellent precaution also against knowledge being locked up in over-large supplies of literature is taken at Chicago, where Dr. Poole, the great cataloguist, receives schools or teachers on a Saturday, surrounded by all the books of the library bearing upon some matter. By showing how interesting that subject is as a department of human thought and industry, and how much the contents of the library may help the student to a knowledge of such a subject, he has succeeded in producing a profound beneficial effect upon the upper grades of the school system. W. ODELL

BIRDS BREEDING IN ANTS' NESTS

THE following communication to Mr. Grant Duff, Governor of Madras, has been forwarded to us for publication by Sir John Lubbock:—

To Major Awdry, Private Secretary to His Excellency the Governor of Madras

OOTY, *January* 18, 1885

SIR,—I beg to acknowledge your letter of yesterday's date.

The Southern Chestnut Woodpecker (*Micropternus gularis*), always, as far as I have observed, uses an ants' nest to nest in, and Mr. Gammie, the Superintendent of the Government Cinchona Estates at Mongphoo, near Darjeeling, has noticed the same thing with regard to the allied northern species, *Micropternus phaloceps*, and the peculiarity probably extends also to the allied species found in Burmah, Siam, &c.

Mr. Gammie thinks that when an ants' nest has been taken possession of by the bird that the ants desert the nest. This is a point on which I cannot speak with certainty. Mr. Gammie has taken nests of the northern species in which, although the bird had laid, the ants remained, and he has taken other nests where not a single ant remained; but there is nothing to show that these nests were not deserted before the bird took possession. I myself have taken nests of the southern form, in which, though the eggs were partially incubated, the ants remained, showing that some considerable time must have elapsed since the bird took possession. This is a point that I hope to be able to elucidate within the next few months, when the birds will be breeding.

When *Micropternus* is breeding the feathers of the head, tail, and primaries of the wings get covered with a viscid matter, having a strong resinous smell, and this substance is usually rather thickly studded with dead ants (*vide* "Stray Feathers," vol. vi. p. 145).

Two species of kingfishers also to my knowledge nidificate in ants' nests—viz. *Halcyon occipitalis*, confined to the Nicobar Islands, and *H. chloris*, which ranges from India as far south as Sumatra.

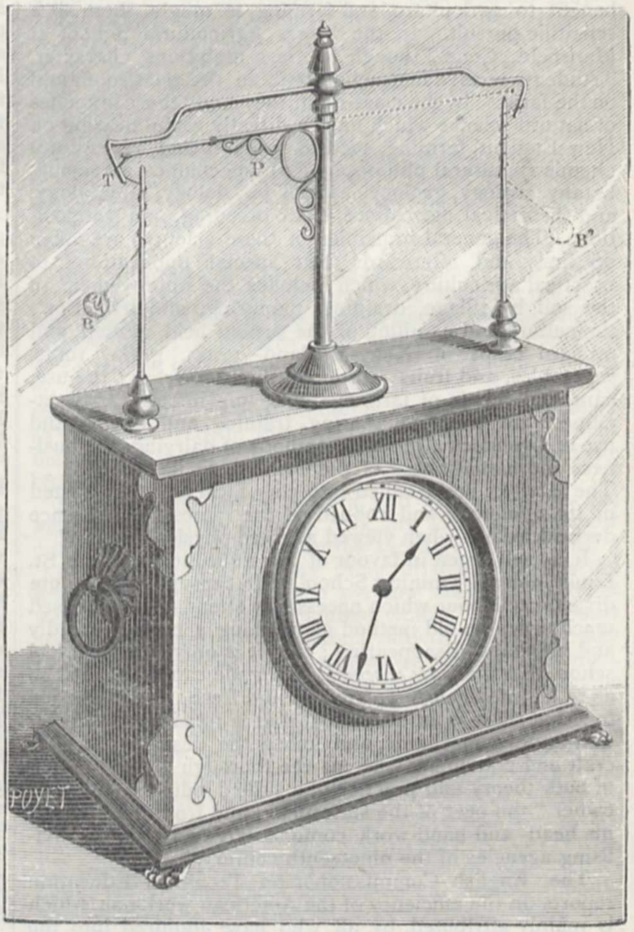
At Mergui, in South Tenasserim, I found a nest of *H. chloris* in a hornets' nest, and although I saw the birds repeatedly enter the hole they had made in the hornets' nest the hornets did not seem to mind it, but they resented in a very decided manner my attempt to interfere with the nest.

I am sorry I cannot give His Excellency more certain information as regards the desertion or otherwise of the ants from their nest after the birds have taken possession of it, but I hope to be able to finally settle the question shortly.

I am, Sir, yours obediently,
(Signed) WM. DAVISON

A NEW AMERICAN CLOCK

THE accompanying figure from *La Nature* illustrates a new American clock of ingenious construction. It is distinguished from all other clocks by the singular and original form of its pendulum: or rather of the system which serves to maintain a synchronism more or less perfect between the passage of time and the indications on the dial. The arrangement of this clock is based on



the principle of torsion. It has to be wound up daily, and the phase of the pendulum—that is to say, the time which elapses between two identical positions of the regulating system—is six seconds. The general mechanism does not differ from that of ordinary clocks; we find the main spring and other usual parts, and a train of wheels giving rotation to a vertical axis which is seen over the case and the rate of motion of which is to be regulated.

Here the new mechanism comes in. This vertical axis supports a sort of bracket, P, to the extremity of which is attached a small bead or ball, B, by means of a thread a few centimetres long. Putting out of view meantime the other parts resting on the case, it will be seen that the axis, by the action of the main spring, will turn with a rapid movement, drawing the ball B along with it. To regulate this movement, it is sought to interpose in its path suitable obstacles; this is the object of the horizontal wire terminating in the hooks T, and of the vertical pillars fixed on the case. The bracket P draws the thread in its movement and makes it strike against the arm T; it is thus arrested, and by virtue of its acquired speed, the ball B winds the thread around the pillar on the left; then follows an unwinding of the thread and a rewinding in an inverse direction, which enables the thread to pass the point T. But in unwinding it strikes a second time against the pillar, winds and unwinds anew, and only succeeds in passing this double obstacle after four successive windings, twice in one direction, and twice in the opposite direction around the same pillar. The thread thus set at liberty permits the bracket to turn 180° around the vertical axis. After this rotation it encounters two analogous objects placed on the right of the clock, and is delayed a certain time before passing these objects and returning to the pillar on the right. By suitably varying the length of the thread, which is easily done by means of a runner on the bracket, we obtain the complete phase of the movement with its eight successive windings of the thread, lasting exactly six seconds; and the clock is thus regulated, if not with all the precision of a chronometer, with an approximation said to be sufficient for ordinary use. The principle applied in this clock might possibly be utilised in cases where it is sought to regulate a slow movement of rotation by simple arrangements, both economical and uncumbrous.

A CLOUD-GLOW APPARATUS

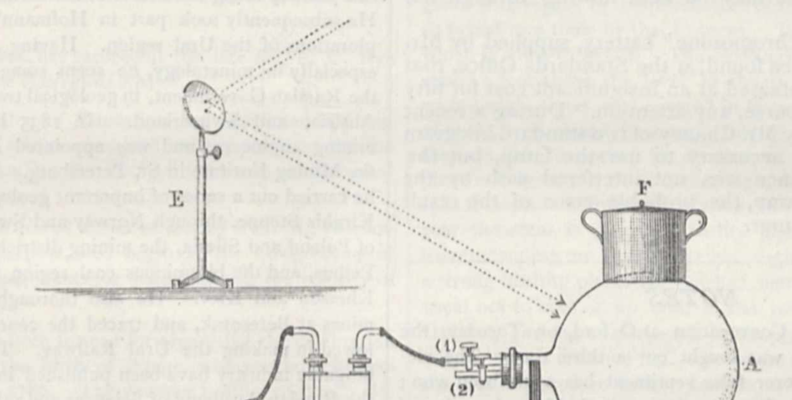
BY the kindness of Prof. J. Kiessling, of Hamburg, we illustrate a simple and easily arranged piece of apparatus which he has designed for the purpose of exhibiting on an experimental scale some of the many colour-phenomena which are produced when direct sunlight, or electric light, penetrates a moist or a dry cloud. In particular the apparatus can be used to produce on an artificially excited mist the same kinds of intense colorations which were visible in such extraordinary brilliancy in the winter 1883–84 during the hours of twilight at almost every place the whole world over.

The following pieces compose the apparatus:—

1. A glass globe, A, Fig. 1, holding about 20 litres, fixed in a wooden support, and closed by a rubber stopper bored with two holes. Through these holes enter two tubes of glass (1) and (2), with taps ground in.

2. An air-filter, C, consisting of a glass tube 30 centimetres long, filled with cotton-wool.

3. An india-rubber pump, B, for producing spray or mist. This is simply part of a common spray-apparatus, and is set so that it draws air from the air-filter and delivers it into the globe. By this means a pressure of one-sixth to one-fifth of an atmosphere is readily obtained. Suppose 15 or 20 grammes of water to have been introduced into the globe and such a pressure to have been produced, and then after about 10–15 seconds the other tap (2) to be suddenly opened, or removed quite out of the tube, the release of pressure will result in a sudden



lowering of the temperature, and the production of a tolerably homogeneous mist, the density of which will depend on the quantity of aqueous vapour present.

4. A simple heliostat, E, consisting of a mirror capable of being turned either in altitude or azimuth on an iron stand, and also of being clamped at any desired height.

5. A Woulff's wash-bottle, D. This can be filled with hot water so as to yield a supersaturated atmosphere; or, by the addition of ammonia or of hydrochloric acid, may furnish vapours of these materials for experiment in the globe.

6. A cylindrical tin-ware vessel, F, with a spherical bottom, to be set upon the glass globe, to heat or cool it as may be desired.

The following experiments may be made with this apparatus:—

[1] *The Ordinary Lunar Halo.* First cover the surface of the mirror with a card disk having a central circular opening 2 centimetres in diameter, covered with tissue paper. In direct sunlight observe the bright surface of this circle of tissue paper (which serves as an artificial moon) through the mist that is produced in the globe by letting in a stream of moist vapour from a flask of hot water for a few seconds. The halo is yellowish with a red-brown edge.

[2] *Blue Sun.* Pour into the globe a little hydrochloric acid, and blow in air through the wash-bottle, having filled the latter first with liquid ammonia. A dust-cloud of fine particles of sal-ammoniac is thereby produced. A ray of direct sunlight viewed through this is curiously coloured, appearing at the first moment red, and then changing to bluish violet and to full blue.

[3] *Artificial Cloud-Glow.* For producing the intense diffraction colours of the cloud-glow it is necessary to procure a cloud consisting of small particles all about the same magnitude. This is best attained if the air before entering the globe is first led through hot water. If the conditions are favourable the colours are sufficiently intense as to permit of their being received on a white screen one metre distant. The colours change rapidly in a regular gradation of order, each colour appearing first at the centre of the field, and moving outwards.

Several additional phenomena are to be observed with this apparatus; and its inventor has devised an ingenious proof of the once-disputed point that the particles of mist are spherules, not vesicles. This he does by showing that certain diffraction phenomena which depend on the size of the particles remain unchanged during a sudden change of external pressure, which, if the particles were bubbles or vesicles, would at once cause them to expand.

ILLUMINATION OF MICROSCOPES AND BALANCES

IN measurements and weighings where high scientific accuracy is needed it is sometimes necessary to use artificial means of illumination, and it is found that when reflected light cannot be conveniently introduced, the heat from ordinary lamps causes variations of the temperature of the room, &c., which slightly affect the accuracy of the results to be obtained. By using, however, an incandescent electric lamp fitted inside a glass vessel of water, the light may be even brought near to the microscope or balance without any appreciable interference with temperature. The glass vessel is provided with a pierced cover or shade, and a little stream of water of a uniform temperature may be kept flowing through the vessel.

By means of a "chromozone" battery, supplied by Mr. O. March, it has been found, at the Standards Office, that a light may be maintained at an insignificant cost for fifty hours without, of course, any attention. During a recent comparison made by Mr. Chaney of two standard kilogram weights it became necessary to use the lamp, but the action of the balance was not interfered with by the proximity of the lamp, the probable error of the result being only ± 0·005 mgr.

