THURSDAY, MAY 30, 1872

BOTANY IN THE OXFORD NATURAL SCIENCE SCHOOL

THE merits and demerits of the "Notice by the Board of Studies for the Natural Science School of the University of Oxford" will by this time have been abundantly discussed among all circles of teachers of Natural Science. That the former preponderate over the latter will hardly admit of a question; and if we once more call attention to the defects of the present "Notice," it is only in order that, by full and free discussion, a thoroughly satisfactory scheme may be at length elaborated. We have already pointed out the subordinate part which Botany plays in the programme, and this defect it is our present object to illustrate more at length. We imagine that the object of the framers of the scheme must have been to lay down in the Preliminary Honour Examination a foundation which will serve to give a solid basis for any superstructure that may be raised upon it—in other words, to supply the student with an adequate mental training to prepare him for whatever special branch he may afterwards take up. Let us see how this works in the case of Botany. The Natural Sciences which will be most useful to the future botanist in enabling him to gain a comprehensive insight into his own subject, are the outlines of Animal Physiology, Geology, and Organic Chemistry. Of not one of these subjects need he necessarily possess any knowledge in order to pass the Preliminary Honour Examination; but, on the other hand, must read up Mechanics, Physics, and Inorganic Chemistry. It seems to us a mistake to make the physical side of Science of such preponderating weight in the preliminary examination, to the entire exclusion of the biological.

If we now turn to the Final Examination in Biology, we still find that although it is specially stated that under Biology are included both Zoology and Botany, yet that his own special subject is still kept entirely in the background. Among the "list of books recommended for use in the preparation for the General Examination in Biology" are a number in General Anatomy and Histology, Comparative Anatomy, Human Physiology, Comparative Physiology, and the General Philosophy of Biology, but not one in any department of Botany, with the exception that in a foot-note we are informed that under the term "General and Comparative Anatomy and Histology" "vegetable structures" are included. Otherwise the examination is exclusively one, not in Biology, but in Animal Physiology and the Comparative Anatomy of Animals. The works, indeed, on this subject to which the intending botanist is referred would require a very long course of study to master. The list is so extensive, and the range so great, that it must necessarily have the effect of deterring many an aspirant for distinction in the Natural Science School.

The arrangements under the special subject of Botany seem to us no less open to objection. The first impression conveyed is that the subject can only have been admitted at all under protest, and that it is looked upon as of decidedly subordinate importance to all the rest. While Mineralogy and Crystallography have three pages devoted to them, Geology five, and Zoology four, Botany is compressed into one, and the information and assistance given is of the most meagre. The books "provisionally recommended" are ten in number; but what is meant by a provisional recommendation we do not know. The Board must surely have made up its mind as to whether the works are to be recommended or not; and we venture to say that some even of these ten are books that ought not to have obtained the sanction of such a body. Not only does the list err on this side; but books which are familiar to every botanical teacher as the best elementary works are not to be found in it. It must be remembered that, as far at least as structural and systematic botany are concerned, the student is now at the outset of his career; and yet what will be thought of a list of books recommended to his notice which makes no mention of either Oliver's "Lessons" or Lindley's "School Botany"? In Geographical and Geological Botany, the recommendations comprise the portions bearing on these subjects of Henfrey's "Elementary Course" and Balfour's "Manual of Botany." Now, we think it is generally admitted that these are the least satisfactory portions of the works quoted; and we have no hesitation in saying that the student will gain from them no adequate knowledge of the present state of these sciences. Not a hint is given of the existence of original memoirs or essays, such as those of De Candolle, Grisebach, Heer, Unger, Hooker, and Carruthers. Again, in the other special subjects the excellent practice is adopted of referring students to monographs or treatises on special branches of the subject, which will not be the least instructive part of his reading. In the botanical list we find no reference even to works so familiar to every student as Mohl "On the Vegetable Cell," Hofmeister "On the Higher Cryptogamia," or the writings of Robert Brown. We venture to say that from the careful study of any one of these works, or even of such smaller treatises as Dr. Hooker's lecture on "Insular Floras," or the introductory essay to his "Flora of Tasmania," the student will gain a deeper insight into the philosophy of his science than from the greater number of the books in the recommended list.

But the greatest defect in the botanical section we take to be the very small stress that appears to be laid on practical work. In accordance with the prominence which is given throughout the whole scheme to histology, it is true that the candidate will be tried with "dissections and descriptions of preparations, illustrating the minute structure and organs of plants;" but he is not informed that his practical acquaintance with morphology and the principles of classification will be tested by requiring him—as is done at all the examinations at the University of London, constituting the most fruitful source of "pluck"—to describe and refer to their natural orders plants presented to him in the room. We the more lament this omission, because it will but have a tendency to confirm the low estimate in which the science of Botany is held even by many biologists, who look upon it as a mere science of terms, leading to no large and comprehensive principles, and susceptible of indefinite "cram." Until Botany is rescued from this degrading position, and teachers learn that it is as much a science of experiment and observation as Animal Physiology or Comparative Anatomy, we shall always have to lament the dearth of

philosophical botanists so remarkably exhibited in this country at the present time ; and to hear it spoken of even by biologists with a covert contempt.

We make these comments with no desire to detract from the great work which the Board of Studies for the Natural Science School at Oxford is doing, in attempting to elevate Natural Science to a prestige equal to that of the older studies at our national universities. In this endeavour we wish them heartily all success, and are fully sensible of their earnestness to effect this object. But in order to secure success, it is necessary that any mistakes in the early steps must be freely and candidly pointed out, and that the plan of the campaign must be made as faultless as possible. We know that there are those at Oxford who are fully sensible of the deficiencies in the programme to which we have called attention, and who have fought a losing battle for a more thorough and comprehensive, and at the same time more eclectic, plan. We would encourage those to persevere in their endeavours, believing that they must ultimately prevail, and that from this beginning a scheme of instruction in Natural Science will ultimately arise which will be a model for the whole kingdom.

MOUNTAINEERING IN THE SIERRA NEVADA

Mountaineering in the Sierra Nevada. By Clarence King. (London : Sampson Low, Marston, Low, and Searle, 1872.)

A VERY pleasant admixture of science and personal adventure, from the hand of one who is evidently a sincere lover of nature, and is gifted with considerable descriptive power. Men and manners in the Far West are depicted with much humour ; and one chapter, entitled Kaweah's Run, narrating the escape of the author from a couple of brigands who attempted to hunt him down, will show that a Government surveyor's work in America is apt to be more exciting than pleasant. It is a good while since we have read a book so thoroughly unaffected and fresh ; redolent of the clear air of those lofty Sierras where (hear it, ye Alpine climbers, who, in your haunts, daily curse Jupiter Pluvius !) fine weather is the rule. The description of some of Mr. King's scrambles is enough to make the Alpine Club rush off in a body to Mount Whitney ; but we cannot help suspecting that his neck would have more than once been safer had he known the rules of that fraternity and carried a good *piolet*.

Mr. King does not intend his book for a scientific treatise, but there are some valuable notes scattered up and down its pages, and with these we must chiefly concern ourselves. The first chapter gives a good sketch of the geology and physical geography of the Sierra Nevada district. It was submerged till Jurassic periods, the ocean shallowing much in the later Triassic time. Then were produced the long mountain waves which stretch from Mexico probably into Alaska, reaching as far east as Middle Wyoming, and forming one broad zone of crumpled ridges, whose westernmost and loftiest member is the Sierra Nevada. Rivers carved the land into cañons, and the sea gnawed its western shores during all the Cretaceous and much of the Tertiary period, in the later part of which the coast ranges were rolled up, facing the Sierra Nevada, and converting the California valley into a great inlet of the sea. Then, from newer and older ranges alike, began an epoch of furious volcanic activity, till at last the fires burnt low and the greater number went out altogether. To this succeeded a period when, as in North-Western Europe, great glaciers flowed down the valleys, polishing the rocks and leaving behind them a huge trail of moraine. Now they have shrunk back into snow-fields ; and it is only here and there, as about Mount Shasta, that we find any mention of true glaciers in Mr. King's book.

The magnificent cañons, which have more than once been mentioned in the pages of NATURE, are frequently and vividly described. This is the author's opinion of their origin : "Although much is due to this cause (the cutting power of rapid streams) the most impressive passages in the Sierra valleys are actual ruptures of the rock, either the engulfment of masses of great size, as Professor Whitney supposes in explanation of the peculiar form of the Yosemite, or a splitting asunder in yawning cracks. From the summits down half the distance to the plains the cañons are also carved out in broad round curves by glacial action." It may seem presumptuous in one who has never seen the region to differ from Mr. King and his chief, at the same time we cannot help suspecting that here, as in the Alps, it will be shown ultimately that streams have been the principal agents in forming gorges, and that, though they may have been guided by rifts and certainly by joints, no traces of the original fissures can now be found.