NOTES

IN an overflowing Convocation at Oxford, on Tuesday, the battle of vivisection was fought out a third time. The victory of sound sense over false sentiment has again been won; and on this occasion the vote is unmistakable. In spite of the most vigorous exertions of the opponents of physiology, the decree to endow the Physiological Laboratory—as the other scientific departments in the University are endowed—has been carried by the large majority of one hundred and sixty-eight. The Dean of Christchurch opened the debate in a moderate speech recommending the grant. He pointed out that the vote was for teaching purposes, and in no way concerned vivisection, for Prof. Burdon Sanderson had given the most complete assurances that he would not use painful experiments on living animals for the purposes of teaching. Canon Liddon opposed the decree on the ground that the Council should have introduced further safeguards against the indiscriminate use of vivisection. He admitted that vivisection was justified in certain cases, and spoke of it as a painful necessity. The Bishop of Oxford denied the moral right of man to inflict pain in order to advance knowledge, and declared vivisection to be degrading to the sensibility and humanity of the operator. The vote was supported by Prof. Dicey and Sir W. Anson, and unintentionally damaged by Dr. Acland. The last speakers were much interrupted by a clamour which prevented their remarks being heard. The announcement of the result—*placets*, 412; *non-placets*, 244—was received with great enthusiasm, both in the arena and in the undergraduates' gallery. It is to be hoped that this decisive vote will put an end to the warfare waged against the teaching of physiology in Oxford.

GEOLOGISTS throughout the world will be interested to learn that Dr. Franz Ritter von Hauer, who for so many years has so admirably guided the progress of the Geological Survey of Austria, has resigned his post as Director of that institution, and has been appointed Intendant of the Imperial-Royal Natural History Museum, Vienna. He carries with him into his new sphere of labour the hearty good wishes of a large circle of friends and well-wishers, who hope that the official duties he must now perform will in no way diminish the service he has rendered to science so long and so usefully.

IT has been proposed that, for the present session, in place of the formal receptions which have hitherto been held, the rooms of the Royal Society should be kept open on certain nights in order that Fellows and their friends may meet together for conversation and for the examination of such objects of interest as may be collected for the occasion. The first of these meetings will take place on Thursday, March 19, from 7.30 p.m. Any one desirous of showing on that evening any experiments, apparatus, or specimens illustrating any inquiry in which he may be engaged, should communicate with the Assistant Secretary, in order that appropriate arrangements may be made.

THE death is announced of the eminent Russian geologist, George Helmersen, at the age of eighty-two. He studied at Dorpat under Engelhardt, whom he accompanied on his scientific journey along the course of the Lower Volga and the Ural. He subsequently took part in Hofmann's and Humboldt's explorations of the Ural region. Having completed his studies, especially in mineralogy, he spent some years, by direction of the Russian Government, in geological travels through Germany, Austria, and Switzerland. In 1835 he joined the body of mining engineers, and was appointed Director of Studies at the Mining Institute in St. Petersburg. During leisure periods he carried out a series of important geological journeys over the Kirghiz Steppe, through Norway and Sweden, the coal districts of Poland and Silesia, the mining districts of Lakes Onega and Peipus, and the bituminous coal region in the governments of Kherson and Kiev. He also thoroughly explored the gold mines at Beresovsk, and traced the course which has been followed in making the Ural Railway. The results of his indefatigable industry have been published in numerous memoirs of the Russian Academy of Sciences and other works.

WE have heard with regret of the untimely death of the eminent Russian naturalist, Mr. N. Severtsoff, which occurred on the evening of January 11, when driving across the Don, in the Government of Voronej, his horses and vehicle breaking through the ice. The coachman managed to extricate Mr. Severtsoff, but the thermometer stood at − 10° Réaumur, and, before he could be taken to a neighbouring village, he was frozen to death. It is a singular coincidence that Prof. Fedchenko, another of the greatest of Central Asian naturalists, who, like Mr. Severtsoff, had so often risked his life in the pursuit of science in Turkestan, was also frozen to death in Europe. Mr. Severtsoff so early as 1867 explored the Thian Shan as far as the sources of the Narin. His work on the vertical and horizontal distribution of Turkestan animals was written in Russian, and he has since published original researches on the birds of the Pamir. Certain portions of his remarks on Turkestan mammals and birds have been translated, and it is chiefly to him that we are indebted for what information we have in English respecting the mammals, birds, and reptiles of

Turkestan. We are glad to see, however, from Messrs. Sampson Low's catalogue the announcement of a book by Dr. Lansdell, on Russian Central Asia, in which are promised the enumeration of 4600 species of fauna and flora, in about 20 lists, with introductions to each.

PROF. SILVANUS P. THOMPSON, of University College, Bristol, has been appointed Principal and Professor of Physics at the Finsbury Technical College. The duties of Principal have hitherto been discharged by Mr. Philip Magnus, the Director and Secretary of the Institute, who temporarily undertook them pending the complete organisation of the College. As Professor of Physics at Finsbury Prof. Thompson succeeds Prof. Ayrton, F.R.S., who has now been appointed Professor of Physics at the Central Institution.

THE gift to the nation by Messrs. Osbert Salvin, F.R.S., and F. Du Cane Godman, F.R.S., of two valuable and highly instructive collections, is announced. One collection, presented on certain conditions, comprises the entire series of American birds brought together by those gentlemen, numbering upwards of 20,000 specimens, and illustrating more than any other collection in existence the life-history and geographical distribution of the birds of tropical America. No labour or expense has been spared in the formation of this splendid group of ornithological rarities. The other gift, which is unconditional, comprises a very fine collection of Central American Coleoptera of the families of *Cicindelidæ* and *Carabidæ*. It contains 969 species, and, moreover, 7678 examples, of which more than 400 are types of new species described in the work entitled "Biologia Centrali American," now in course of publication by Messrs. Salvin and Godman. To this collection will be ultimately added, by gift, the remaining families of Coleoptera, with other entomological specimens.

PROF. JEFFREY BELL has succeeded the late Mr. E. C. Rye in the editorship of the *Zoological Record*.

THE French Minister of Education has appointed a Commission, composed of astronomers and others, to report on the opportuneness of extending the decimal system to astronomical distances and time.

M. WOLF having received a sum of money from M. Worms, of Romilly, for the purpose, will begin at the Observatory of Paris a series of experiments for redetermining the velocity of light.

A COMMITTEE has been formed for organising the celebration of the centenary of the birth of Arago, who was born in Perpignan on March 17, 1786. The younger brother of Arago, M. Etienne, is director of the Luxembourg Museum.

MR. H. L. BIXBY, of Chelsea, Vt., U.S., is taking steps, *Science* states, to introduce a system of weather warnings throughout his State by means of blasts from factory whistles. The signals are as follows: after the first long, unbroken blast, usually given at about 7 a.m., a single five-second blast indicates fair or probably fair weather for the day; two blasts, foul weather; three, fair, changing to foul; four, foul, changing to fair; five, doubtful or irregularly variable. After any of these, five short blasts signify a cold wave or unseasonable frosts. The managers of the *Free Press* at Burlington undertake to send the necessary telegrams on payment of a small fee. Randolph is the first town to adopt the system: the signals are regularly given there now from a 10-inch steam-whistle.

AN experiment is being tried in the Jefferson physical laboratory, we learn from *Science*, which promises to be successful. An ordinary seconds clock, with a wooden pendulum, is controlled by the signals from the Harvard College Observatory, with no other mechanism than a fine spring connecting the pendulum to the armature of a telegraph instrument in the circuit. If the signals are interrupted during the day or night, the error of the clock, which seldom exceeds half a second in that time, will generally be rectified within an hour of their recurrence. The rate is in no way affected by the irregular signals caused in storms by the interference of the wires, and the regular impulses conveyed at intervals of two seconds increase but slightly the swing of the pendulum. The attachment can easily be made to any seconds clock at the cost of a few dollars, and may be of interest to those intolerant of the rates charged by companies for the use of electric dials.

FROM an article in the *Boston Journal* of February 7 we see that preparations are being made in the United States to observe the partial eclipse which will be visible there on March 16. Nearly 11/12ths of the sun's surface will be obscured at Washington, Baltimore, Philadelphia, New York, Boston, and Portland.

THE University of Glasgow having accepted the resignation of Dr. Bayley Balfour, the Chair of Botany in that University is now vacant. The patronage belongs to the Crown.

A PARLIAMENTARY paper published during the week (Corea, No. 1) contains, besides the trade report for Corea in the usual form, the account of a journey made by the Consul-General of Great Britain in the Peninsula. As for trade, the reports may be summed up much like the chapter on the snakes of Ireland: there is no trade, and there is no probability of there being any. The journey was from Seoul, the capital, to Songdo, to the north-east, the ancient capital of one of the three kingdoms into which Corea was divided. Some interesting information is given with regard to the production of the famous drug ginseng, so prized as a tonic by the Chinese. It is grown from a seed which is sown in March. The seedlings are planted out in beds raised a foot above the level of the surrounding soil, bordered with upright slates, and covered in from sun and rain by sheds of reeds, well closed in except towards the north side, where they are left to open. In the first or second year the ginseng plant is only two or three inches high, and has only two leaves. It is transplanted frequently during this period. In the fourth year the stem is about six inches high, with four horizontal leaves standing out from it at right angles, and in the fifth year a strong healthy plant has reached maturity, though it is more usual not to take it up until it has reached the sixth season. Ordinary ginseng is prepared by simply drying the root in the sun, or over a charcoal fire. To make red or clarified ginseng, the root is placed in wicker baskets, which are put in a large earthenware vessel with a closely-fitting cover, and pierced as the bottom with holes. It is then placed over boiling water and steamed for about four hours. Ginseng was for centuries regarded as a very elixir of life all over the East; and especially in China and Japan. Its properties were supposed to be miraculous, but they were generally supposed to be confined to the Corean ginseng. But its enormous price put it out of the reach of the poorer classes. The wild ginseng of Corea has frequently fetched twenty times its weight in silver in China. The export from Corea is a strict monopoly, which affords a considerable revenue, and is said to be the king's personal perquisite. Death is the punishment for smuggling it out of the country. The total export is only about 27,000 pounds avoirdupois.

ON February 8 died, near Hamburg, Johann Cæsar Godeffroy, until lately head of the great German firm of traders to the South Sea Islands. He was, however, much more than a merchant. Besides captains and supercargoes, he sent to Micronesia, Melanesia, Polynesia, and especially to Samoa, men of science, whose duty it was to make collections and send them to

Hamburg, to form there an exhaustive museum of natural history. The first whom he sent out on a mission of this kind was Dr. Graefe, of Zurich, now inspector of the zoological station at Trieste, who went to Samoa in 1861, and from this as a centre visited the Fiji, Tonga, and other groups in the region. He returned to Europe after eleven years, bringing with him important collections, and he undertook the editorship of a "Journal of the Godeffroy Museum." Amongst others thus despatched to the South Seas was a lady who spent ten years studying the botany of Northern Queensland, and a Polish surgeon, who lived for five years in the Marshall and Caroline Islands, then returned to Europe; returning again to the Carolines, where he is at present. A list of the men employed by Herr Godeffroy to travel in the South Seas to study the various islands, make collections for his museum, and report to him would embrace all nationalities, all departments of study, and every portion of the Southern Pacific. Eight catalogues of the Museum were published between 1864 and 1881, several of them containing zoological and geographical monographs as well. The *Journal*, which commenced in 1871, contained not only papers on the Museum and its contents, but was open to the discussion of any scientific subject connected with the South Sea Islands. Its most important feature was formed by the papers by specialists on sections of the collections sent home for the Museum. Fourteen parts were published in all, the most remarkable being on the fishes, which contained 140 plates and 312 illustrations. Through financial reverses this princely merchant died poor, and no purchaser was found for his museum, which will probably be broken up.

ACCORDING to a writer in the *North China Herald* on Chinese worship, it is certain that a great amount of fetichism prevails in that country. Near Peking, a few miles from the walls, on the east, is an enormous tree which fell more than two centuries ago, and which has been there ever since. It is called the Divine tree, and a temple has been erected for its worship. The people believe that a spirit lives in or near the tree, and should be worshipped from motives of prudence. The immense size of the tree is the result of the spirit's energy. It is believed it could not have grown so large without a present divinity. At Hantan, five or six days south from Peking, there are some iron bars in a well. In times of drought they are taken all the way to Peking to be prayed to for rain. They are placed in one temple after another, and prayers are offered to them till the showers fall. The bars are then reverently escorted back to Hantan, and placed in the well till they are again needed. In such a case the Chinese believe that there is a powerful spirit or genius in the well and in the bars, and that this spirit accompanies the bars to Peking and back again. This is Chinese contemporary fetichism, but in the ancient books there is no trace of fetichism. The objects of worship were either individual spirits or parts of nature. The ruling powers of the universe, from the highest to the lowest, were divided into four great classes—God, the subordinate heavenly powers, the higher earthly powers, and the numberless spirits that people earth and air. The subordinate heavenly powers were the seasons, the sun, moon, stars, cold and heat, floods and drought. The earthly powers were the gods of the mountains and rivers, and the last named are the spirits still remaining. Nothing is said of human spirits, though these were worshipped, then, as now, in the ancestral temples. But the worship in this instance consisted only of kneeling, prayer, and offerings.