Among the scientific "plums" of light description scattered throughout the pudding, we may notice the following :—The granite of some of the mountains of the Yosemite valley exhibits spheroidal structure on a colossal scale, "concentric layers like the peels of an onion each one about two to three feet thick." This structure never descends into the mass for more than a hundred feet. The author notices a peculiar flaky structure on the surface of ice-worn granite (p. 147) developed, as he believes, by the great pressure which it has undergone. A curious case of granite polished by sand friction is also recorded on p. 146, reminding us of the polished basalt on the shore of Fife. Earth pillars in the cañon of the McCloud glacier (Mount Shasta) are described, "from one to seven hundred feet high, each capped with some hard lava boulder which had protected the soft (trachyte) *débris* beneath from weakening." A curious cavern in a lava floor in the same region—roughly tubular in shape and more than half a mile long—doubtless produced, like those in Iceland, by the outburst and escape of the still liquid interior of the hardening stream, is worth notice ; as well as the fresh-water deposits of a lake which existed through the Cretaceous and Tertiary periods between the Rocky Mountains and the Blue Mountains of Oregon. Nor must we in conclusion forget the humorous tale of how the author, after being sternly rebuked by the palæontologist of the survey for loving snow-peaks better than fossils, repented and found a cephalopod in the auriferous slates of Mount Bullion, and so determined their age. We note but one desideratum, and that is a map, which we trust will be supplied should the book reach, as we hope it will, another edition.

T. G. BONNEY

HINRICHS' CHEMISTRY

The Elements of Chemistry and Mineralogy, by Gustavus Hinrichs, A.M. (Griggs, Watson, and Day, Davenport, Iowa, U.S.)

THIS is the second volume of Prof. Hinrichs' series of science instruction for schools. In the former volume the elements of Physics were given ; this volume contains the elements of Heat, Chemistry, and Mineralogy, and will be followed by a third, called the "Students' Cosmos." The author has thrown himself entirely into the practical method of teaching the physical sciences—the student has first to perform an experiment, and then draw his own deductions from it. In chemistry, perhaps, more than in the other sciences, this system leads to the best results ; for on all sides laboratory practice is recognised as essential to its true understanding. If, however, large laboratories and costly apparatus are required, its introduction in our schools cannot become universal. The author has, however, shown in this volume that by excluding special branches, a considerable knowledge of the elementary methods of laboratory practice may be furnished, almost free of charge, by any school to all its pupils. At a time when science instruction in our schools is attracting so much attention, a series of volumes like the present is peculiarly valuable, and thanks are due to Prof. Hinrichs for his bold effort to show how the physical sciences should be taught.

The subject "Heat" occupies two chapters. The first deals with the sources of heat, modes of heating, radiation and induction, thermometry, calorimetry, and fusing and boiling ; the second treats of the relation of heat to mechanical work. These are extremely clear and practical ; we think better than those which follow. The third chapter is on "Dissociation and Electrolysis." After a few examples of the splitting up of compounds into their elements have been studied, the student is led naturally to the definitions of elementary bodies, of compounds, and mixtures. The next chapter is confined to the elements and compounds, and some of the principles of chemical nomenclature ; to this chapter we must certainly take exception, the author has introduced a novel and arbitrary classification of the elements, which, we think, will tend to confuse the student. He groups the elements into nine genera, giving the characteristic properties of each : thus we have the kaloids, analogous to potassium ; calcoids, analogous to calcium ; cuproids to copper, and so on ; under the last head we find classed, copper, silver, gold. We cannot see any reasons for such grouping, for neither in their chemical nor in their physical properties do these three elements correspond.

The author divides chemical substances into monaries, binaries, ternaries, and serials ; the monaries are the elements themselves, the binaries the compounds of two elements, the ternaries of three, whilst the serials comprise organic bodies ; there is, however, no reason in the author's definitions why the greater number of the serials should not be classed under the ternaries. The term "serials" the author has taken from the fact that numerous organic compounds can be classed together to form series of substances, differing from each other by a definite increment. The next chapter treats of the synthesis of acids and bases, and chapter 6 is devoted to chemical processes. Under the head of "substitution," the quantitative relations of the elements to each other are brought out. We do not think, however, that the difference between the terms "atomic weight" and "equivalent" is by any means sufficiently defined. A considerable space is devoted to the phenomena of double decomposition and to the complex processes, such as fermentation, &c., which concludes the chemical portion of the work. A chapter on mineralogy follows, but on this it will be difficult to give an opinion, as the method the author uses is novel, but, according to his account, quite satisfactory. The book on the whole is most carefully written, so that the student cannot fail in his experiments provided he follows his instructions ; these also are so given as to lead to economical and precise methods of working. At the end of the book a number of blank pages are left for the pupil to fill up with his notes of experiments performed, and results obtained, forming quite a new feature in this class of works. The chapter on the "Chemical School Laboratory" we should recommend to the notice of our teachers, as it gives a description of the author's system of teaching, which, we believe, has succeeded extremely satisfactorily in the case of physics, and, we trust, will be equally successful in chemistry.

OUR BOOK SHELF

The Figure of the Earth. By Archdeacon Pratt. (4th Edition. London : Macmillan and Co.)

THIS is the fourth edition of a well-known book, of which we shall unfortunately not now have any more new editions from the hand of its lamented author. The book has grown much since its first edition as a separate work in 1860. The chapter on the attraction of table lands, mountains, oceans, &c., has been much enlarged since the first edition, and also the chapter on the determination of the figure of the earth by geodetic operations. A chapter, most valuable to the student of physical mathematics, is inserted on the determination of the ellipticity of the earth (considered as a body whose surface is one of its own equipotential surfaces) from pendulum experiments, the moon's motion, and the precession of the equinoxes, respectively. The student of this subject must carefully bear in mind that no observations taken exterior to the surface of the earth can throw any light whatsoever on the internal arrangement of its matter, inasmuch as, according to the well-known theorems of Gauss, there are an infinite number of ways in which that matter might be conceived as being arranged so as to produce the same external effect. The observations above noticed, however, are calculated to throw light on the question as to whether the surface may, within the limits of approximation, be considered as a surface of equilibrium.

In fact, it is known that in any event the external effect of the earth may be precisely effected by the distribution in a concentrated form of the whole matter of its interior over its surface.

The important proposition that any function, which does not become infinite within the limits considered, can be expanded in a series of Laplace's functions, is proved by Mr. Pratt in the text by rather a long method, in order to get over a certain apparent objection as to discontinuity. The following proof of that proposition seems short, and not open to objection.

Let A and B be two points on a sphere of centre O. Let the co-ordinates of any point R referred to A be p and q, where p is the cosine of the angle between OR and OA,

and q the angle between the plane $A\,O\,R$ and a fixed plane. Let μ, ω, be similar co-ordinates of R referred to B, and let μ', ω', be the values which μ and ω assume at the point A. Let $F(\mu'\,\omega')$ be a function of μ' and ω', which, when μ' and ω' become μ and ω, may be written $F(\mu, \omega)$. If δS be an element of the surface of the sphere, whose radius we shall take as unity, then δS may be expressed by $-\delta p \,.\, \delta q$, or by $-\delta\mu \,.\, \delta\omega$, according as occasion requires.

It is obvious from spherical trigonometry that

$$p = \mu\mu' + \sqrt{1-\mu^2}\,\sqrt{1-\mu'^2}\,\cos(\omega-\omega')$$

and that therefore in the expansion

$$\frac{1}{(1+x^2-2xp)^{\frac{1}{2}}} = 1 + P_1 x + P_2 x^2 + \ldots$$

The quantities P_1, P_2 &c, satisfy Laplace's equations in μ and ω, and also in μ' and ω'.

Differentiating this equality, multiplying by $2x$, and adding, we get

$$\frac{1-x^2}{(1+x^2-2xp)^{\frac{3}{2}}} = 1 + 3P_1 x + 5P_2 x^2 + \ldots + (2n+1)P_n x^n + \ldots$$

Integrating each side of this equation over the whole surface of the sphere, and equating the results, we have

$$\int_0^{2\pi}\int_{-1}^{+1} \frac{1-x^2}{(1+x^2-2xp)^{\frac{3}{2}}}\,dp\,dq = \int_0^{2\pi}\int_{-1}^{+1} (1 + 3P_1 x + 5P_2 x^2 + \ldots)\,d\mu\,d\omega$$

The first of these two integrals is readily found to be equal to 4π, being thus independent of x.

$$\therefore \int_0^{2\pi}\int_{-1}^{+1} (1 + 3P_1 x + 5P_2 x^2 + \ldots)\,d\mu\,d\omega = 4\pi$$

Now as x approaches unity, every term in the series whose limit is represented by the integral

$$\int_0^{2\pi}\int_{-1}^{+1} \frac{1-x^2}{(1+x^2-2xp)^{\frac{3}{2}}}\,dp\,dq$$

becomes more nearly equal to zero, except the terms in the immediate vicinity of the value $p = 1$, which increase in value, *i.e.* in the neighbourhood of the point A. Hence, as we diminish x, the ratio of

$$\int_0^{2\pi}\int_{-1}^{+1} F(\mu\,\omega)\left\{1 + 3P_1 + 5P_2 x^2 + \ldots\right\}d\mu\,d\omega \text{ to}$$

$$F(\mu'\,\omega')\int_0^{2\pi}\int_{-1}^{+1}\left\{1 + 3P_1 x + 5P_2 x^2 + \ldots\right\}d\mu\,d\omega$$

that is to $4\pi \,.\, F(\mu'\,\omega')$ becomes continually more nearly a ratio of equality, since $F(\mu'\,\omega')$ is the value towards which $F(\mu\,\omega)$ continually approximates as we draw nearer to the point A. Hence we have in the limit

$$4\pi.F(\mu'\,\omega') = \int_0^{2\pi}\int_{-1}^{+1} F(\mu\,\omega)\,(1 + P_1 + 5P_2 + \ldots)\,d\mu\,d\omega$$

and since P_n satisfies Laplace's equation of the nth order in $\mu'\,\omega'$

$$\therefore \int_0^{2\pi}\int_{-1}^{+1} F(\mu\,\omega)\,P_n\,d\mu\,d\omega$$

also satisfies it, because $\mu'\,\omega'$ are constants so far as this integration is concerned. Hence $F(\mu'\,\omega')$ is expanded in a series of functions satisfying Laplace's equations.