DURING the late Health Exhibition at South Kensington the building and grounds were overrun with rats, food being plentiful and access to it comparatively easy. When the Exhibition closed, however, this ample source of provisions ceased to exist, and starvation seized upon the hosts of rodents who had for six months increased and multiplied upon the fat of the land. For a long time they were to be observed scampering here and there for food with abnormal temerity, often fighting fiercely over fragments of refuse, which evidenced their extreme voracity; and the officials on duty in the building have stated that the rats abounded in such large numbers that the noise of their movements resembled the "sound of wind." By degrees, however, they disappeared, some dying of starvation, whilst the majority emigrated to the houses in the neighbourhood; and at the present time there is scarcely one in the building.

IN connection with the Italian occupation of Massowah, materials for a meteorological station are being sent to that place.

IN the report of the Berlin Physiological Society for February 26 (NATURE, vol. xxxi. p. 404) the name of Dr. Kossel appears as Dr. Rossel.

IN the corrections in Sir William Thomson's Baltimore lecture given in last week's NATURE (p. 407), that for p. 296 should be π and π instead of ϖ and $\bar{\varpi}$. Sir William Thomson also asks us to state that in his Bangor address (p. 410, 2nd col. line 12 from bottom) he has inadvertently given the date of his coming to Glasgow as 1845 instead of 1846.

THE additions to the Zoological Society's Gardens during the past week include a Dwarf Common Ass (*Equus asinus* ♂) from Tripoli, presented by Mr. J. Skelding; a Bonnet Monkey (*Macacus sinicus* ♂), a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mrs. M. Strachan Carnegie; an Alexandrine Parrakeet (*Palæornis alexandri* ♂) from India, presented by Mrs. Abbott; two Common Gulls (*Larus canus*), two Black-headed Gulls (*Larus ridibundus*), British, presented by Mr. F. S. Mosely, F.Z.S.; a Roan Kangaroo (*Macropus erubescens* ♀) from South Australia, three Coal Tits (*Parus ater*), British, purchased.

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—Prof. Schönfeld, in the notes to his second catalogue of variable stars, which was published in 1875, refers to the singular circumstance that R Serpentis had not been observed at its minimum, though he doubted if it descended below the twelfth magnitude. Considering that the variability of this star was detected by Harding in 1826, the want of satisfactory determinations of the times of minima might hardly have been expected; it does not appear that our knowledge in this direction has advanced during the last ten years. Schönfeld's formula assigns for dates of maxima January 27, 1885, and January 19, 1886; the middle date is July 25, somewhere about which we may look for a minimum, though it is to be remarked that the increase of light has been observed to be more rapid than the decrease, especially near maximum. Observations made during the approaching summer, and continued as long as practicable, may perhaps lead to a well-determined minimum being put on record. The position of R Serpentis for the commencement of the present year is in right ascension 15h. 45m. 23·6s., declination +15° 29′ 3″.

A star in R.A. 14h. 8m. 0s., decl. − 11° 15′·2 for 1885·0 is probably variable from at least 7·5m. to 10m. On April 18, 1854, it was estimated a tenth magnitude, at a subsequent date 8·5, and on March 18, 1874, it was as bright as 7·5. It is not in Lalande, Bessel, Santini, Lamont, nor in the Bonn Observations, vol. vi. It is entered on Harding's Atlas as a seventh magnitude.

THE OCCULTATION OF ALDEBARAN ON MARCH 21.—The disappearance of Aldebaran at its next occultation by the moon takes place while the star is yet above the horizon at Greenwich, but its altitude there will be less than 2½°. At Exeter the star disappears at 11h. 45m. 19s., Greenwich time, at an altitude of 4½°, so that there is a possibility of observations in the west of England.

THE NAVAL OBSERVATORY, WASHINGTON.—In accordance with an intention notified several months since, Commodore

Franklin, U.S.N., Superintendent of the Observatory at Washington, issued a programme of work which it was proposed to undertake in that establishment during the present year. With the great equatorial, measures of a selected list of double stars, showing rapid motion or other peculiarity, are to be continued; the conjunctions of the inner satellites of Saturn will be observed, and a complete micrometrical measurement of the rings executed; observations which have been commenced for stellar parallax will be finished. The Transit Circle is to be employed on observations of the sun, moon, and larger planets, the latter being observed from fifteen to twenty times near opposition, and in addition each minor planet will be observed at least five times, if practicable, near opposition. The 9·6-inch equatorial will be utilised for observations of all the minor planets whose brightness at opposition is greater than their mean brightness, for positions of comets, and for occultations. The prime-vertical transit instrument is to be used in observing a selected list of stars, in conjunction with the Royal Observatory at Lisbon, in pursuance of a plan recommended by the International Geodetic Association, for the determination of variability of latitude. With the mural circle observations will be made of stars down to the seventh magnitude, south of 10° north declination, the positions of which have not been recently determined at any northern observatory, the observatory list including stars in Gould's *Uranometria Argentina* not found in Yarnall's catalogue, the transit circle list of B.A.C. stars, or the recent catalogue of the Glasgow Observatory. These principal items in the programme prove that it is not intended that the Naval Observatory shall fall short of its usual activity during the year 1885.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *MARCH* 15–21

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

At Greenwich on March 15

Sun rises, 6h. 16m.; souths, 12h. 8m. 58·1s.; sets, 18h. 3m.; decl. on meridian, 1° 57′ S.: Sidereal Time at Sunset, 5h. 37m.

Moon (New on March 16) rises, 5h. 34m.; souths, 11h. 9m.; sets, 16h. 52m.; decl. on meridian, 5° 51′ S.

Planet	Rises	Souths	Sets	Decl. on Meridian
	h. m.	h. m.	h. m.	° ′
Mercury	6 25	12 17	18 9	2 29 S.
Venus	6 2	11 23	16 45	8 17 S.
Mars	6 10	11 45	17 20	5 34 S.
Jupiter	15 14	22 27	5 40*	13 24 N.
Saturn	9 30	17 34	1 38*	21 44 N.

* Indicates that the setting is that of the following day.

Occultations of Stars by the Moon

March	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image	
			h. m.	h. m.	°	°
18	B.A.C. 481	6½	18 58	19 54	153	314
21	B.A.C. 1351	6½	18 30	18 58	193	242
21	75 Tauri	6	20 37	21 34	111	336
21	B.A.C. 1391	5	22 0	near approach	43	—
21	Aldebaran	1	23 43	0 32†	128	305

† Occurs on the following day; is below horizon at Greenwich.

Phenomena of Jupiter's Satellites

March	h. m.		March	h. m.	
15	1 21	II. occ. disap.	20	2 12	I. occ. disap.
	5 22	II. ecl. reap.		5 9	I. ecl. reap.
	18 31	I. tr. egr.		22 24	III. tr. ing.
16	19 28	II. tr. ing.		23 31	I. tr. ing.
	22 24	II. tr. egr.	21	1 51	I. tr. egr.
18	18 40	II. ecl. reap.		2 2	III. tr. egr.
19	5 4	I. tr. ing.		20 38	I. occ. disap.
				23 37	I. ecl. reap.

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

March	h.	
15	19	Venus in conjunction with and 3° 32′ south of the Moon.
16	6	Mars in conjunction with and 2° 32′ south of the Moon.
16		Annular eclipse of Sun; not visible in England. In Ireland the commencement of the eclipse may be seen, the sun setting very shortly afterwards.
17	1	Mercury in conjunction with and 1° 37′ south of the Moon.
20		Sun in equator.

GEOGRAPHICAL NOTES

The Australian journals which have arrived by the last mail contain full reports of the four days' conference of the Geographical Society of Australasia at Melbourne. Gen. Sir Edward Strickland was elected President, and Baron F. von Müller, Vice-President. The first resolution proposed that the term "Australasia" should be strictly defined. The expression was first used by Mr. Wallace, but it appears to have already had various inconsistent meanings applied to it. The proposer suggested that the following definition would serve all purposes: Australasia is that part of Oceania of which Australia is the geographical, commercial, and political centre. Limits: on the west and part of the north the 100° of longitude; east, to the point of its intersection with the 20° south latitude, thence by a line running in approximate parallelism to the western and northern coast of New Guinea, and around its north-western extremity to the equator; thence on the north, by the equator, to its intersection with the 120° of longitude west, and on the east by the 120° to the south pole, including groups of islands on the equatorial line. The question was ultimately referred to a strong committee. The next resolution affirmed the desirability of a scientific exploration of New Guinea under the auspices of the Society. A corollary calling on the Government to define the boundaries of the British possessions in that island was rejected in favour of one for complete annexation. The compilation of standard works on the geography of Australasia, as well as of school maps, was also discussed. After much discussion it was decided that the consideration of the aptest means for discovery of the fate of Leichhardt and his party should be left to the Colonial Councils of the Society, with a suggestion that a circular should be addressed to pastoral tenants in Western Queensland and Central Australia, requesting information on the subject. The formation of geographical societies, and their affiliation with the central body, in South Australia, Queensland, Western Australia, New Zealand, and Tasmania was also recommended. The next Conference will meet at Sydney.

At the meeting of the Geographical Society of Paris on February 20 a communication was read from Dr. Gustave Le Bon, the author of a work on Arab civilisation, who is at present travelling in Nepaul. For the purpose of measuring the ancient monuments of various native states he has employed certain new instruments, which he will explain to the Society on his return a few months hence. Nepaul is closed to Europeans, and Dr. Le Bon is said to have been the first who has been permitted to travel through it.—M. de Lavigne spoke on the French law protecting cartographers from piracy, which he held to be ample. A method of discovering counterfeits, adopted by certain French cartographers, is said to be the insertion of some street, town, or place with an imaginary name.—M. Pinart described a journey which he made in Chiriqui, in Panama, to study the manners, language, and monuments of the inhabitants.—M. Potel discussed the present situation of French trade in the River Plate.

From *Science* we learn that several expeditions to Alaska are projected during the coming season. Gen. Miles, commanding the military district of which the territory forms a part, desires to acquire a knowledge of the unexplored region between the head of Cook's Inlet and the Tananah watershed. The course of the Tananah is likewise unmapped, except from hearsay, though often traversed by traders in the last fifteen years; so that the opportunity exists here for a fruitful expedition. It is hoped that arrangements may be practicable by which Lieut. Ray, well known for his successful direction of the Point-Barrow party, may be able to command such an exploration. The plan contemplates work either from the Yukon as a base, with a steam-launch and a small party, ascending in June and July, and returning before navigation closes, or an expedition by way of Cook's Inlet, making the portage to the Tananah, and then descending; but a final decision is not yet reached. The party under Lieut. Abercrombie did not succeed in obtaining native assistance, as expected, and were unable to pass beyond the glacier alleged to obstruct the Copper or Atna River, about sixty miles from the sea. Meanwhile, a party has actually started, under Gen. Miles's orders, January 30, for the Copper River, consisting of Sergeant Robinson and F. W. Ficket, signal-observer U.S.A., and commanded by Lieut. Allen. They intend to go to the mouth of the Atna or Copper River by steamer, and ascend as far as possible on the ice, pushing on by water as soon as the ice breaks up and the freshets are over. They hope to cross the divide from the Upper Atna, and descend by one of the Yukon tributaries to the mouth of the latter river, and rejoin civilisation at St. Michael's. They may be fortunate enough to make the journey in one season, but are prepared to stay two years. They will add a number of Indians to the party at Sitka, and carry various peace-offerings for the Atna Indians. Lieut. Stoney, of the navy, is reported to have a new expedition nearly organised to continue his investigations of the Kowak River. The plan adopted, so far as yet decided upon, is to take a steam-launch, ascend the river as far as possible, and pursue the explorations to its source, and winter in the region if necessary. It is stated that the party is to be composed of sixteen men, which is dangerously large, considering the limited food-resources of the region, and might be advantageously diminished by one-half for explorations in the interior. If the party were to pass over the divide, and investigate the course of the Colville, returning *viâ* Point Barrow next summer, it would accomplish a praiseworthy and much-needed investigation.

WE have received from Messrs. W. and A. K. Johnston a school physical wall map of England and Wales, in which the altitudes above sea-level are shown by varieties of tint. Of its kind this map is good, though we should prefer to see the method of tints combined with the graphic method, in order that pupils may be taught to read the maps with which they have to deal when they become men and women. Accompanying the map is a little hand-book of the physical geography of England and Wales.

THE SCOPE AND METHOD OF PETROGRAPHY[1]

IN considering the history of geology we are struck by the fact that towards the close of the last and during the commencement of the present century, when the science was taking rank as an important branch of human knowledge, petrography occupied a much higher position than it has at any subsequent period.

Werner, whose influence was almost unrivalled at the time to which I have referred, was a mineralogist, and his formations were therefore naturally based on the mineralogical characters of the different rocks. His observations were limited for the most part to his own district of Saxony, but he regarded his formations as sediments or precipitates from a universal ocean, and his numerous pupils, fired by his love of science and his intense enthusiasm, rejoiced in extending his classification to the districts with which they were severally acquainted.