JAMES STUART

LETTERS TO THE EDITOR

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

The Volcanoes of Central France

THE eruptions of A.D. 458-460, whose showers of pumice or ashes reached and alarmed the city of Vienne, then the capit a of the chief State in Gaul, and led to the institution of the Rogations (now called Litany) and the "Rogation Days," cannot have proceeded from the province of Auvergne, as Mr. Green supposes (NATURE, May 16). That province, containing about half the French volcanoes, is the most distant of the three volcanic ones from Vienne, and moreover is held to have been quiescent in that age (as well as ever since); because the eminent writer, Sidonius Apollinaris, who had settled there, and wrote a poem on its scenery, betrays no knowledge of its volcanic phenomena. So, at least, Sir Charles Lyell has repeatedly insisted. It is true that, writing before the date of the Vienne calamities, his silence proves nothing; but as fully half the French craters are not in the Auvergne, but between that province and Vienne, namely, in either the Velay or Vivarais, within about fifty miles of that city, and ranged along almost a quadrant (the S.W. quadrant) of its horizon, there can be little doubt that some of them were the scene of the "portentous fires," and sources of the "Sodomitic showers" that alarmed the Burgundian capital, and led St. Mamertus to institute these fasts. Of Mamertus himself there remain no writings, and the memory of any historic eruptions in France appears to have died out from that very century to the present; though none in all history were better attested, none within many centuries of Pliny's even so well. For it is strange that no later chroniclers mention anything but the earthquakes and some fires of buildings; the sole authorities for the eruptions being their contemporaries, the above Sidonius and the bishop who succeeded Mamertus in his see, and these two being the sole men in Gaul of that generation whereof any document remains. The former writes to Mamertus himself a very fulsome, adulatory, but necessarily a materially true memoir of the facts; and the latter allusively recounts them in a sermon to the very flock among whom the observances had begun. It seems impossible to conceive better witnesses to any event whatever, and they are literally all the contemporary writers extant.

The late Sir Francis Palgrave appears the first modern to have disinterred this page of forgotten history, in the *Quarterly Review* of October 1844. See also a most extraordinary paper on it in the *Gentleman's Magazine* of May 1865, commented on by me in the *Reader* of the next month (p. 683). As the original passages, however, of Sidonius and Bishop Avitus have not been reproduced, I enclose literal translations of them, if you think they would interest your readers. The style of their time must be allowed to be detestable, but not quite without parallels.

E. L. GARBETT

"Sidonius to Lord Patriarch Mamertus, health! It is reported the Goths have advanced their camps on to Roman soil! To this kind of eruption we wretched Auvergnats are always the gate. For we afford to the enemies' malice peculiar satisfaction; because, as they have not yet marked their bounds from Ocean to Rhone by the course of the Loire, they (under Christ's mercy) find their sole hindrance from our opposition only. Indeed, the tracts and regions of the surrounding country the eager assault of their threatening power would long ago have devoured. But in this, our so bold and dangerous a resolution, we trust not in our hearts either to the crumbling face of ramparts, the rotten barrier care (*studium*), or the failing defence of sentinels for assistance, but are only soothed by the comfort of the Rogations introduced, of which you were the author; which, being to be founded and instituted, the Auvergne people has begun to practise, if not with equal result, certainly with not inferior zeal, and on this account does not turn its back to the surrounding terrors. For it does not escape our research (*latet nostram sciscitationem*) how, in the first times of these supplications being instituted, by the terrors of what manner of prodigies the city divinely committed to you was being emptied. For at one time the walls of the public fortifications were shaken down by the continual earthquakes; at another the fires, often attended with flame, were smothering (*tumulabant*) the frail roofs with a load of showered ashes (*superjecto favillarum monte*). Now the vast lairs (*stupenda cubitia*) in the forum harboured the boldness (O portentous tameness!) (*pavenda mansuetudo!*) of deer. When you, amid that flight of the nobles and the common people, the state of the city being desperate, quickly had recourse to new imitations of the ancient Ninevites, lest your despair, too, should mock the divine admonition. And truly at that time you could the least distrust God without sin, after your experience of his mercies. For once, when a certain city had begun to blaze, your faith had glowed more than the fire," &c. (He proceeds to relate the extinction of a former conflagration by the prayers of Mamertus; but this

and the remainder of the letter, though translated by Colenso to throw ridicule on the people's religion, has evidently no bearing on the calamities and portents of A.D. 458-60, but refers to an earlier event.)—*Epistles of Sidonius Apollinaris.* Book vii. Ep. 1. (From Migne's *Patrologia*, tom. 57, p. 563.)

"There pervades, indeed, the vital way (or faith) not through the lands of Gaul only, but almost the whole world, the fertilising stream of these Rogation Day observances, and cleanses the earth infected with vices by the wholesome flux of an annual expiation. More special reason, however, have we in this same institution for service and rejoicing, because from hence in a manner it flowed for the benefit of all. From our source at the first it spread; and perhaps even (we may say) it pertains to some dignity or privilege, the first beginning of such an institution. At any rate, when an ineffable distress (*necessitas*) tamed down the proud hearts of our Viennese to this manner of humiliation, our Church, perceiving the cause of her chastisement (*ægritudinis*), caught to herself not as chiefly before all others, but as alone among all, feeling the need there was for the present observance to be instituted, far more eagerly a remedy than a primacy (or precedence). And, indeed, the causes of the terrors of that time, I know that many of us recollect well (*recolere*). For truly the repeated fires, the frequent earthquakes, the mighty noises, threatened to add to such a cremation (*cuidam funeri*) of a whole world some equally prodigious entombment (*bustuale*). For in the populous haunts of men the tame appearance of the beasts of the forests was observed; God knows whether deluding our eyes or driven there by the portents. But whichever of these two it might be, it was perceived to be alike monstrous, whether thus in reality the wild natures of the beasts were tamed, or whether so frightfully in the views of the spectators phantoms of false visions could be formed. Amid these things various were the notions of the populace, and divers the opinions of different classes. Some, concealing what they felt, ascribed to chance what they would not allow to (be matter of) weeping. Others, of healthier mind, discovered truly the new iniquities (*abominabilia*) aptly agreeing to the natures and significance of the ills. For who, in the oft-seen fires, would not dread Sodomitic showers? Who, in the shaking elements, would not believe either falls of roofs (*culminum*) or openings of the earth to be at hand? Who, when seeing, or certainly thinking he saw, the naturally timid deer advancing through the straits of doorways, even to the sides (colonnades) of the forum (*ad fori latera*), would not presage an impending doom of desolation?" (He then recurs, like Sidonius, to the story of the earlier conflagration of a palace or town hall, arrested by Mamertus, which leads to the confusion of these two calamities by all later chroniclers, and loss of memory of the eruptions, and showers of favillæ.)—*Homily of Avitus concerning Rogations.* "*How the Custom of the Rogations arose.*" (*Migne Patrologia, tom.* 59. *p.* 289.)

SOME years ago my attention was especially directed to the date of the latest eruptions in Auvergne, as usually supposed to be indicated by the appointment of the Rogation Days, A.D. 469, by Mamertus (rather than Mamercus), Bishop of Vienne. A reference to original authorities convinced me that there is no satisfactory evidence of anything beyond long-continued earthquakes of such severity as to drive the wealthier part of the population out of the city, and, as it would seem, the wild beasts into it. Much is said about fire, but the rhetorical and inflated expressions of those living nearest to the event may be applied to either volcanic or domestic conflagration; and there is great reason to believe that the latter only was intended, in the apparent absence of volcanic foci in the neighbourhood. These, according to Scrope's map, all lie at a considerable distance (if I recollect aright, twenty or thirty miles); and though it is of course possible that the site of some nearer outburst may have been hitherto unnoticed, the expressions used hardly warrant the trouble of any laborious search for it. Should any of the residents in the neighbourhood of Vienne be conversant with geology, they would be able to furnish decisive evidence on the subject. The original story is a curious one, but it has not lost in the telling.

Hardwick Vicarage, May 25 T. W. WEBB

The Approaching Transit of Venus

IN NATURE of the 4th of January last Mr. J. Carpenter gives an interesting sketch of the arrangements in progress for observing the forthcoming Transit of Venus. He states that French and German astronomers have decided on establishing a station of observation at Muscat (Mascate) or at some place between that nasty little port and Teheran. Now, as a point along this line is considered so favourable by Continental astsonomers, will you allow me through your pages to call Mr. Airy's attention to the peculiar advantages of Jask in this respect. Cape Jask, on the Mekran Coast, is situated, roughly, in lat. 25½ N. and long. 57½ E. We have here a large and intelligent English telegraph staff, and work a double line of telegraphs to Europe. We have three large stone-built bungalows (houses) with strong, flat, cement-covered roofs, which are approached by spacious staircases. The large bungalow, forming the clerks' quarters, is about 250 feet long, 20 high, and 40 broad. It is divided in the centre by a sort of tower, in which are situated the stairs leading to the roof. The latter would be a most convenient place for erecting the astronomical instruments, &c. There is no telegraphic communication with Muscat, and it is about two days' sail, with a fair wind, from Jask, which is the nearest telegraph station. Should the Astronomer Royal decide on sending out a couple of observers here, I promise them a hospitable reception and every assistance. The fortnightly mail steamers between Bombay and Bussorah, pass within fifteen or twenty miles of this place, and could be easily induced by Government to call in and land the party.

Mr. Latimer Clark, who visited this station towards the end of 1869, will, I daresay, if called upon, be able to give some further particulars, and can vouch for the accuracy of my statements.

J. J. FAHIE

Persian Gulf Telegraph Dept., Jask Station

Recent Climatic Changes

MR. HOWORTH'S letter on "Recent Climatic Changes" in NATURE of the 9th May, is most instructive and interesting, more especially to those who have visited the Arctic Sea; but on one point I must venture to differ from him, that is, when he expresses his belief that the Esquimaux migrated from the northward in consequence of the increasing rigour of the climate in high northern latitudes.

I have seen the Esquimaux at the mouths of the MacKenzie and Coppermine Rivers and at Repulse Bay in longitudes 135°, 115°, and 87° West, respectively. At all these places I found their traditionary belief to be, that they came originally from the west, across a narrow sea (probably Behring Strait), followed the coast line eastward, then southward along the west side of Hudson's Bay; some of them making their way to the east coast of that great bay and to Labrador by crossing the comparatively narrow channels separating these places from Southampton, Mansfield, and other islands, at the entrance of Hudson's Bay.

As Victoria and Wollaston lands, and other places still farther north, were probably at that time (as some of them are at present) well stocked with game, part of these people in their eastward drifting would naturally turn to the northeastward, until they reached North Lincoln and Ellesmere lands in lat. 77° or 78° North, from which they probably crossed Smith Sound to Greenland, along the west shore of which they would then have gradually spread southward.

Thus the Skrellings who destroyed the Norse colonists of South Greenland, came, as Mr. Howorth says, from the north. Indeed, they could not have come from any other direction, except by making a long sea voyage, for which their frail craft (if they had any canoes at that time) were by no means well fitted.

That the "Saga" writers knew that Esquimaux were to be found in Labrador before they were seen in Greenland, goes far, I think, to support the view I have expressed; because, if coming from the west, they could much more easily and speedily reach Labrador than the southern parts of Greenland; whereas had they come originally from the north, the facilities for arriving at these places would have been reversed.

I have been told by one of the greatest authorities, perhaps the very highest, on such subjects, that it is not likely that the Esquimaux originally came from Asia, as the form of their heads differs most materially from that of the heads of those Asiatics whom in other respects they most resemble.

This seems almost an unanswerable fact or argument against the correctness of the tradition of the Esquimaux, and the theory I have advanced, which very likely may have no novelty in it.

In opposition to this very strong fact, may I suggest the possi-

bility that the change in the mode of life of the Esquimaux in their new country (to which they were probably forcibly driven), and a change in the manner of carrying the child in infancy, may have caused a material alteration in the form of the head, whilst other peculiarities of face and form remained nearly the same.

The Esquimaux infant is carried in the hood of the mother's coat, and its head is perfectly free, with no pressure on one part more than another.

The peculiar form of head of the Red Indian of America may in a greater or less degree be caused by the kind of cradle used. The baby is fastened in its cradle in such a manner that the whole weight of the little creature's head rests almost constantly on the back part or occiput: the effect would be to reduce the longitudinal and increase the lateral diameter of the skull.

Of course I do not allude to the intentional and artificial alteration of the form of the skull, as practised among the Chenooks.

The discovery of many reindeer and muskcattle by the Swedish (? German) expedition on the East Coast of Greenland, as mentioned by Mr. Howorth, where previously none had been seen, may be accounted for by these animals—after having been much hunted and harassed by the natives near Smith's Sound and Melville Bay, on the north-west extremity of Greenland—migrating to the east shore, where, finding food and rest, they remained unmolested to increase and multiply, which they do very rapidly under such conditions.

Deer, muskcattle, and hares were found in great numbers, and very tame and in good condition on the Parry Islands, in latitude 76°, and on Banks Land in latitude 74° N., by several of the recent Arctic expeditions, and these do not appear to have migrated southward in the autumn. I have no doubt that were those localities visited by a band of hunters, these animals would after a few years become shy and timid, and finally move off to a more safe position, either north or south, as their own instinct or the trending or nature of the country might lead them. This I have known to occur frequently in America farther to the south.

These sudden and unforeseen migrations (being an exception to the usually very regular habits of the animals) are among the chief causes of the suffering and deaths by starvation among the Esquimaux.

Although what I have written above has been the result of my own observation, it may have been spoken or written by some one else before, much better than I can pretend to do. If so this communication will find its way, as it deserves, to the waste-basket.

JOHN RAE

A Scientific "Bone-Setter"

THE interesting article on "Bone-Setting" in NATURE for May 9 induces me to narrate my own experience. More than twenty years ago, in the city of New York, while swinging upon parallel bars in the gymnasium, I fell backwards, and to save my head threw out my left arm, thus catching the fall upon the palmer end of the radius, and, as it proved, fracturing the neck of the radius at the point of articulation with the ulna. I sent for one of the most eminent surgeons, then Professor and surgeon to a large hospital, but several hours elapsed before his arrival; and by that time the swelling and inflammation at the elbow had all the appearance of a sprain, and the fracture was not detected. Some days afterwards the surgeon discovered that there had been a fracture, and that a false adhesion had begun. This was broken up, and the arm set in splints, according to the approved method. After the usual time the bandages were removed, but the fore-arm was incapable of flexion, extension, or rotation. Every appliance was used to restore it to its normal condition, such as lifting, friction, sponging, &c., but without effect. The arm became useless, and began to shrivel. It was examined by the first surgeons of New York and other cities. Some thought that the radius had adhered to the ulna, others that there was a deposit of interosseous matter, but none could suggest a remedy.

Nine months after the accident I chanced to be in Philadelphia, and called upon Dr. Rhea Barton, who, though he had retired from practice, consented to look into my case. After careful examination, he said, "If you will consent to suffer the pain (it was before the use of chloroform) I will agree to restore the arm." He went on to say that pressure demonstrated a slight crepitation at the joint, and also a slight elasticity; and this assured him that the trouble was in the ligaments; that in consequence of the long imprisonment of the arm in splints, while under inflammation, a ligamentous adhesion had taken place, and the synovial fluid had been absorbed. He then applied one hand firmly to the elbow and the other to the palmer extremity of the radius, and, diverting my attention by anecdote and wit, thus relaxing the resistance of the will to pain, he gave a sudden wrench, there was a sound like the ripping of cotton cloth, and the arm lay outstretched before me, quivering with pain, but capable of motion. Mechanical appliances for a few weeks so far completed the restoration that I have ever since had about four-fifths of its normal use and power.

Now, Dr. Barton did, upon scientific knowledge, what the "bone-setter" does empirically—"by manipulation, suddenly and forcibly tearing asunder the adhesions" formed between the ligaments and the bone; and he assured me that the whole difficulty would have been averted had the arm, when under treatment for fracture, been gently moved at times according to nature. I think he has published a monograph upon this point, but I cannot now refer to it.

JOSEPH P. THOMPSON

Berlin, May 22

Pathological Legends

MR. TYLOR speaks of vampires as illustrations of Savage Animism, and regards them as inventions to explain wasting disease. The records of such unseen agents point to two classes of vampires, one of which has nothing to do with wasting disease. To take two extreme cases: the story of Grettir's conflict with Glam the house churl, contrasts with the Vampire Cat of Nabeshimes, as told by Mitford in the "Tales of Old Japan." The Northern hero seeks the evil one and overpowers him, but his success is dearly bought, for evil temper and nervousness never leave him, and his after life is unlucky from these two causes. The Japanese Prince is visited nightly by the counterfeit of his lovely concubine, he pines away, and is only saved by the energy of a retainer, who slays the fair persecutor. Here are types of two kinds of malady; one is truly wasting, the other is of that kind which ends in apoplexy, epilepsy, acute mania, or if death is not speedy and sudden, dyspepsia may reduce the hero to Grettir's state without obviously impairing his strength. The Japanese story gives the common superstition among polygamous people with whom progressive exhaustion is not uncommon, as "Hawke's Voyages" quaintly explain. The Grettir Saga gives a pagan version of what figures more than once in Christian legends as saintly intervention. Thus, the Scandinavian invader blasphemes the English saint, who straightway appears to him, and points the finger; the blasphemer drops down dead. Glam, the churl, gorges himself with food, and goes to the hill, the next morning he is found crushed and distorted, and the horror of his punishment is proportioned to his crime, for he ate meat on a Church fast, and it was doubtless sweet to his neighbours to recall the fact that they heard his shrieks when sitting in church. Glam's successors perish violently, one of them being found convulsed and broken on Glam's cairn, just as in more places than one in Scotland men have been found in convulsions near places which superstition had made terrible on account of some great crime. But Grettir, for twenty years after his fight with Glam, leads a life of incessant fighting as an outlaw. He cannot go alone, his nerve is shaken, he sees things in the dark, and his temper is irritable. It is of course impossible to separate out the various forms of unseeen agency to which men in rude times were subject. But the Vampires of the North and Incubi are members of the same family; the Vampires of Asia belong to another family. The former represent indigestion, the results of gross overeating and drinking, aggravated, doubtless, by the circumstances that the opportunities of excess were not frequent, and that semi-starvations occurred often between copious meals. The demons are mostly men; in all cases they give rise to violent conflicts, in which, if a man dies, his distorted convulsed body suggests the presence of a corporeal enemy, a reasonable enough notion among those to whom natural death meant, in the case of a strong man, death by the sword. The latter represents the results of lechery in some form or other; there is no tale of conflict, though now and then sudden death is accompanied by convulsions such as, we know, frequently terminate cases of general paralysis and *Tabes dorsalis*. The correspondence between the Northern Berserker and the furious Malay who runs amuck, is interesting in reference to this contrast. The insanity of the Berserker is that of an individual; the persecution of the Northern vampire falls on the whole family of the sufferer; and, while it is difficult under ordinary circumstances for any large number of people to become simultaneously affected by genuine

fury (though Mr. Wallace furnishes a possible analogy to ancient custom in what we may call a sociable Amok), the contagion of fear makes it easily intelligible how even a district might come to see and hear what had no existence save in the disturbed imagination of one. The Incubi and Suscubi of the Middle Ages in Europe may be paralleled at the present day in asylums, and, now as then, are met with among those who have placed themselves in conditions similar to the unhealthy ones of the Convent.