The magnificent work of those who devoted special attention to the organic remains in the sedimentary deposits, and especially that of William Smith, the "Father of British Geology," had the effect of deposing petrography from the position which it held under the influence of Werner and his followers. It was clearly shown that the fossil contents of the strata were far more reliable as evidence of chronological relations than their lithological characters, and as soon as this became generally recognised, the reduction of the fossil-bearing rocks all over the world to something like definite order followed as a natural consequence.

The principle that strata may be identified by means of their fossil contents has not only proved applicable to the Secondary and Tertiary formations to which it was originally applied by Smith, Cuvier, and others, but it has been extended by Murchison, Sedgwick, Barrande, and others to the older rocks. Speaking broadly, there can be no doubt that over large areas the succession of the forms of marine life has been remarkably uniform from the Cambrian times down to the present, so that we have in the fossil contents of the different strata by far the most reliable means of determining chronological relations.

It is not surprising, then, that petrography has been comparatively neglected by geologists, for their main object during the present century has been to classify the stratified rocks which form so large a portion of the existing land surfaces.

At the present time, however, we are witnessing a great revival of interest in petrography, not only in this country but all over the globe. This is due in part, no doubt, to the introduction of new methods of research; but it seems to me that there are other and more general causes. The clear recognition of the great principle with which the name of William Smith is so indissolubly united at once made it possible for a host of observers to do excellent work in every quarter of the globe. The interest awakened by the study of the geological structure of the most densely populated regions was akin to that which is felt by the geographical explorer of unknown lands. Until the main features of the geology of fossiliferous regions were described, it was not to be expected that observers would turn aside from a field of research in which they were certain to meet with success for the purpose of attacking problems which, after all, might prove to be insoluble. As time went on, the unexplored tracts in which fossiliferous rocks occur became more and more restricted, or more and more inaccessible, and when the old chaos of Grauwacke fell into order before the brilliant researches of Sedgwick, Murchison, and Barrande, geologists were placed in an entirely new position. They had conquered that portion of the world which was open to their special method of attack. A number of fortresses still held out, it is true, and many of these remain unsubdued at the present day. They will doubtless occupy the attention of those who are most skilled in the old methods of warfare for many years to come. At the same time I think it will be admitted on all hands that the brilliant successes of the old generals have left a large portion of the army with little to do. We must, therefore, look for other worlds to conquer.

Now, on taking a general survey of the subject-matter of geology it will be seen at once that we are profoundly ignorant on questions relating to the origin and sequence of volcanic rocks, the cause or causes of volcanic action, the mode of formation of the crystalline schists, and the origin of mountains. That these questions are really unsolved is proved by the difference of opinion which exists between competent observers. Another point which strikes one is, that if a solution of these problems be ever realised, it will be due in a great measure to the combination of field geology and petrography. This, it seems to me, will explain the great interest which is taken in the latter branch of science at the present day. If I am right in my opinion as to the present state of things, then we may safely predict that petrography will occupy as prominent a position in the immediate future of geology as palæontology has done in the past. In making this statement I trust it will not be thought that I am claiming too high a position for that branch of geology with which I am most intimately acquainted.

Let us turn now to a more detailed consideration of the scope and method of petrography. The rocks of the earth's crust form the subject-matter of the science. Now these may be studied from two more or less distinct points of view—the descriptive and the ætiological. We may set to work to describe the rocks, that is, to ascertain and record every possible fact with regard to them; or we may endeavour to trace the succession of events which has culminated in the state of things which we actually observe. It is perfectly obvious that we cannot hope to attain any considerable success in the second branch of the subject until we have devoted a considerable amount of attention to the first.

Descriptive petrography then concerns itself with the chemical, mineralogical and physical characters of the individual rocks, and also with the distribution and mutual relations of the different varieties. The last-mentioned branch of the subject occupies the same position in petrography as comparative anatomy does in zoology. It may therefore be termed comparative petrography.

When the history of the science comes to be written, it will be recognised that it is to the Germans we are especially indebted for our knowledge of descriptive petrography. The amount of work which has been done in Germany is immeasurably greater than that produced by other nations. For years past they have been steadily improving their methods of observation, as well as observing and recording facts. Moreover, they have been training petrographers who are now scattered all over the world. The Americans especially have availed themselves of the laboratories of Rosenbusch and Zirkel, and almost every Annual Report of the American Survey now bears witness to the influence of

[1] Lecture delivered in the Woodwardian Museum, Cambridge, by J. J. H. Teale, M.A., F.G.S.

Germany from a teaching point of view on the growth of petrographical science. In this sketch, of course, I am only calling attention to the broad facts of history as far as regards the special branch of descriptive petrography. Many observers in France, England, and America have done independent work of the very highest order, and to England especially belongs the credit of having, in the person of Sorby, determined to a very large extent the introduction of the modern methods of microscopical research.

Consider now what is involved in the description of any particular rock, and take, for example, a specimen of the Whin Sill, that mass of basic igneous rock which plays such an important part in the Carboniferous region of the North of England.

The rock is dark gray or bluish-gray when freshly exposed. In texture it varies from compact to coarsely crystalline, the most common variety being one in which the individual constituents are just recognisable by the naked eye. Its specific gravity varies from 2·90 to 2·95. Its chemical composition is shown on this table. (Table referred to.) We have now to consider its mineralogical composition. In the determination of minerals in rocks we use physical and chemical methods. Colour, general appearance, hardness, cleavages, specific gravity, crystalline form, fusibility, and flame coloration are some of the most important physical properties available for the determination of minerals in rocks when they can be examined macroscopically. In thin sections we can use colour, general appearance, cleavages, form, and also the many properties which are brought out by the use of parallel and convergent rays of polarised light. Chemical tests may be applied both to macroscopically recognisable minerals and also to those which can only be observed by the use of thin sections or minute particles and the microscope. The latter are generally referred to as microchemical tests.

By applying these methods, some of which will be more fully explained in the subsequent lectures, we can prove that the rock of the Whin Sill is composed of felspar, pyroxene, titaniferous magnetic iron ore, quartz in the form of grains and also as a constituent of micro-pegmatite, apatite, pyrite, brown hornblende, mica, and some green decomposition products. Apatite, pyrite, hornblende, and mica occur only in very small quantity, and cannot be said to form any appreciable portion of the rock.

In order to give a complete petrographical description, however, it is necessary that we should not only know what minerals are present, but also that we should know the precise composition of each and the relative abundance of the different species. Information on these points can only be obtained by isolating the different constituents of a rock and analysing them separately. Methods of isolation will be described in subsequent lectures. The most important are those which depend on the use of heavy solutions, the magnet and electro-magnet, and various chemical reagents, especially hydrochloric and hydrofluoric acids. The chemical composition of each of the three principal constituents of the Whin Sill is represented on these tables. (Tables referred to.) Now, having obtained a knowledge of the composition of the principal constituents of the rock, it becomes possible to determine with a very fair amount of accuracy the relative proportions of these constituents by calculations based on the bulk analysis of the rock.

There is yet another point of great importance to which attention should be paid in subjecting a rock to an exhaustive examination. Owing to the brilliant researches of Sandberger, it is beginning to be recognised that many of the heavy and so-called rare metals are present in ordinary rocks in minute quantities. Until recently we have been disposed to regard these substances as occurring only in mineral veins and in the deeper portions of the earth from which the mineral veins have been supposed to derive their supply of material. Now it is beginning to be clearly recognised that these substances are very widely distributed even in the superficial crust of the globe. As an illustration of the interest and practical importance of the subject above referred to I may call attention to the important work by Dr. Becker, on the "Geology of the Comstock Lode," recently published by the U.S. Geological Survey. This lode, the yield of which is supposed to have sensibly affected the bullion markets of the world, occurs in a region which is remarkable for the extreme development of igneous rocks (diabase, diorite, andesites, &c.), and for the widespread alteration to which these rocks have been subjected. The bisilicates, especially, have been affected by this alteration, and for immense distances they have been entirely replaced by a green chloritic mineral.

Most careful assays have been executed, under the supervision of Dr. Becker, for the purpose of determining the amount of bullion in the fresh and unaltered rocks, and the relative amounts of gold and silver. He says: "By comparison of the different assays it appears that decomposed diabase carries somewhat less than half as much silver as the fresh rock. When the decomposed rocks are pyritous, the experiments made do not indicate any essential diminution of the gold contents. This fact, however, is quite possibly due to irregularity in distribution and the minuteness of the quantities of gold to be determined. As the decomposition of the rock in question has proceeded at a great depth beneath the surface, it is highly unlikely that silver should have been extracted unaccompanied by gold. Much of the decomposed rock, too, is nearly free from pyrite, and had the gold contents of such specimens been determined, a smaller percentage would probably have been found. The omission [to select specimens free from pyrite] was not detected until it was too late to resume the investigation. So far as quantitative relations are concerned, the silver only can be relied on, though the qualitative detection of gold as well is both interesting and important."

Another point of great interest was determined by Dr. Becker. He isolated the felspar and the augite of the diabase and tested both from silver. He found that for equal weights the augite was eight times as rich as the felspar substance, and as the latter contained some augite, this appears to furnish substantial proo that the silver is a constituent of the augite.

Having subjected a rock to exhaustive chemical and mineralogical examination, it next becomes necessary to compare it with other rocks, and to give it a name. The subject of nomenclature is a very difficult one. It is much to be regretted that notwithstanding all that has been done in descriptive and comparative petrography, we are still far from having any system of classification which is capable of general acceptance. Indeed, we are not agreed as to the first principles on which a classification of rocks should be based. The German petrographers, in most cases, adopt at the outset a principle which we cannot accept. They divide igneous rocks into older and younger: the former including all those which they regard as pre-Tertiary, the latter all those which are of post-Cretaceous age. The division is based, of course, on the assumption that the conditions of eruption in pre-Tertiary times were essentially different from those which have prevailed since. There seems, so far as we can judge, little or no ground for this assumption. The few facts which do at first sight lend support to it appear to be equally capable of explanation on the other hypothesis. The typical pre-Tertiary rocks of the German system are the granites, diorites, gabbros, diabases, and syenites. Now there is reason to believe that these are all plutonic rocks; in other words, that they are the result of slow consolidation beneath the surface, and therefore under great pressure. If this view be correct then their exposure at the surface can only occur long after their formation, and the fact that the majority of those known to us should be of pre-Tertiary age, as Lyell long ago pointed out, need occasion no surprise.

Again, it must be remembered that the mere association of eruptive rocks with pre-Tertiary deposits is no proof in itself that the former are of pre-Tertiary age, and also that many competent observers believe that these are clear cases of Tertiary granite, diorite, diabase, and gabbro.

The igneous rocks, which are regarded by the German petrographers as especially characteristic of the post-Cretaceous period, are the basalts, andesites, trachytes, and rhyolites; in other words, the surface-products of volcanic action. That these should be mainly Tertiary, and that they should differ to a certain extent from their pre-Tertiary equivalents in consequence of alteration, is only what might be naturally expected. This, however, is not sufficient to justify the refusal to give the same name to different specimens of one and the same rock merely because they have been produced at different periods; and the work of Allport, Bonney, Geikie, and others has proved that there are basalts, andesites, and rhyolites of Palæozoic age which are identical in structure, composition, and mode of occurrence with modern rocks.

In the absence of any generally recognised system of nomenclature it becomes difficult to assign a name to the rock of the Whin Sill. It is a holo-crystalline rock composed essentially of plagioclase, pyroxene, titaniferous and magnetic iron ore. In sections the felspar occurs in lath-shaped forms. To such a rock, provided it be of pre-Tertiary age, Rosenbusch would give the name diabase. We are inclined, on the other hand, to call the rock a dolerite. The important point for the student to remember, however, is that in the present unsettled state of nomenclature his primary duty is to make himself familiar with the structure and composition of the various rock types. The question of names is, after all, only of secondary importance, provided we remember that in looking at the facts through the medium of an unphilosophical nomenclature we may so distort them as to fail to realise their true forms and relations.

Consider now the ætiological aspect of petrography. Most of us are so constituted that we cannot rest satisfied with a mere description of facts; we almost instinctively endeavour to discover what we call the origin of things. This, after all, merely consists in tracing back as far as possible the chain of events of which the object or phenomenon in question represents the last link. The search after causal relations in the organic world has led to the introduction of a principle which is now recognised as one of the greatest importance in almost every branch of human knowledge. Changes in the characters of organisms are now admitted to be determined by two factors—the inherent properties of the organism and the influence of surrounding circumstances. A very little consideration will serve to show that the changes which occur during and subsequent to the development of minerals and rocks are determined by two allied factors.

Take the case of crystallogenesis. It is not difficult to see in a general kind of way that the characters which a crystal possesses have been determined (1) by the inherent properties of the crystallising substance, and (2) by the influence of surrounding circumstances—of the environment. When we examine thin sections of rocks, furnace-slags, or the refuse products of glass-works, we frequently find a number of bodies which are intermediate as it were between glass and true crystals. These have been carefully examined and admirably described by Hermann Vogelsang, who has also succeeded in producing many of them by artificial means. As they serve to illustrate in a very striking way the principle above referred to, a short description of Vogelsang's experiments will not be out of place.

The crystallising substance finally selected by Vogelsang for the purpose of his experiments was sulphur. This substance is readily soluble in bisulphide of carbon, out of which it crystallises in the rhombic form. If the process of crystallisation be followed under the microscope, nothing definite as to the nature of crystalline growth can be made out. The first objects which appear are definite crystals, and these grow by accretion. If, however, the solution of sulphur be thickened with Canada balsam then, provided the proper proportions of the different substances have been employed, some very interesting phenomena may be observed by the aid of the microscope as the bisulphide of carbon evaporates. Minute fluid spheres arise in the medium and grow by mutual absorption. They finally consolidate as clear, transparent, isotropic bodies, and to them Vogelsang has applied the term globulites. It is impossible to determine absolutely the composition of these globulites, but there seems no reason to doubt the conclusion of Vogelsang that they are portions of the Canada balsam which are richer in sulphur than the surrounding mass, and that they arise in consequence of the attempt of sulphur to crystallise under unfavourable circumstances. Similar bodies may be observed in certain rocks, slags, and blow-pipe beads, although the crystallising compounds must be very different in the different cases.

Under certain circumstances the mass of sulphur and Canada balsam solidifies with the formation of globulites, but under other circumstances additional phenomena may be observed. When the resistance of the medium is too great to prevent the union of the globulites, but not too great to prevent their approach, they become united into various more or less definite forms. The mode of union depends partly on the way in which the globulites attract each other, and partly on the movements in the mass. A linear arrangement of the globulites is very common, and to the form arising in this way Vogelsang has given the name margarite. A rectangular grouping is also not uncommon. From a study of the various forms arising in consequence of the union of globulites, Vogelsang concludes that in the case of sulphur there are in each globulite, as it were, three directions at right angles to each other, in which the attraction is considerable, and that in one of these the attraction is decidedly greater than in the other two.

The building up of the compound forms naturally leaves the surrounding space free from globulites.

Under certain circumstances the globulites become fused, as it were, at the points of contact. This occurs when the resistance is sufficient to prevent the assumption of the spherical form, but not sufficient to resist the destruction of the pellicle at the point of contact. In this way rod-like bodies, termed longulites, arise.

It must be remembered that all these forms are strictly isotropic. They are not, therefore, in any sense of the word, crystals. The moment a true crystal of sulphur appears, it can be recognised by its doubly-refracting properties. They have been termed crystallites, wherever they occur, by Vogelsang, and they evidently arise in consequence of the attempts of some definite chemical compound to crystallise under conditions which do not admit of the free approach of the molecules.

Between crystallites and perfect crystals showing definite external faces there are numerous intermediate forms, such as microlites and skeleton crystals. As further illustrations of the influence of the environment we have only to consider the facts that no two crystals of the same substance are precisely alike in all their characters, and that some substances, like sulphur and carbonate of lime, may be made to crystallise in two different systems by varying the conditions under which the crystallisation is effected.

There can be no doubt, then, that two factors are involved in the determination of the properties which crystals present: the inherent forces of the crystallising substance and the influence of surrounding substances.

So far we have referred only to the birth and growth of crystals. But the history of a crystal does not cease with its formation. With a change in the surrounding circumstances the crystal may be modified or destroyed. Thus we see that crystals have a kind of life-history: they are born, they grow in size by accretion, and finally they cease to exist as distinct individuals.

As an illustration of the influence of a change of physical condition on the character of a crystal, consider the case of leucite. At ordinary temperatures this mineral is generally regarded as tetragonal, and it certainly shows double refraction in thin sections. Klein has shown that by heating leucite to a point far short of its fusibility it may be rendered perfectly isotropic, and hence follows the conclusion that leucite is really isotropic when subject to the conditions under which it is formed. That crystals should be in a state of stable equilibrium, so far as molecular forces are concerned, when subject to the physical conditions under which they are formed, is exactly what we should expect, and that this equilibrium may be disturbed by a change in these conditions is also very easy to understand.

As further illustrations of the principle here referred to, consider the various cases of paramorphosis, such as the change from arragonite to calcite, or from calcite to arragonite; or, again, the corresponding changes in sulphur.

Illustrations of the changes which arise in crystals in consequence of changes in the chemical conditions to which they are subjected, need not here be referred to in detail; the destruction of crystalline rocks by denudation is of course a consequence of these changes.

Consider, now, the rocks of which the earth's crust is composed. They also have a life-history. They are formed and destroyed, and it is the business of the petrographer not only to describe and classify them, but also to trace out the cycle of change. For the purpose of illustrating this branch of petrography let us consider certain facts with reference to the genesis of crystalline igneous rocks. It will be admitted on all hands that such rocks as granite, syenite, diabase, rhyolite, trachyte, andesite, and basalt have originated by the consolidation of an intensely heated silicate-magma under different conditions as to temperature and pressure. The consolidation has been accompanied—except in those cases where the magma has consolidated as a homogeneous glass, and these will be left out of account for the present—by the development of crystals. If, then, we would understand the manner in which crystalline igneous rocks have been formed, we must consider the subject of crystallogenesis in silicate-magmas. Numberless facts which need not here be referred to prove that the process of consolidation is not a sudden one. As the surrounding circumstances (environment) become more and more favourable to crystallisation, the minerals separate out one after the other, and at last the whole mass becomes solid, and the rock is formed. The temperature at which any given mineral forms is not determined by its own fusibility. The laws of the formation of minerals in igneous rocks are analogous to those which determine the formation of salts from concentrated aqueous solutions. Cooling influences the separation of the different minerals only in so far as it affects the solubility of the constituents of the minerals in the silicate-magma. The point at which a mineral forms from a silicate solution has, then, no more connection with its fusibility than the point at which graphite forms in molten iron has with *its* fusibility.

Another point of very great importance is this: the differentiation of crystals in an originally homogeneous magma must necessarily be accompanied by a variation in the composition of that magma. It becomes, then, of great interest to determine the general order of the formation of crystals in igneous magmas. On this subject we have a most valuable and suggestive paper by Rosenbusch, entitled "Ueber das Wesen der körnigen und porphyrischen St uctur bei Massengesteinen" (*Neues Jahrbuch*, 1882, ii. p. 1). Before proceeding to give an account of the portion of this paper which bears more particularly on the subject we are now discussing, it may be well to call attention to the methods available for the purpose of determining the order of the formation of the minerals in a rock. There are two. In the first place we may observe the phenomena of inclusions, and in the second place we may observe the extent to which crystalline form has been developed. If one mineral is seen to be included in another, then we may safely infer, subject to certain precautions, that the included mineral is the earlier of the two, and if one mineral shows a more perfect form than another with which it is associated, then we may infer—again subject to certain precautions—that the mineral with the more perfect form is the earlier.

Now in the paper above referred to, Rosenbusch divides the constituents of igneous rocks into four groups:—

(1) The ores and accessory constituents (magnetite, hematite, ilmenite, apatite, zircon, spinel, sphene).

(2) The ferro-magnesian silicates (biotite, amphibole, pyroxene, olivine).

(3) The felspathic constituents (felspar, nepheline, leucite, melilite, sodalite, haüyn).

(4) Free quartz.

He then calls attention to the contrast which is presented by the granites and syenites on the one hand, and the diabases on the other. In the former the following law is adhered to with a very great amount of persistence:—The order of formation is that of increasing basicity: the ores and accessory constituents are first formed, and the quartz is the final product of consolidation. In the diabases and gabbros there is apparently an exception to this law of increasing basicity, the augite consolidating after the felspar. Rosenbusch proposes to divide the granular holo-crystalline rocks into two classes: (1) those in which the minerals of the 2nd group in the above classification consolidate before those of the 3rd, and (2) those in which the reverse relation holds. He then calls attention to cases illustrative of the law of increasing basicity which are furnished by the order of separation in the individual groups. Thus in the ferro-magnesian group, olivine is older than biotite, amphibole and pyroxene; and biotite is older than the bisilicates. In the felspathic group triclinic felspars are older than monoclinic [there are exceptions to this rule, as, for instance, in the porphyroid of Mairus in the Ardennes, where orthoclase crystals are seen to be surrounded by a narrow zone of oligoclase], and the basic triclinic felspars are older than those which contain a large percentage of silica.

The views of Rosenbusch are based on the assumption that the order of formation of crystals in igneous magmas is determined solely by chemical conditions. That these conditions are the more potent seems quite clear, but there are facts which appear to show that physical conditions are not altogether without influence on the result.

The law of increasing basicity may be accepted without hesitation as expressing in a general way the truth as regards the order of separation of the different constituents of igneous rocks.

Now a very interesting conclusion follows as a natural consequence of this law. The effect of progressive crystallisation in a magma must be to increase the percentage of silica, to decrease the amount of lime, iron, and magnesia, to increase the total amount of alkalies, and to increase the potash relatively to the soda in the part which remains liquid. It is always satisfactory to find independent evidence confirmatory of any conclusion at which one may have arrived. Now I think we have confirmatory evidence of this kind in the present case. It will be admitted on all hands that the crystals in porphyritic rocks, such as hypersthene-andesite, have been formed in a magma the composition of which is represented by the bulk analysis of the rock. If, then, we compare the bulk analysis with the analysis of the ground-mass deprived of its crystals, we ought to find confirmation of the above conclusion.

Dr. Petersen has isolated and analysed the ground-masses of two of the Cheviot porphyritic rocks, and by comparing these with the bulk analyses of the rock the truth of the conclusion is most strikingly illustrated. The effect of progressive crystallisation in the andesitic magma has led unquestionably to an increase in the amount of silica, a decrease in the amounts of lime, iron, and magnesia, an increase in the amount of alkalies generally, and an increase in the potash relatively to the soda. In the rock itself soda is in excess of potash; in the ground-mass potash is in excess of soda.

There is yet another piece of independent confirmatory evidence. Every geologist is familiar with the phenomenon of contemporaneous veins. The general view held with regard to them is that they represent portions of material which remained fluid after consolidation had progressed to a considerable extent. If this view be correct, then they should hold the same chemical relation to the main mass of the rock as the ground-mass of the Cheviot andesite does to the main mass of the andesite. Mr. Waller has recently analysed certain contemporaneous veins which occur in the bronzite-diabase of Penmænmawr. He finds that they contain about 7 per cent. more silica than the normal rock, less lime and magnesia, more alkalies, and more potash than soda, although in the normal rock soda is in excess. Contemporaneous veins in the Rowley rag dolerite have also been investigated by Mr. Waller, with the same result as far as increase in silica and total alkalies is concerned. The relation of potash to soda has not yet been determined.

I believe it is admitted to be a general rule that contemporaneous veins contain more silica than the rock with which they are associated. It will be seen that there is abundant evidence of an independent character to confirm the general truth of the conclusion which follows from a consideration of the facts brought forward by Rosenbusch.

I should not have treated this subject at such length did it not appear to have an important bearing on the origin and sequence of volcanic rocks. I can best explain this by referring to the Cheviot district, with which I am slightly acquainted.

Andesitic lavas and tuffs cover large tracts of this district. These are unquestionably the products of surface volcanic action. In the central portion of the volcanic area there is a mass of augitic granite. A consideration of the mineralogical composition of this granite shows that it cannot belong to the acid group of rocks, and this conclusion is confirmed by an examination of the chemical composition of allied rocks from the Vosges. So far as we can judge in the absence of analyses there appears to be a very close connection between the composition of the plutonic and that of the volcanic rocks of the Cheviot district, and we therefore seem justified in concluding that the plutonic masses differ in character from the andesitic lavas merely in consequence of differences in the conditions of consolidation. The plutonic rocks represent the consolidation of the andesitic magma beneath the surface, and therefore under great pressure; the lavas and tuffs represent the consolidation of the same magma at the surface.

I now come to the point to which I wish to direct special attention. The andesitic lavas and tuffs are traversed by quartz-felsite dykes in such a way as to show that a magma of rhyolitic composition must have been erupted by the Cheviot volcanoes subsequently to the period characterised by the eruption of the andesitic magma. Contemporaneous veins similar in character to the quartz-felsite dykes also occur in the plutonic rocks. Again, an analysis of one of the quartz-felsite dykes by Mr. Waller agrees almost exactly with the analyses of the ground-mass of the hypersthene-andesite by Dr. Petersen.

Putting all these facts together, we conclude that the eruption of an andesitic magma was followed, in the history of the Cheviot volcanoes, by that of a rhyolitic magma in consequence of progressive crystallisation in the deep-seated plutonic source. The rhyolitic magma is, so to speak, the mother liquor out of which various basic minerals have crystallised. Suppose a half-consolidated plutonic mass, originally of andesitic composition, to become subjected to a powerful crush such as that which unquestionably arises in the earth's crust under certain circumstances. The mother liquor will be squeezed out of the mass, like whey out of cheese, and it may finally consolidate as contemporaneous veins in the plutonic rock, as dykes in the surrounding volcanic rocks, or as rhyolitic lavas and tuffs at the surface. The ideas here thrown out appear to me to be capable of extension to other volcanic regions; but as the sequence in these regions is generally complicated by the coming in of basic rocks during the later phases of volcanic activity, it will not be advisable to enter more fully into the subject on the present occasion.