In reading over the confessions of the witches in England and Scotland, it is strange to find how exactly the language employed expresses the frequently described sensations of women labouring under uterine and ovarian disease. Doubtless, not all thus suffered; but the confusion once made and heard would be repeated by the unhappy imbeciles from whom chiefly the witch ranks were recruited.

JOHN YOUNG

Glasgow University

The Vervain and Yellow Fever

ALLOW me to say a few words on the report of the English Vice-Consul at Ciudad, Bolivar, concerning the efficacy of the Vervain plant as a remedy for yellow fever and black vomit (NATURE, March 21, p. 412). The plant in question is *Stachytarpha jamaicensis*, Vahl, a very common and rather troublesome weed, called in Spanish America "Verbena," in the British West Indies "Vervain," and in the Brazils "Gervaô." Its medicinal properties have been greatly exaggerated, though it is certainly somewhat aromatic and astringent; but in yellow fever and black vomit its efficacy is next to nothing. For a good description of the plant and some notes on its supposed and real virtues, I refer to Auguste de St. Hilaire, "Plantes usuelles du Brésil," plate 39 (Paris, 1824). Another tolerably good figure is given by Sloane, "The Natural History of Jamaica," plate 107, 1, who mentions several diseases against which it was used in his times (and probably still), stating finally, that "it is good against charms."

A. ERNST

Caracas, Venezuela, May 6

ELECTRIC VALENTINE

TELEGRAPH CLERK ♂ TO TELEGRAPH CLERK ♀

"THE tendrils of my soul are twined
With thine, though many a mile apart;
And thine in close-coiled circuits wind
Around the magnet of my heart.

"Constant as Daniell, strong as Grove;
Seething through all its depths, like Smee;
My heart pours forth its tide of love,
And all its circuits close in thee.

"O tell me, when along the line
From my full heart the message flows,
What currents are induced in thine?
One click from thee will end my woes."

Through many an Ohm the Weber flew,
And clicked this answer back to me—
"*I am thy Farad, staunch and true,*
Charged to a Volt with love for thee."

$$\frac{dp}{dt}$$

[NOTE BY THE EDITOR—

Ohm = Standard of resistance.
Weber = Electric current.
Volt = Electromotive force.
Farad = Capacity (of a condenser).

$$\text{Velocity of Puck, } \frac{\text{Once round the Earth}}{\text{40 minutes.}}$$

$$\text{,, of Ohm, } \frac{\text{Quadrant of meridian of Paris}}{\text{1 second.}}$$

∴ 1 Ohm = 600 Pucks.]

NATURAL SCIENCE AT OXFORD

IT has been resolved in Convocation that the Curators of the University Chest be authorised to pay to the credit of the Museum Delegates the sum of 1,000*l.*, to be employed at their discretion for the maintenance and improvement of the Collections in the Museum; a full statement of the expenditure for these purposes being prepared annually and reported to Convocation.

MAGDALEN COLLEGE.—*Demyships and Exhibition.*—There will be an election at this College in October next to not less than Six Demyships and One Exhibition. Of the Demyships, one at least will be Mathematical, one at least in Natural Science, and the rest Classical. The Exhibition will be in Mathematics, is of the value of 75*l.* per annum, inclusive of all allowances, and is tenable for five years.

EXETER COLLEGE.—There will be an Election to a Natural Science Fellowship in this College on Wednesday, June 10. The Examination will be in Biology. The Fellow elected will be required to reside and take part in the instruction of the College. The election will take place under the conditions of the following special ordinance of the College:—"Any Fellow who shall be elected previous to June 1874, with the declared purpose of taking part as Tutor or Lecturer in the College, shall *ipso facto* vacate his Fellowship on ceasing to reside. Provided also that if the said Fellow shall have taken part as Tutor or Lecturer in the College for seven academic years, consecutively or not, or for part of the time in one office and part in the other, he shall retain his Fellowship, subject only to the other causes of avoidance of Fellowship. Any fellow so elected shall hold himself bound, on pain of the loss of his Fellowship, to take part, if required, as Tutor or Lecturer in the College. If any such Fellow be incapacitated through ill health for educational work in the College, it shall be competent for two-thirds of the Governing Body, with the sanction of the Visitor, to dispense with the required residence during the continuance of such ill health." The Fellow elected under the ordinance will be subject in all other respects to the Statutes of the College. The Examination will begin on Tuesday, June 11, and no person can be admitted as a Candidate who has not passed all the Examinations necessary for the degree of Bachelor of Arts in the University of Oxford, or been incorporated as a graduate in the University.

SECOND PUBLIC EXAMINATION.—*Pass School.*—In pursuance of the statute, the Board of Studies for directing the Examination of Candidates who do not seek Honours at the Second Public Examination, and also the Examination in the Rudiments of Faith and Religion, gives notice that the books and subjects which may be offered in the Easter and Trinity Terms 1874, and until further notice, are—

In Group C.—(1) The Elements of Plane Geometry, including the doctrine of similar triangles. This includes the portion of Geometry treated of in Euclid Books I.-IV., with the definitions of Book V., and such parts of Book VI. as treat of similar triangles. These subjects may be read in any other treatise. The Elements of Trigonometry, including the trigonometrical ratios of the sum of two angles, the solution of plane triangles, the use of logarithms, and the mensuration of plane rectilinear figures. (2.) The Elements of the Mechanics of Solid and Fluid Bodies, including the composition and resolution of forces, centre of gravity, the simple machines and the application of virtual velocities to them, the laws of motion, the laws of falling bodies, the motion of projectiles, the pressure of fluids on surfaces, the equilibrium of floating bodies exclusive of the theory of stability, the methods of determining specific gravities, the laws of elastic fluids, simple hydrostatical and pneumatical machines. (3.) The Elements of Chemistry, with an elementary practical examination. Candidates who intend to offer this

subject for examination are recommended to read that part of Roscoe's "Lessons in Elementary Chemistry" which treats of Inorganic Chemistry (pp. 1-268, new edition, 1869). The practical examination will be in the following subjects as treated of in Harcourt and Madan's "Exercises in Practical Chemistry":—1. The preparation and examination of gases (pp. 59-107); 2. The qualitative analysis of single substances (pp. 247-300; see also sections IV. and V., omitting that which relates to substances or properties of substances not referred to in the Analytical Course). (4.) The Elements of Physics. Candidates offering themselves for examination in this subject will be expected to show an acquaintance with Part I., together with any two of Parts II., III., IV. of the following treatise;—"Elementary Treatise on Natural Philosophy," by Deschanel. Translated and edited by Prof. Everett. Part I. Mechanics, Hydrostatics, and Pneumatics. Part II. Heat. Part III. Electricity and Magnetism, of which chapter 39 may be omitted. Part IV. Light and Sound (which will be published in a few weeks(.

THE MURCHISON CHAIR OF GEOLOGY

UPWARDS of a year ago we duly chronicled the founding of a chair of geology and mineralogy in the University of Edinburgh by Sir Roderick Murchison, and we augured that the munificence of the founder would not be long in bearing fruit. It is pleasant to learn that the first session has been concluded successfully, and that the class has been greatly larger than the most sanguine friends of geology in Scotland had anticipated. In addition to the ordinary lectures of the class-room, there have been frequent afternoon excursions to the field, where the principles of the science have been learnt in a way in which they cannot be from mere lectures or books. Edinburgh is peculiarly favoured by nature for instruction of this practical kind. The crags and ravines which surround, or even stand in the midst of, the streets and gardens furnish admirable models of many of the more important and striking facts of physical geology. These advantages have been fully made use of during the past winter and spring. There has been, we are told, a brisk sale of geological hammers, and bands of hammerers have been seen on Saturday afternoons wandering over hillside and quarry. At the close of the session Prof. Geikie and his students celebrated the termination of their labours together by a week's holiday in the island of Arran. For such an excursion good weather is the first grand essential, and in this respect the party appears to have been singularly lucky. The days were bright and bracing, so that from the highest hill tops the eye could wander over all the wide expanse of firth and fell which lies between the mountains of Jura and the far-off faintly-seen uplands of Galloway.

It was chiefly to the northern half of the island that the attention of the excursionists was devoted. They traced, of course, the well-known and often-described features—the granite mountains and veins, the schists, the trap-dykes, the carboniferous sandstones, conglomerates, limestones and tuffs, the raised beaches, &c. But they noted some points which deserve, perhaps, more special remark than has yet been accorded to them, and of these we have been furnished with the following jottings:—

1. Some interesting observations were made on the relation between the joints of the granite and the forms of surface into which that rock has been wasted. Everybody who has seen the Arran mountains remembers their sharp serrated ridges and deep corries. It was noticed in all the examples which were visited that each knife-edged crest coincided with the intersection of two sets of joints dipping in opposite directions, as the ridge of a roof coincides with the line along which the two opposite slopes meet. Where the one set of joints differed most in angle of inclination from the other, there was seen to be a corresponding difference in the slope on two sides of the crest, the highly inclined joints having a steep face, sometimes quite a precipice, on their side, while the less inclined joints had a gentler declivity on the other. From the summits it seemed as if the changes in the direction and inclination of the granite ridges were largely due to changes in the trend and slope of the systems of cross-joints. But there was not time to work out this problem.

2. Some mineralogical and petrographical facts of interest were gleaned. The passage of the Arran pitchstone was traced into a dull pearlstone which appeared to be closely connected with, if, indeed, it did not pass into one of the pale compact felstones or "compact felspars." The common association of pitchstone with the tertiary volcanic rocks of the west coast, and its entire absence from any of the abundant palæozoic volcanic masses of the mainland, raises the suspicion that perhaps the Arran pitchstones are likewise of tertiary date. The association of these pitchstones with some of the characteristic felstones or porphyries of that island also suggests as late an origin for the latter. Some facts, indeed, were noted, which, if properly worked out, might throw light on this question. It was observed, for example, that in the picturesque columnar ridge above Corriegills the columns are so arranged as to indicate that the mass of rock flowed along and consolidated in a trough or hollow. Was this hollow a valley carved out of the denuded surface of the carboniferous rocks, and did the porphyry flow into it as a *coulée?* A phenomenon of rare occurrence was noted in this Corriegills porphyry. Usually the quartz in such rocks exists merely as irregularly-shaped blebs or grains. In this rock, however, it is crystallised, and frequently appears in little doubly-terminated pyramids. Some of the party spent half an hour in gathering up perfect crystals from the weathered hollows of the rock. These crystals do not occur in amygdaloidal cavities but as essential constituents of the rock. In the Goatfell granite some cavities were found with well crystallised quartz, and one of the party was fortunate enough to light upon one cavity from which he obtained a handful of small cairngorms.

3. The moraines of the Glen Cloy afforded a pleasant afternoon. It was matter for surprise to some of the party that amid all that has been written about Arran these truly remarkable moraines have not received more notice. It is true, they do not lie among the group of the higher mountains of the island, and they have not the magnificent setting around them which they would have had if they had stood in Glen Rosa, or Glen Sannox, or Glen Iorsa. But in none of these glens, even though they plunge into the very heart of the central mass of granite, is there anything in the way of moraines at all to compare with the huge concentric mounds of rock-rubbish, cumbered with blocks, which roughen the bottom and sides of the deep recess in which the upper part of Glen Cloy terminates. The plateau which served as the snow-field whence the Glen Cloy glacier was fed rises to an average height of only about 1,400 or 1,500 feet above the sea, while the neighbouring granite peaks are about twice as high. Yet the higher granite mountains have afforded comparatively few and small moraines. It gives a good notion of the severity of the climate during the glacial period to reflect that the little isolated patch of elevated ground, forming now the island of Arran, was large enough to nourish, even on its lower plateaux, snow-fields and glaciers.

4. Many striking lessons were learnt regarding some of the broad aspects of atmospheric denudation. Particularly were these lessons brought home to the mind among the wasted crags and corries of the granite mountains. Granite which, in the popular creed, is regarded as one of the most imperishable of rocks, was seen to be covered

with acre upon acre of its own wasted *débris*. On the crests of the heights the rock was found to be split by frosts along its joints; numberless blocks had fallen off, and the slopes below were thickly strewn with them. On smoother declivities, such as those that descend from the lonely and barren Beinn Bharrain, each casual torrent was seen to have ploughed out of the loosened and corroded granite a deep trench, which in time might get widened and deepened into a lateral valley. The waste of mountains could not be more eloquently revealed. As the party in long file threaded its way through these solitudes, a feeling which had been growing all day found at last expression, and as the scattered scouts who, in the exuberance of young life, had dispersed up and down hill on either side of the main body, gathered together into one merry company at the edge of the dark and lonely Corrie au Lachan, it was unanimously agreed that had this band of stone-breakers seen nothing more than these proofs of how a mountain may be sculptured, the lesson was worth all the trouble and fatigue of the excursion.

NÖE'S THERMO-ELECTRIC BATTERY

A SUPPLY of dynamic electricity is almost as requisite now for the lecture table as the supply of gas or water. The decomposition of water and various other liquids, the decomposition of certain gases in Hoffmann's U tube, with the aid of Rhumkorff's coil, and the physical test afforded by the passage of electricity through vacua containing traces of different gases, are most constant lecture experiments. And no wonder: the brilliant purple light afforded by the passage of electricity through a nitrogen vacuum, is, perhaps, the best and most reliable, if, indeed, it be not the only, test for nitrogen gas; while the decomposition of water gas, of ammonia, and of marsh gas, are experiments of the utmost importance in modern Chemistry. Hitherto the chief drawback has been the voltaic battery; the setting up of the battery before the lecture, the taking it to pieces afterwards, the constant amalgamation of the zinc plates, the consumption of zinc and acid, the fumes—in a word, the general inconvenience inseparable from any form of voltaic battery, but reduced to a minimum in Sir William Thomson's constant gravitation battery. The former of these inconveniences are more apparent, when, as is often the case, the battery is only required for five minutes during the whole lecture.

Hence, when a statement recently appeared in Poggendorff's "Annalen," to the effect that a thermo-electric battery of great power had recently been constructed in Vienna by Franz Noë, we were glad to take the first opportunity of trying to what extent it could replace the ordinary voltaic battery for the lecture table. It was stated that the battery could readily decompose water, work a Rhumkorff's coil, and powerfully excite electro-magnets. As we understand from the maker that the battery about to be described is the only one in use in this country, it may be of interest to give a short account of its capabilities.

The battery consists of eighty elements, which are heated by eighty small Bunsen burners, the cooling of the opposite extremities being effected by broad, blackened sheets of copper, which of course radiate freely. The negative metal is a silver-white alloy drawn into wire, and partially enclosed in small copper cylinders to protect it from the direct action of the flame. The positive metal is a dull grey alloy extremely crystalline and brittle, and is cast into cylinders abont 20 mm. long by 7 mm. diameter. The composition of both these alloys is kept secret. Alternate pairs are separated by small square plates of mica. The elements can with readiness be combined either for quantity or intensity. Thus the eighty elements may be used together in one series, or in two series of forty elements, or in four series of twenty elements.

The battery under consideration differs somewhat from that described in Poggendorff; it is larger; a sliding double groove keeps the burners in one position, exactly midway between the double rows of elements; and arrangements have been introduced in order to prevent radiation from the sides of the flames to the blackened copper radiators, that is, to the cool end of the elements.

According to the maker, the battery is equal to "8 grosse Daniell'sche Elemente." The electromotive force of one element, according to M. Von Waltenhofen, was found to be equal to 1·24 to 1·36 Jacobi-Siemens's unit, while a Daniell's cell (no dimensions given) is equal to twelve of these units. One Noë's elements is said to be equal to 11 of the ordinary bismuth-antimony elements.

On testing the battery of eighty elements, we found it to be somewhat weaker than we expected. It is, however, very difficult to know to what extent the elements may be safely heated. No definite directions are given on the subject by the maker, and as the composition of the alloys is kept secret, one is unable to ascertain their fusing point without sacrificing a pair of elements.

With large iron electrodes placed in a solution of very dilute potash, water was decomposed by the battery at the rate of 22 cub. centimetres per minute. With small platinum electrodes exposing less than one square centimetre of surface in water rendered acid by dilute sulphuric acid, 10 cc. of the mixed gases were evolved per minute. One of Gaiffe's induction coils, capable of giving a spark 15 mm. long, was connected with the battery. A copious stream of sparks 11 mm. long was produced. With a small 6-inch electro-magnet, surrounded by only two coils of wire, the battery produced a portative force of more than 20 lbs., when the gas was turned down so as to be nearly level with the orifice of the burners, and the flame was distant some 9 mm. from the surface of the elements. It is very possible that the battery might be heated to a higher temperature than that employed for decomposing water without detriment. In no case did the upper cylinders glow with even a faint red heat.

Here then we have an instrument which at a moment's notice can be set in action, which consumes a small amount of gas, is tolerably portable, and which is sufficient for all ordinary electro-magnetic experiments, for lecture demonstration of the decomposition of water, ammonia, &c., and for many purposes for which a voltaic battery has now to be used. Four or six of these batteries would be sufficient for all purposes save the electric light; they might be made more compact, and could with ease be placed beneath and at one end of the lecture table. The lighting of a row of gas jets would thus furnish us at any moment with an abundant current of electricity. The battery is, indeed, less strong than one could wish, but the production of it is a step in the right direction; and we look forward to the time when powerful and compact thermo-electric batteries will be found in every lecture-room, and when the lighting of a row of gas jets will, through the medium of such batteries, furnish us at any moment with a powerful electric light.