The special characters which igneous rocks present, then, are to be traced to the chemical and physical properties of the original magma and to the influence of surrounding circumstances. Rocks, like minerals, are in a state of stable equilibrium when subjected to the conditions of their formation. When subjected to other conditions, whether physical or chemical, they usually undergo a change. The destruction and disintegration of igneous rocks by the various agents of denudation are familiar to every student of geology, and need not therefore be described on the present occasion.

I trust I have now said sufficient to show that the science of petrography is one of the greatest importance to the geologist of the present day. The remarks on ætiological petrography are, of course, only intended to illustrate the nature of this branch of the subject, and to show that conclusions of the greatest theoretical interest may be expected to follow from a careful consideration of the facts acquired by work in the other branch of the science.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—A Report recently issued gives particulars of the successful raising of the roof of the Mineralogical Museum to form a Morphological Laboratory on the new floor thus created. The firm of builders who had furnished estimates ultimately declined the work, and the Department of Mechanism undertook it. Under the continual superintendence of Prof. Stuart and Mr. Lyon the work was so skilfully done that not a crack was occasioned in the ceiling of the Mineralogical Museum, and the deflection of the new timbers was so well calculated that no timber moved upwards or downwards more than the eighth of an inch when the load came upon it. The cost was several hundred pounds less than the estimate. The roof raised was 110 feet long, and the weight fifty tons. A special vote of thanks is to be given to the Department of Mechanism for the care, skill, and economy with which the building operations were conducted.

The Botanical Laboratory has cost a little over 800*l.*; the Morphological Laboratory has cost about 2500*l.*

In the Natural Science "Special" Examinations for the ordinary B.A. degree during the past year, the great majority of candidates chose Chemistry, and showed that they had bestowed considerable pains on laboratory work while yet they were only imperfectly acquainted with the *rationale* of the processes they employed. The candidates in Botany had neglected systematic, and especially descriptive, botany. In June the descriptions of easy, well-marked specimens of flowering-plants were so worthless, that it was difficult to find out, from some descriptions, to which of the specimens they were intended to apply.

In Mechanism and Applied Science book-work was satisfactorily done, but deductions and numerical applications were very imperfect. Drawing was well done, and the candidates also showed a practical acquaintance with the use of tools; but they did not sufficiently connect their mathematical with their practical knowledge.

In the previous examination or little-go, Jevons's logic was set as an alternative subject to Paley with considerable success last year. Out of forty-four candidates only six failed. In arithmetic a knowledge of decimals and the use of common sense were strikingly wanting. The gradual elevation of standard in Euclid and Algebra of late years appears to have produced beneficial results. The papers in Mechanics in the October examination (on entrance) were unsatisfactorily answered; the candidates had for the most part read treatises dealing with the subject incompletely and popularly.

The proposal to discontinue entirely the additional examination in Mathematics for Honours Candidates has been rejected by a large majority, it having been found impossible to provide any substitute which would command general assent.

Mr. M. C. Potter, Assistant Curator of the Herbarium, has been approved as a Teacher of Botany.

The Physiological class-rooms having again become seriously overcrowded, owing to the increase of the medical school, a scheme for building new class-rooms with a large lecture-room is put forward by the Museums and Lecture Rooms Syndicate. The lecture-room is to be 45 feet by 40, and 32 feet high, and is calculated to accommodate 247 students comfortably. A new class-room 80 feet long to accommodate 100 students working at one time is an important feature, and rooms will also be provided for Prof. Roy's temporary Pathological Laboratory. The estimate cost is 9000*l.*

SCIENTIFIC SERIALS

Journal of Anatomy and Physiology, January, contains:—Diseases of the reproductive organs in frogs, birds, and mammals, by J. B. Sutton (plate 8).—Oviduct in an adult male skate, by J. D. Matthews (plate 9).—On the influences of some conditions on the metamorphosis of the blow-fly, by J. Davidson.—On the sources and the excretion of carbonic acid at the liver, by J. J. Charles.—On a method of maceration, by A. M. Paterson (plate 10).—Floating kidney, by D. Hepburn.—The movements of the ulna in rotation of the fore-arm, by Thos. Dwight.—Dissection of a double monster, by A. Hill.—Relation of the alveolar form of cleft palate to the incisor teeth and the intermaxillary bones.—The dumb-bell-shaped bone in the palate of Ornithorhynchus compared with the pre-nasal bone of the pig.—The infra-orbital suture; and an additional note on the oviducts of the Greenland shark, by W. Turner.—Anatomical notes.

Quarterly Journal of Microscopical Science, January, contains:—On the significance of Kupffer's vesicle, with remarks on other questions of vertebrate morphology (plate 1), by J. T. Cunningham.—Blastopore, mesoderm, and metameric segmentation, by W. H. Caldwell (plate 2).—On the origin of the hypoblast in pelagic teleostean ova, by G. Brook.—On the presence of eyes in the shells of certain Chitonidæ, and on the structure of these organs, by H. N. Moseley (plates 4, 5, 6).—*Archerina boltoni*, nov. gen. et sp., chlorophyllogenous protozoon allied to Vampyrella, by E. Ray Lankester (plate 7).—On the apex of the root in Osmunda and Todea, by F. O. Bower (plates 7 and 8).—Correction of an error as to the morphology of *Welwitschia mirabilis*, by F. O. Bower.—E. Van Beneden's researches on the maturation and fecundation of the ovum, by J. T. Cunningham (plate 10).—On the suprarenal bodies of vertebrata, by W. F. R. Weldon (plates 11 and 12).—On the life-history of certain British heterœcismal uredines, by C. Plowright.—On the occurrence of chitin as a constituent of the cartilages of Limulus and Sepia, by W. D. Halliburton.

Journal of the Royal Microscopical Society, February, contains:—On the apparatus for differentiating the sexes in bees and wasps. An anatomical investigation into the structure of the receptaculum seminis and adjacent parts, by F. R. Cheshire (plates 1 and 2).—On the occurrence of variations in the development of a Saccharomyces, by G. F. Dowdeswell.—Notes on the life-histories of some little-known Tyroglyphidæ, by A D. Michael (plate 3).—The usual summary of current researches in zoology, botany, and microscopy.

THE *American Naturalist*, February, contains:—On the habits of some Arvicolinæ, by E. R. Quick and A. W. Butler.—On a parasitic copepod of the clam, by R. R. Wright.—On the rudimentary hind-limb of Megaptera, and on the finger-muscles in *M. longimana* and in other whales, by J. Struthers.—The structure and development of the suspensory ligament of the fetlock in the horse, by J. D. Cunningham.—The Winooski or Wakefield marble of Vermont, by G. H. Perkins.—A botanical study of the mite-gall found in the black walnut, by Lillie J. Martin.—On the evolution of the Vertebrata, progressive and retrogressive, by E. D. Cope.

Rendiconti del Reale Istituto Lombardo, January 8.—Annual report on the work of the Institute in the various branches of science and letters during the past year, by the Secretary.—Biographical notice of Baldassare Poli, by Prof. Carlo Cantoni.

January 15.—On the secular variations in the elements of terrestrial magnetism at Venice, by Ciro Chistoni.—On a rare case of congenital malformation of the bladder, by Dr. G. Fiorani.—Extent of the diurnal oscillation of the magnet of declination at Milan in the year 1884, by Prof. G. V. Schiaparelli.—On the anatomy of the human brain, by Dr. Casimiro Mondino.—On the appearance of Halley's comet in the year 1456, by Prof. G. Celoria.

Rivista Scientifico-Industriale, January 15.—Influence of static electricity on lightning conductors, by Prof. Eugenio Canestrini. —On Trouvé's universal incandescent electric lamps (four illustrations), by the Editor.—On the various forms of *Scleranthus marginatus*, Gussone, by Dr. Leopoldo Nicotra.

Zeitschrift für wissenschaftliche Zoologie, December 1884, contains :—Observations on the origin of the sexual cells in Obelia, by Dr. C. Hartlaub (plates 11 and 12).—Studies among the Amœbæ, by Dr. A. Gruber (plates 13 and 14).—On the propagation and development of *Rotifer vulgaris*, by Dr. O. Zacharias (plate 16).—On the amœboid movements of the Spermatozoa of *Polyphemus pediculus*, by Dr. O. Zacharius.—On the uropneustic system in Helicinæ, by Dr. H. v. Ihering (plate 17).—On the metamorphosis in Nephelis, by Dr. R. S. Bergh (plates 18 and 19).—On the intercellular spaces and bridges in epithelia, by P. Mitrophanow.

Morphologisches Jahrbuch, Band x. Heft 3, contains :—On the occurrence of spindle-shaped bodies in the yolk of young frog eggs, by Prof. O. Hertwig (plate 14).—Researches upon the *Pori abdominales*, by H. Ayers (plate 15).—Contribution to a knowledge of the eye in gastropods, by C. Hilger (plates 16 and 17), and a postscript by Dr. O. Bütschli.—Studies on the development of the medullary cord in bony fish, with observations on the first appendages of the germinal vesicle and the chorda dorsalis in Salmonidæ, by N. Goronowitsch (plates 18 to 21).—Dinosaurs and birds : a reply to Prof. W. Dames, by Dr. G. Baur.—On the carpi centrale, and on the morphology of the tarsus in the Mammalia, by Dr. G. Baur.—Remarks on the abdominal pores in fish, by Prof. C. Gegenbaur.

SOCIETIES AND ACADEMIES

London

Royal Society, January 13.—"On the Constant of Electromagnetic Rotation of Light in Bisulphide of Carbon." By Lord Rayleigh, F.R.S.

A complete account is here given of the experiments briefly referred to in the Preliminary Note,[1] and of others on the same plan of more recent date. As regards the method, it may be sufficient to add to what was there said, that the electric currents were estimated by comparing the difference of potential generated by the current in traversing a known resistance with that of a standard Clark cell, the value of the cell being known by converse operations, in which the current was measured by a special electro-magnetic apparatus.[2] Allowance being made for temperature, the determination of the currents by this method was abundantly accurate and very simple.

The results are grouped in three series, of which the first two were considered in the Preliminary Note. In both of them the same tube was used, the principal difference being that in the first the light traversed the tube three times, and in the second but once. In the third series another tube was employed, and some improvements in respect to thermal insulation were introduced. The readings were taken with a double-image prism in place of the ordinary analysing Nicol, a substitution by which it is believed some advantages were obtained.

From the fifteen sets of observations of Series I. we find as the rotation of sodium light in bisulphide of carbon at 18° corresponding to a difference of potential equal to unity C.G.S. the value ·04203 minute. From the four observations of Series II. we get in like manner ·04198 minute, and from the seven observations of Series III. ·04202 minute. The last value is adopted as the most probable.

In an appendix some remarks are made upon polarimetry in general, especially in relation to the half-shade method. A device proposed by M. Becquerel for augmenting the precision with which rotations can be determined with the aid of a half-wave plate is considered, and the conclusion is arrived at that no advantage can thus be obtained.

February 19.—"Note on a Preliminary Comparison between the Dates of Cyclonic Storms in Great Britain and those of Magnetic Disturbances at the Kew Observatory." By Balfour Stewart, F.R.S., and Wm. Lant Carpenter.

The authors had made this comparison, through the kindness of Mr. Whipple, in the case of about thirty storms, the dates of which were taken haphazard from those given by Mr. R. H. Scott in his paper on the cyclonic storms of the last ten years, in the *Quarterly Journal* of the Meteorological Society for October, 1884. Out of these thirty cases, in twenty-three there war a distinct magnetic disturbance, for the most part preceding the storm by somewhat more than a day. The authors intend to pursue the subject, considering that there is a *primâ facie* case for investigation.

[1] *Proc. Roy. Soc.* vol. xxxvii. p. 146.

[2] "On the Electro-chemical Equivalent of Silver, and on the Absolute electromotive Force of Clark Cells." *Proc. Roy. Soc.*, vol. xxxvii. p. 142.