We are at the outset of invention in this direction; several improvements in Noë's battery seem to us to be both advisable and practicable. Let the elements be enlarged, the brittle cylinders of alloy protected, the radiation of heat from the sides of the row of gas jets to the cool ends of the elements entirely prevented, which is by no means the case now; and, if possible, let a current of cold water flow through pipes interspersed among the cooling plates. Again, let the pressure and amount of gas be indicated, and let the stop-cock admitting the gas be furnished with a projecting pin, moving on a graduated dial, so that any desired amount of gas (pre-determined) can at any time be caused to issue from the burners, and thus any desired strength of current (pre-determined in reference to the heating effect by ordinary electrometrical means) be obtained.

G. F. RODWELL

ON THE MEASUREMENT OF MUSICAL INTERVALS *

IN a series of communications to the *Académie des Sciences* (February 8 and 22, 1869, July 17, 1871, and January 29, 1872), M. Cornu and I have shown that musical impressions are based upon several systems of musical intervals. We were also able to announce, as a preliminary result of experiments not yet completed, the following propositions, which, while they show clearly the origin of discussions that have gone on for more than two thousand years, appear to be capable of putting an end to these discussions, by reconciling the two contrary opinions which have always been entertained upon this subject.

1. The musical intervals formed by the successive sounds of a melody without modulation, belong to the Pythagorean scale, the degrees of which are represented by the following ratios, containing only the factors 2 and 3†:—

do	re	mi	fa	sol	la	si	do
1	$\frac{3^2}{2^3}$	$\frac{3^4}{2^6}$	$\frac{2^2}{3}$	$\frac{3}{2}$	$\frac{3^3}{2^4}$	$\frac{3^5}{2^7}$	2.

2. The intervals formed by the simultaneous sounds of the concords, which are the basis of harmony, belong to very different systems, depending upon the complexity of the cords. Those which form part of the simpler concords of two or three sounds, thirds, sixths, perfect concords, &c., may be included in the scale given in all treatises on physics, the degrees of which are represented by the following ratios formed by the factors 2, 3, and 5 :

do	re	mi	fa	sol	la	si	do
1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	2.

To demonstrate these propositions several conditions require to be fulfilled.

In the first place, in the two scales above given, the three different intervals, viz., the major third *do—mi*, the sixth *do—la*, and the seventh *do—si*, differ from one another by the interval called a "comma," the value of which is $\frac{81}{80}$, as will be found on dividing one by the other the fractions which represent these intervals on the two scales. Now this value of the comma is very small, though very perceptible to the ear ; to demonstrate it we must, therefore, seek the assistance of skilled musicians, and employ apparatus of considerable delicacy.

Secondly, to measure the intervals formed by successive sounds it is best to study these intervals not separately, but as they occur in the actual course of a melody. Consequently, if we employ as our means of measurement the process which consists in causing the sounding body to trace out its own vibrations (and in the present state

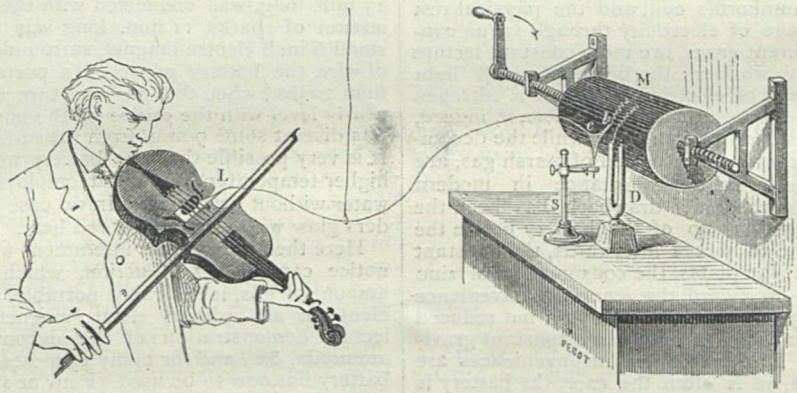

Fig. 1

of science no better method can be adopted), we must have the means of inscribing continuously the sounds which constitute fragments of melodies as they are executed upon an instrument.

Lastly, it is clearly necessary that the registration of the vibrations shall be automatic, and independent of the volition of the observers. The player must have nothing to do with it ; he must not even see it going on, so that his attention may be entirely devoted to the music which he is playing.

After many trials we have succeeded in fulfilling these conditions. The apparatus which we use is very simple, the elements of it being found in every physical cabinet. It will, therefore, be useful to describe it.

Experiment shows that a metallic wire of steel, copper, brass, &c., without tension, and merely supported in such a manner that its vibrations may be executed freely, transmits to one of its extremities, by transverse vibrations, the sounds emitted by a sonorous body fixed to the other extremity. To show this it is sufficient to take two tuning-forks having mirrors attached to them, and tuned exactly in unison. Fix the end of a wire to one of them, and attach to the other end a feather carrying a shining point placed in front of the mirror of the second tuning-fork. On setting one of the forks in vibration, and properly adjusting the feather, the shining point is seen to describe an ellipse characteristic of the unison, and varying in form when a weight however small (a little piece of wax for example) is attached to the tuning-fork fixed to the wire.

A wire five, six, eight, ten, &c., metres long, suspended by narrow strips of caoutchouc, is soldered at one end to a small plate of brass, L, placed between the sounding-board of a stringed instrument and the foot of the bridge, the other end being slightly clasped to a heavy stand S. Near the fixed point a small piece of tinsel (*c*) is soldered on, and to this is attached a feather (*b*), by means of a little soft wax (by this arrangement a greater amplitude of vibration is attained than if the feather were directly attached to the wire). The musician stands in such a position that the wire may not impede the movements of his bow, and plays fragments of simple melodies in slow time (each note lasting at least a second). The vibrations of the strings are transmitted to the bridge, the metal plate, the wire, and, lastly, to the feather, which vibrates synchronously. It only remains to trace these vibrations.

The registering instrument is composed of a metal cylinder, M, the axis of which is furnished with a screw moving a double nut, firmly fixed to a table or to the wall. This cylinder is covered with a sheet of paper, which is blackened by making it revolve over the smoky flame of an oil-lamp. A tuning-fork, D, making from 300 to 500

* Translated from the *Journal de Physique*.

† See the same volume, p. 109, Sur l'Histoire de l'Acoustique Musicale.

double vibrations per second, and carrying a strip of tinsel to serve as an index, is firmly fixed in a vice or in the wall, and arranged so that its index may vibrate in the direction of the generating lines of the cylinder. These vibrations serve to mark the time, and the tuning-fork serves as a chronograph, obviating the necessity of giving to the cylinder a regular and uniform motion. Further, the feather is moved forward, so that its point may just touch the blackened paper, and that it may vibrate quite close to the index, and, like the latter, in the direction of the generating lines of the cylinder.

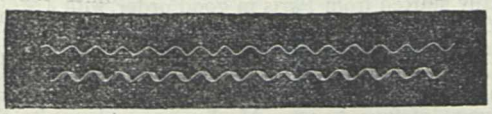

FIG. 2

These arrangements being made, the tuning-fork is set in vibration, either with a bow or by striking it with a stick covered with leather, and the musician plays, while the cylinder is turned at a suitable rate either by the hand or by any convenient motive power.

In this manner a tracing is obtained like that of which a fragment is shown in Fig. 2, each note of the melody being represented by a form of vibration peculiar to itself. The number of vibrations for each note, corresponding to 100 vibrations, for example, of the tuning-forks, is counted, and the ratio of the numbers thus obtained gives the values of the intervals. The vibrations are sometimes complicated with harmonics (Fig. 3), but they are almost always octaves, rarely fifths, very rarely thirds; moreover, it is not possible to make a mistake on this point.

To preserve the tracing after it is detached from the cylinder, it is split longitudinally, dipped for an instant into a 4 per cent. solution of shellac in alcohol, whereby it becomes covered with a very thin layer of unalterable varnish.

If, instead of measuring intervals of melody, we wish to measure the harmonic intervals of two sounds, two strings of the instrument are tuned simultaneously (in the ordinary way), to the third, fifth, sixth, &c., till beats are no longer perceptible, and the ear is perfectly satisfied; the sounds of the two strings thus tuned are then separately traced.

We have made numerous experiments with several persons, in particular melody experiments with M. Léonard, the Belgian violinist, and M. Séligmann, the violoncellist. The mean values of the results obtained with the assistance of these eminent artists are given in the following table; other experiments gave octaves equal to 2.

	Do.	Re.	Mi.	Fa.	Sol.	La.	Si.	Do.
Mean of the results.	1·000	1·128	1·265	1·330	1·500	1·686	1·917	...
Pythagorean Scale.	1·000	1·125	1·266	1·333	1·500	1·687	1·898	2·000
Ordinary Scale.	1·000	1·125	1·250	1·333	1·500	1·666	1·875	2·000
Values of the Comma.*	0·013	0·014	0·016	0·017	0·019	0·021	0·024	0·025

FIG. 3

It is necessary to add that the mean deviations of the experiments rarely exceed the third of a comma. As to the differences between the mean values of the results and the values of the intervals of the Pythagorean Scale, it is a mere fraction of the comma, insensible to the ear. For the seventh alone the difference amounts to five-sixths of the comma; but this result is remarkable, inasmuch as it exhibits a fact well known to musicians, namely, that in the case where the sensitive note Si is resolved upon the tonic Do (which is precisely what occurs in the four cases in which we obtained sevenths), it is perceptibly higher than in the inverse movement.