Geological Society, February 20.—Annual General Meeting.—Prof. T. G. Bonney, F.R.S., President, in the chair.—The Council's Report announced the awards of the various medals and of the proceeds of the Donation Funds in the gift of the Society.—In handing the Wollaston Gold Medal to Dr. W. T. Blanford, F.R.S., for transmission to Mr. George Busk, F.R.S., F.G.S., the President addressed him as follows :—The Council of the Geological Society has awarded to Mr. George Busk the Wollaston Medal in recognition of the value of his researches in more than one branch of palæontology. Polyzoa, not only fossil, but also recent, he has made peculiarly his own, and his numerous separate papers, his British Museum Catalogue, and his memoir on the Polyzca of the Crag, have entitled him to the lasting gratitude of workers at this class of the Molluscoida. But, perhaps as a relief to the study of these minute invertebrates, he has occupied himself, not less successfully, with the larger vertebrata, so that to him we are indebted for much information on the fauna of Post-tertiary deposits, especially from the caves of Malta and of Brixham. Permit me, in handing you this medal for transmission to Mr. Busk, to express my pleasure at having such a duty to discharge, and my earnest hope, in which I am sure all present will share, that restored health may enable him to continue his work in the cause of our science.—The President then presented the balance of the proceeds of the Wollaston Donation Fund to Dr. Charles Gallaway, F.G.S., and addressed him as follows :—The Council of the Geological Society has awarded to you the balance of the proceeds of the Wollaston Donation Fund, in recognition of the value of your researches among the older British rocks. By your identification of Upper Cambrian rocks in Shropshire you have placed beyond question the antiquity of the Rhyolitic Group of the Wrekin, our knowledge of which and of yet older rocks in that district you have greatly augmented. Your contributions also to the geology of Anglesey and to unravelling the stratigraphy of the Scotch Highlands have been of great value, and we look forward to the results of further researches, in aid of which I have great pleasure in placing in your hands the amount of the award. That you receive it from a fellow-labourer will, I hope, make it not the less welcome. The President then handed the Murchison Medal to Dr. Henry Woodward, F.R.S., for transmission to Dr. Ferdinand Römer, F.M.G.S., of Breslau, and addressed him as follows :—The Council has awarded to Dr. Ferdinand Römer the Murchison Medal and a sum of ten guineas from the Donation Fund. His life-long and unwearied labours in the service of our science have long since made his name familiar to his fellow-workers. When I state that the Royal Society Catalogue, published now more than eleven years since, records the titles of 122 separate memoirs written by him, when I mention his other important works, such as that on "The Chalk Formation of Texas," on "The Silurian Fauna of Tennessee," on "The Geology of Upper Silesia," and the "Lethæa Geognostica," I have said enough to prove that this memorial of an illustrious geologist could not well have been bestowed on a more illustrious recipient. In transmitting it to Dr. Römer, be so kind as to express our regret that the distance and the season of the year have deprived us of the pleasure of his presence on this occasion. In presenting the balance of the proceeds of the Murchison Geological Fund to Mr. Horace B. Woodward, F.G.S., the President addressed him as follows :—The balance of the proceeds of the Murchison Donation Fund has been awarded to you in recognition of the good service which you have already rendered to geology, especially by your work among the later deposits of the eastern counties, and to aid you in further researches. But the excellent papers which you have written, in addition to the work done by you as a member of the Geological Survey, do not constitute your only claim to our recognition. You have made use of the opportunity of your official position to promote a love of science among those who live in our eastern counties, and we are indebted to you for that admirable volume, "The Geology of England and Wales," which, though in one sense a compilation, is such a one as only a skilled geologist could produce. The President next presented the Lyell Medal to Prof. H. G. Seeley, F.R.S., F.G.S., and addressed him as follows:—The Council has awarded to you the Lyell Medal and a grant of 40*l*. in recognition of your investigations into the anatomy and classification of the Fossil Reptilia, especially the Dinosauria. Not that you have limited yourself to this field of research; your papers on *Emys* and *Psephophorus*, on *Megalornis* and British Fossil Cretaceous Birds, on *Zeuglodon*, and on remains of Mammalia from Stonesfield, prove your extensive knowledge of vertebrate palæontology, as your proficiency in invertebrate is evidenced by your earlier work, both stratigraphical and directly palæontological. Furthermore, your excellent edition of the first volume of Phillip's "Manual of Geology" indicates an exceptional familiarity with the literature of our science. Since our acquaintance first began, some twenty years since, at Cambridge, we have both had our disappointments and our successes; you, undiscouraged by the one, unelated by the other, have pushed on to your present high position in science, making no enemies, winning many friends. I trust that your future career may be even more prosperous than your past, and that this medal may be an augury of many good gifts of fortune. You will, I know, believe me when I say that I feel an exceptional pleasure in being commissioned to place in your hands this medal, commemorative of the great geologist whose philosophic spirit you so well appreciate, and whose memory, I know, you so greatly revere. The President then handed the balance of the proceeds of the Lyell Geological Fund to Mr. J. J. H. Teall, F.G.S., for transmission to Mr. A. J. Jukes-Browne, F.G.S., and addressed him as follows:—The balance of the Lyell Donation Fund has been awarded to Mr. A. J. Jukes-Browne in recognition of the excellent work that he has done on the Cretaceous formation and on glacial geology, and to aid him in further researches. His papers on the Cambridge greensand cleared up many difficulties connected with that interesting formation; and in his Sedgwick prize essay on the Post-tertiary deposits of Cambridgeshire he commenced those investigations which have since brought us more than one valuable contribution on glacial and later deposits. You can tell him that his old college tutor feels a little pardonable pride and much real pleasure in being the instrument of placing this award in your hands for transmission to him. In presenting the Bigsby Gold Medal to Prof. Renard, of Brussels, the President addressed him as follows:—When to a familiarity with geology in the field and a love of nature are united the skill of a finished chemist and the experience of a practised worker with the microscope, the results cannot fail to be of the utmost importance to our science. These qualifications, rarely united in any one man, are in yourself combined with an untiring industry and a love of science for its own sake. Thus we are indebted to you for many important contributions to our knowledge in geology. Your early memoir, "Sur les Roches Plutoniennes de la Belgique et de l'Ardenne Française," written in conjunction with M. de la Vallée Poussin, will long be classic; your papers on various subjects connected with the Carboniferous limestone, on the coticule, the phyllites, and other altered rocks of Belgium, and on the deep-sea deposits, are too well known to need more than mention, and in recognition of these the Council has awarded you the Bigsby Medal. In placing it in your hands may I be allowed to express for myself and others the hope that it will be always a pleasant *souvenir* of your many friends on this side of the Channel, some of whom, myself included, will not soon forget the pleasant and, to us, most profitable days spent under your guidance in geological studies by the limestone cliffs of the winding Meuse and the wooded crags of the Ardennes. The President then read his Anniversary Address, in which, after giving obituary notices of some of the members lost by the Society during the year 1884, he referred to the principal contributions to geological knowledge which have been made during the past year, both in the publications of the Society and elsewhere in Britain, concluding with a notice of the new views which have been adopted with regard to the structure of the Western Highlands, and a brief history of the steps by which they have been arrived at. The concluding portion of the address was devoted to a discussion of the principles of nomenclature which should be followed in petrology, with remarks on the classification of igneous rocks, and on the significance of certain structures, especially the more minute.—Officers and Council, 1885:—President: Prof. T. G. Bonney, F.R.S.; Vice-Presidents: W. Carruthers, F.R.S., John Evans, F.R.S., J. W. Hulke, F.R.S., J. A. Phillips, F.R.S.; Secretaries: W. T. Blanford, F.R.S., Prof. J. W. Judd, F.R.S.; Foreign Secretary: Warington W. Smyth, F.R.S.; Treasurer: Prof. T. Wiltshire, F.L.S.; Council: H. Bauerman, W. T. Blanford, F.R.S., Prof. T. G. Bonney, F.R.S., W. Carruthers, F.R.S., Prof. W. Boyd Dawkins, F.R.S., John Evans, F.R.S., A. Geikie, F.R.S., Henry Hicks, M.D., Rev. Edwin Hill, M.A., G. J. Hinde, Ph.D., John Hopkinson, W. H. Hudleston, F.R.S., J. W. Hulke, F.R.S., Prof. T. Rupert, F.R.S., Prof. J. W. Judd, F.R.S., J. E. Marr, M.A., J. A. Phillips, F.R.S., Prof. J. Prestwich, F.R.S., Warington W. Smyth, F.R.S., J. J. H. Teall, M.A., W. Topley, Prof. T. Wiltshire, F.L.S., Rev. H. H. Winwood, M.A., Henry Woodward, F.R.S.; Assistant-Secretary, Librarian, and Curator: W. S. Dallas, F.L.S.; Clerk: W. W. Leighton; Library and Museum Assistant: W. Rupert Jones.

Physical Society, February 28.—Prof. Guthrie, President, in the chair.—Messrs. G. R. Begley and O. Chadwick were elected Members of the Society.—Mr. J. C. McConnel presented two notes on the use of Nicol's prism. The first note related to the error in measuring a rotation of the plane of polarisation due to the axis of rotation of the prism not being parallel to the emergent light. After pointing out that this error was, to a first approximation, eliminated by taking the mean of the readings in the two opposite positions of the Nicol, the author proceed to push the calculation to a second approximation, so as to get a measure of the residual error. This is given by the equation—

$$\frac{\theta+\theta_1}{2} - \psi = \text{const.} + .24r^2 \sin\psi \cos\psi,$$

where θ and $180 + \theta_1$ are the two readings of the circle; ψ the angle between the plane of polarisation and a fixed plane, and r the angle between the axis of rotation and the incident light. This equation is practically correct for a flat-ended as well as an ordinary Nicol. The residual error cannot amount to 1′ in a rotation of 60° if r is less than 2°. The optical properties of the Nicol tend to neutralise the geometrical error due to the rotation taking place about one axis and being measured about another. The second note dealt with a new method of obtaining the zero reading of a Nicol circle. This is often defined as the reading when the plane of polarisation is parallel to the axis of rotation of the table of a spectrometer. A Nicol is fixed on the table, the light quenched by turning the Nicol circle, and the reading taken. The table is then rotated through 180°, the light quenched, and the reading taken again. The mean of the two readings gives the result required. It was described how the error due to the want of symmetry of the Nicol might be found and eliminated.—Mr. H. G. Madan exhibited and described some new forms of polarising prisms. The first of these is by M. Bertrand, and has been described by him (*Comptes Rendus*, September 29, 1884). The prism consists of a parallelopiped of dense flint glass of refractive index 1·658, the same as that of Iceland spar for the ordinary ray. The glass prism is cut like the spar of a Nicol's prism, a cleavage plate of spar being cemented between the two halves by an organic cement of refractive power slightly greater than 1·658. A beam of light traversing the prism is incident upon the spar at an angle of 76° 44′. The ordinary ray passes through without change, but the extraordinary ray is totally reflected at the first surface. The prism gives a field of 40°. M. Bertrand's prism has the great advantage of requiring only a very small quantity of Iceland spar, a substance that is becoming very scarce and expensive. The other prisms shown were: a similar one by M. Bertrand, described in the same paper; a double-image prism by Ahrens, described in the *Phil. Mag.* for January, 1885; and a modification of the latter by Mr. Madan, described in NATURE for February 19. Mr. Lewis Wright pointed out as a practical objection to M. Bertrand's prism that it was very doubtful whether a glass could be obtained of so high a density as to possess a refractive index of 1·658 and at the same time be colourless and unaffected by the atmosphere. He also remarked that the principle of the prism was by no means new.—Prof. W. E. Ayrton read a paper by himself and Prof. J. Perry on "The most economical potential difference to employ with incandescent lamps." The authors commenced by pointing out the importance of experiments being made on the lives of incandescent lamps, in addition to experiments on efficiencies. Referring to the experiments on life given by M. Foussat in *The Electrician* for January 31, they showed that if p be the price of a lamp in pounds, n the number of hours per year that it burns, $f(v)$ the life of the lamp in hours, and $\theta(v)$ the number of candles equivalent to the lamp, $f(v)$ and $\theta(v)$ being expressed as a function of the potential difference in volts $\frac{p \times n}{f(v) \times \theta(v)}$ stands for the cost per year per candle, as far as the renewal of lamps is concerned. Also, if H stands for the cost of an electric horse-power per year for the number of hours electric force is employed, and $p(v)$ the number of watts per candle, $\frac{H}{746} \times p(v)$ stands for the cost per year per candle as far as the production of power is concerned. The sum of these two represents the total cost per candle per year, and the value of v that makes this a minimum may be found either graphically or analytically. Solving the problem graphically for the 108 volt Edison lamps used at the Finsbury Technical College, where n may be taken as 560 and $H = 5l.$, they find that the minimum value of the total cost is given by $v = 106$. The curve connecting total yearly cost per candle with v they found to be very flat at this point, showing that the lamps may be burnt with a potential difference varying as much as 4 volts, with only 5 per cent. addition to the annual cost. It is found that with certain types of incandescent lamps the candle-power of the lamp varies as the potential difference minus a constant. The authors also find that in rough photometric experiments No. 8 sperm candles may be substituted for standard ones.—Mr. Macfarlane Gray gave an account of a most extended investigation upon the second law of thermodynamics. From considerations connected with the specific heats of liquids and gases the author comes to the conclusion that the second law is not true. The experimental results used are chiefly those of Regnault, to which, however, Mr. Gray has applied some corrections.

EDINBURGH

Royal Physical Society, February 18.—The Rev. Prof. J. Duns, D.D., F.R.S.E., President, in the chair.—The following communications were read, viz. :—Prof. W. Turner, F.R.S., exhibited and described a collection of fossil bones of mammals obtained in excavating the new dock and a gas-holding tank at Silloth. He was indebted for these to Dr. Leitch, Mr. Charles Boyd, and Mr. J. T. Middleton. The specimens consisted of antlers and a humerus of the Red Deer, vertebræ of two whales and two skulls and some of the bones of the limbs of the great extinct ox of Britain, *Bos primigenius*. Those found in excavating the dock were within a short distance of each other, lying in a bed of wet gravel and shingle, mixed with oyster, mussel, and cockle beds, the material overlying the bones being twenty-six feet in thickness. One of the antlers contained eight points, and it is doubtful if a finer specimen could be found on any existing red deer. The lower jaw of one skull of the *Bos primigenius* was obtained, and it is apparently the only specimen that had been seen in Britain, and, comparing it with the wild cattle in Cadzow Forest, he found that the extreme length of the jaw of the fossil ox was 18¼ inches, as against 15⅝ inches in the Hamilton cattle, being a difference of nearly 3 inches. The leg bones also showed the massive character of the Great Ox, and enabled the Society to realise its magnitude.—Dr. R. Milne Murray, M.A., M.R.C.P.E., described and exhibited some new modifications of recording apparatus.—Dr. Ramsay Traquair, F.R.S., described and exhibited a new fossil fish, *Elonichthys multistriatus*, found in the black-band ironstone at Gilmerton.—Mr. George Brook, F.L.S., described a new method for the aëration of marine aquaria.—Mr. John Hunter, F.C.S., read a paper on a new modification of Lunge's nitrometer.—Prof. A. G. Nathorst and Prof. Gustav Lindström, of Stockholm, have been elected Corresponding Fellows of the Society.

Institution of Civil Engineers, February 19.—Sir Frederick J. Bramwell, F.R.S., President, in the chair.—The second of a course of lectures on "The Theory and Practice of Hydromechanics" was delivered by Dr. William Pole, F.R.SS., L. and E., M.Inst.C.E., Honorary Secretary of the Institution, the subject being "Water Supply."

CAMBRIDGE

Philosophical Society, February 16.—Prof. Foster, President, in the chair.—The following communications were made to the Society :—Some remarks on the urea-ferment, by Mr. A. S. Lea.—On the occurrence of reproductive organs on the root of *Laminaria bulbosa*, by Mr. Walter Gardiner.—On the types of excretory system found in the Enteropneusta, by Mr. W. Bateson.

SYDNEY

Linnean Society of New South Wales, December 31, 1884.—C. S. Wilkinson, F.L.S., President, in the chair.—The following gentlemen were present as visitors :—Messrs. W. H. Caldwell, B.A., C. E. Smith, James Mosely, Alex. Hamilton.—The following papers were read :—Occasional notes on plants indigenous in the immediate neighbourhood of Sydney, No. 8, by Edwin Haviland.—The geology and physical geography of the State of Pérak, by the Rev. J. E. Tenison-Woods, F.G.S., &c.—Note on an apparently new parasite affecting sheep, by R. von Lendenfeld. In several localities sheep were affected by a disease similar in appearance to epithelial cancer, which appeared on the feet behind the hoofs and on the lips. The histological investigation shows that the rete malphigii is inflamed and the Papillæ attain a very large and abnormal size ; the outer layer of the skin and the horny epithelium are very much thickened, and it is apparent that between the horny layer granular masses, apparently parasites, are disposed, in which nuclei can be detected. The author supposes these to be an Amœba, and to cause by irritation the hypertrophy of the epithelium. The sections were exhibited under the microscope ; the specimens were hardened with chromic acid and stained with picric acid carmin.—On the temperature of the body of *Ornithorhynchus paradoxus*, by N. de Miklouho-Maclay. The result of some observations on the temperature of the *Ornithorhynchus* is here given, showing it not to exceed 40° C. or 76° Fahr. Previous observations made by the Baron had shown that the temperature of the body of the Echidna was at least 5° Fahr. higher than that of the other Monotreme.—Mr. W. H. Caldwell, B.A., exhibited several specimens which he had recently obtained in Queensland, showing the stages in the development of the Monotremes from the laying of the egg to the hatching.—Mr. J. Mitchell, of Bowning, exhibited a large number of Silurian fossils collected by him in the neighbourhood of Bowning. They consisted of a variety of mollusks, corals, and about sixteen species of trilobites. Among the trilobites are *Phacops caudatus*, *P. longicaudatus*, *P. encrinurus punctatus*, and *P. Jamesii* (?), *Calymene* (*Lenaria ?*), *Harpes ungula*, *Staurocephalus Murchisonii*, *Bronteus*, and several of the genus *Acidapsis*, one of which attained a considerable size. The mollusks included representatives of *Pentamerus*, *Orthoceras*, *Avicula*, *Strophomena*, &c.

PARIS

Academy of Sciences, March 2.—M. Bouley, President, in the chair.—Note on "Les Origines de l'Alchimie," by the author, M. Berthelot. In this work the origin of alchemy, forerunner of the modern science of chemistry, is traced back by means of Greek manuscripts and Egyptian papyruses to the remotest historic times.—Researches on isomery in the aromatic series ; heat of neutralisation of the polyatomic phenols, by MM. Berthelot and Werner.—Observations of the small planets and of Wolff's comet made with the great meridian at the Paris Observatory during the last quarter of the year 1884, communicated by M. Mouchez.—On the periodicity of the solar spots, and the anomaly of their last maximum, by M. Faye. The periodicity is regarded as established, and the irregularity in the last maximum is referred to a possible quasi independence of the northern and southern solar hemispheres, in virtue of which the epochs of their respective greatest activity may not coincide exactly.—First explorations of the mission sent by the Academy to study the recent earthquakes in the south of Spain, by M. Fouqué. The mission, consisting of MM. Fouqué, Lévy, Bertrand, Barrois, Offret, Kilian, and Bergeron, arrived at Malaga on February 7, and from that point visited Periana, Zaffararia, Venta de Zaffararia, Alhama, Arenas del Rey, and Albuñuelas, which places suffered most during the disturbances.—On a characteristic reaction of the secondary alcohols, by M. G. Chancel.—Action of oxygenated water on the oxides of cerium and thorium, by M. Lecoq de Boisbaudran.—Correction of a previous communication (*Comptes Rendus*, February, 1879, p. 322) regarding the spectrum of Samarium, by M. Lecoq de Boisbaudran.— On the prevailing winds of North Persia, and on the south wind of the province of Ghilan, by M. J. D. Tholozan.—Report of the International Commission for the widening and deepening of the Suez Canal, presented by M. de Lesseps. — Election of M. Grand' Eury as Corresponding Member for the Section of Botany in place of the late M. Duval-Jouve.—Reply to some of the criticisms, formulated in connection with the note of January 5, on the reproduction of phylloxera and the employment of the sulphate of carbon for its destruction, by M. P. Boiteau.—On the spectrum and formation of the tail of Encke's comet, by M. Ch. Trépied.—On a theorem of M. Darboux in mathematical analysis, by M. E. Picard.—The poles of the gyroscope and rotating solids in connection with Coriolis's theorem, by M. Henry.—On the maxim phase in the diurnal variations of terrestrial magnetism in 1882, according to the results obtained at the Montsouris Observatory, by M. L. Descroix.—Claim of priority in respect of the process of annulation of the extra current employed by M. d'Arsonval to avoid the dangers of mechanical generators of electricity, by M. A. Doussin.—On the means of counteracting or diminishing the dangers of the extra current in dynamo-electric machines in case of rupture in the exterior circuit, by M. J. Raynaud.—On the limit of density and atomic value of the gases, and especially of oxygen and hydrogen, by M. E. H. Amagat.—Composition of the gaseous products of the combustion of iron pyrites, and influence of Glover's tower on the production of sulphuric acid, by M. Scheurer-Kestner.—On the separation of alumina and the sesquioxide of iron, by M. P. Vignon.—On some basic and ammoniac nitrates, by M. G. André.—On the composition of the glyoxal-bisulphate of ammonia ($C_4H_2O_4$, $2(AzH_4O, S_2O_4)$, $2HO$), by M. de Forcrand.—Action of the sulphate of cinchonamine on the circulation and secretions, by MM. G. Sée and Bochefontaine.—On the substitution of quinine for creosote and phenic acid in the treatment of typhoid fever, by M. G. Pécholier.—Measure of the pressure necessary to determine the rupture of blood-vessels, by MM. Gréhant and Quinquaud.—On some peculiarities relative to the connections of the cervical ganglia of the sympathic nerve and the distribution of their afferent and efferent branches in *Anas boschas*, by M. F. Rochas. — On the nature of the placental neo-formation, and on the unity maintained in the development of the placenta, by M. Laulanie.—Note on the fœtus and placenta of a gibbon, by M. J. Deniker. —On some points in the physiology of the muscular system of the invertebrates, by M. H. de Varigny.—On *Bos triceros*, Rochbr., and on preventive inoculation against epizootic peripneumonia as practised by the Moors and Fulahs of Senegambia, by Dr. A. T. de Rochebrune. This variety of domestic ox, peculiar to Senegambia, is characterised by a third horn growing from the nasal process and identical in its constitution and development to the two frontal horns. The variety, which is of unknown origin, is thoroughly established, and from time immemorial has been inoculated by the natives with the virus of epizootic peripneumonia, a disease prevalent in the country.—On the mosses of the Carboniferous epoch, by MM. B. Renault and R. Zeiller.—Origin of the iron, magnesia, and zinc ores in and at the foot of the Jurassic Limestone hills on the periphery of the central plateau in France, by M. Dieulafait.—On a remarkable deposit of running water in the mines of Carmaux, Tarn, by M. Stan. Meunier.—Destructive effects of a waterspout which recently passed over the Argentan district, Orne, by M. E. Vimont.—A new method of observing stars during their transit across the meridian, by M. Ch. V. Zenger.

BERLIN

Physiological Society, February 13.—Prof. Fritsch produced a few specimens of *Lophius piscatorius*, and drew special attention to the two rays situated above the wide gape, and ending in flap-like appendages, which in some had the shape of a fly, in others that of a worm, and were used by the fish as bait to attract its prey. The jaws and fins were likewise covered with flap-like appendages, excrescences of the skin, which rendered the animal, especially in mud, completely irrecognisable. The peculiar development of the skin of this fish induced the speaker to search for corresponding peculiarities in its nervous system—peculiarities which he soon discovered in its medulla oblongata. He found there, on the posterior side of the medulla, and quite superficially situated, a group of huge ganglion-cells, recognisable by means of a lens, such as had hitherto been found only in Malapterurus. While, however, this latter fish possessed but two such gigantic cells, Lophius had a larger number of them, and these offered for study a series of general problems on the structure of ganglion cells. The protoplasm of these colossal nerve-cells was not fibrous, but granular, the nucleus large and bladder-like. The nutriment was provided by a close capillary net which closed tightly around the protoplasm and sent loops into its recesses. The cells were multipolar, yet one process, which in every case was the peripherical, preponderated in size over all the others. From these cells there branched off gigantic nervous fibres consisting of powerful fibrous axis cylinders and sheaths. Such gigantic nerves were found partly also in the roots of the vagus and trigeminus, and probably spread to the peculiar cuticular appendages of Lophius. Altogether Prof. Fritsch believed he was justified in concluding from what he had observed in his investigations of the ganglion-cells of Lophius, that there were neither apolar nor unipolar ganglion-cells, but only bipolar and multipolar, and that the processes of the ganglion-cells might unite, so that frequently an axis-cylinder would be produced from two ganglia.—Dr. Uhthoff spoke in detail of the experiments carried out by him in the Physical Institute regarding the dependence of visual acuteness on light intensity. By way of supplement to the report on the subject given by Dr. König at a recent meeting of the Physical Society, be it here observed that differences among the eyes examined showed themselves specially under weak light intensities, and that the minimum of visual acuteness (1·1000th of the normal value) was, in particular cases, still observable under an illumination corresponding with the removal of the petroleum lamp to a distance of 360 m. The visual acuteness was further examined under a changing intensity with red and blue light. Red light, just as much as white, showed with increasing intensity a very rapid increase of visual force. The curve in the case of red light was, however, different from that in the case of white light. Under a blue light the visual sharpness very slowly declined with increasing light intensity. Dr. Uhthoff next described an apparatus he had constructed for the purpose of measuring the angle of the visual line with the line perpendicular to the cornea, without the use of the ophthalmometer. The principle of the apparatus was based on measuring the angular displacement of a plane paralleled glass plate, the glass plate standing perpendicular first to the normal and then to the (actual) visual line. Both the apparatus of Dr. Uhthoff and the microscopical preparations of the gigantic ganglion-cells and fibres of Lophius were shown to the Society in the demonstrating hall.

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