E. MERCADIER

DISCOVERY OF A LARGE BONE CAVE IN BAVARIA

DURING the cutting of the railway from Nuremberg to Regensburg by the Bavarian Eastern Railway Co, it was necessary to cut directly through a piece of mountain chain in Schelmengraben near Regensburg. It was owing to this that this bone cave was discovered, and its miscellaneous contents were able to be examined and arranged. Since the railway cut right across the middle of the cave, it allowed it to be very thoroughly examined, and under the most favourable circumstances and in daylight, as has been the case in very few other instances. The railway company have given every facility in their power that the cave should be thoroughly examined, and under the direction of Profs. Fraas and Zittel, a gang of men were actively employed for many days, and the objects so obtained were carefully preserved. From the local German papers the following particulars have been obtained, which, allowing for a little local colouring and exaggeration, show the find to have been a most important one, and one that may well come under the notice of the International Congress of Archæology and Anthropology at their meeting this year, where the whole question of bone caves and their contents is to form a prominent subject for discussion.

The cave in question was originally, when first discovered about two years ago, 28 metres (about 91 ft.) long, and was simply a fissure in the Jura limestone which had been enlarged by running water. Its opening was visible half way up the mountain side, partly hidden in dense woods. It stretched from North to South, with a slight turn towards the West of about 15°. The new line of railway cut deeply into the hill side, and during the course of this year has already cut away one half of the cave, but unfortunately the contents were employed on the line. On this account, only the part not touched was able to be excavated and examined, and this was 11 metres (36 ft.) long, 2 metres (6½ ft.) wide, and in the middle 3 metres (9½ ft.) deep. Wood ashes and pieces of coal, together with pieces of pottery, had accumulated to about the height

* These numbers are the *differences* between the numerical value of each interval I, and the mean of this same interval raised by a comma, that is to say,

$$\left(\frac{81}{80} - 1\right) \times I = I \times 0{\cdot}015$$

of three feet, in the midst of which were sharp splinters of flint, and a thick mass of broken and split bones, and the shattered skulls and jaw bones of a heterogeneous mass of animals of all kinds. In the lowest layer no trace of men, either by their remains or by their handiwork, could be found, all the remains consisted of bones of animals, chiefly the cave bear, hyæna, and lion. These cave-dwelling animals appear to have been the first and earliest possessors of the cave. But soon after this men must have discovered the cave and inhabited it, for from this layer up to the newest layer of all the presence of man is clearly shown, and the remains of their feasts and of their daily life are mingled with those of the previously-named animals. The most numerous remains consist of flints of which many thousand were found, but these do not appear to have been used as implements, but come rather under the category of flint-flakes, the chippings from knives, saws, lances, &c. The most perfect one found is three inches long, and half-an-inch wide, and is toothed like a saw, and was probably used as such to saw off the ends of the deer's horns, of which quantities were found.

In order to judge the age in which men began to inhabit this cave, we must examine the remains of the bones and skeletons of the animals which they hunted, and whose flesh was eaten in the cave. The most conspicuous amongst these is the cave bear, and although it might at first sight appear very difficult to recognise in the broken and burnt bits of bone that they really do belong to the cave bear, nevertheless, careful comparison with specimens in museums has proved that this is the case. Every care seems to have been made to utilise to the utmost all parts of this animal, which was apparently the most important game in the surrounding forests, and which no doubt required much labour and time to capture. At the same time, together with the bones of the cave bear are found bones of the elephant and of the rhinoceros, but not many in comparison. These remains, however, show conclusively, by the way in which they have been split up and broken, that man hunted these animals at the time he first appears on the scene. Remains of horses, oxen, cats, and wolves were also met with, and in proof that the early inhabitants were not unmindful of fish, there are the bones and scales of large pike and carp. The smaller bones of mice and frogs do not appear to owe their origin so much to man as to the owls which seem to have held possession of the cave as well.

Great interest attaches to the fragments of pottery which were found in the cave, and which rival the flint flakes in quantity. It appears to have been all hand made, but although rough, shows considerable beauty of shape and form. It is possible to put together from the fragments one or two more or less complete vessels, which, however, show great diversity as to size, &c., some being between 10 and 20 centimetres in diameter. The material of which they are made appears to be clay mixed with sand, but few, if any, seem to have been regularly burnt. Much of the pottery is ornamented with lines or rows of dots, which run in zigzag lines over the wider parts. The internal smoothness would appear to be due to the river mussel, Unio, obtained from the River Naab which flows close by, and of which many well rubbed and polished specimens were found in the cave. A block of granite with one side rubbed smooth, and by long usage appearing quite polished, can hardly be anything else than a well-worn millstone, and this is rendered more probable by two holes having been bored into the upper side as if for the purpose of affixing a handle. The presence of this millstone would indicate the cultivation of land in the immediate neighbourhood, which is confirmed by the finding of several spindles made of clay.

The different objects found in this cave are of great interest, as they apparently run counter to the somewhat hard and fast lines which have been drawn as to different well marked periods in the early history of man.

THE PARIS SIEGE BALLOONS

THE lessons learnt at Paris in regard to balloon navigation will be of great value in any future employment of aërial machines, and the statistics which have now been collected and published are well worthy of a brief notice. As many as sixty-four balloons, it appears, actually started from Paris in good order, with a *personnel* of 161, and with something like three million letters. The first ascent was made on the 23rd of September, 1870, by M. Duruof with safety, and the fifth balloon carried in it Gambetta, who arrived without accident at Amiens after a voyage of four hours. M. Janssen, whom, it will be remembered, was desirous of watching the approaching eclipse in the south of Europe, left Paris with all his instruments complete in the balloon Volta, on the 2nd of December, landing at Savenay (Loire Inférieure) after a journey of five hours and a half. One of the later voyages was made with two cases of dynamite, to be dropped and exploded at a seasonable moment; but fortunately for the enemy no such opportunity presented itself. The last balloon left Paris on the 28th of January, 1871.

Of these sixty-four balloons only seven were unsuccessful in fulfilling their purpose, two of the machines being utterly lost at sea; while five were captured by the enemy. As many as sixteen actually fell within the hostile lines; but the aëronauts were in most cases too quick for their pursuers, and managed to escape. Indeed, of the five actually taken only three were really captured by the enemy's forces, the other two falling in fact upon German soil, namely, in Prussia and Bavaria. The most interesting voyage was certainly that of M. Rollier, who travelled safely from Paris to Christiania in fourteen hours, after a journey across the North Sea of nearly twelve hours. Of the two lost at sea, one was observed to go down by some sailors at Rochelle; while of the other nothing certain is known.

The regularity with which the balloon service was conducted during the winter of 1870 under grave disadvantages will be remembered by all who studied the daily newspapers at that period, the news from the French Capital never being interrupted for more than three or four days together. Most of the aërial machines contained 2,000 cubic metres of gas, and one of them consisted of twin spheres tethered together; they were usually started from the Orleans or North railway stations at nightfall, so that they might escape the vigilance of the German troops posted round the city. Besides a freight of letters the majority carried baskets of pigeons, and in five cases dogs, destined to return with news to the beleagured city; how well the pigeon-post itself was organised may be gathered from the fact that fifty thousand messages were sent into Paris by its means alone.

Some attempts were made by MM. Tissandier Frères to return to Paris by means of aërial machines impelled by favourable winds; but two successive essays made from Rouen on the 8th and 9th of November were quite fruitless. M. Jules Godard, the aëronaut, and M. Nadar were the principal agents in organising the balloon service.

NOTES

AT the Anniversary Meeting of the Royal Geographical Society, held on Monday last, the Royal medals for the encouragement of geographical science and discovery were presented. The Founder's Medal was given to Sir W. Baker for Colonel Henry Yule, C.B., in recognition of the eminent services he has ren-

dered to geography in the publication of his three great works—"A Mission to the Court of Ava," "Cathay, and the Way Thither," and "Marco Polo." The Patron's or Victoria Medal was personally presented to Mr. Robert Berkeley Shaw, for his journeys in Eastern Turkestan, and for his extensive series of astronomical and hypsometrical observations, which have enabled us to fix the longitude of Yarkand, and have given us, for the first time, the basis of a new delineation of the countries between Leh and Kashgar. A gold watch was also awarded to Lieut. G. C. Musters, R.N. (now travelling in America, and represented at the meeting by his brother), for his adventurous journey in Patagonia, through 960 miles of latitude, of which 780 were previously unknown to Europeans; and the sum of 25*l.* to Karl Mauch, in acknowledgment of the zeal and ability with which he has devoted himself for a series of years to the exploration of South-Eastern Africa. Mr. Shaw, who was addressed by the gallant president as "the hero of the hour," was loudly cheered by the meeting when he briefly acknowledged the honour paid to him. The annual geographical medals offered by the Society to the chief public schools were presented to the following successful competitors:—Physical Geography: Gold medal, S. E. Spring-Rice, Eton College; bronze medal, A. S. Butler, Liverpool College. Political Geography: Gold Medal, W. G. Collingwood, Liverpool College; bronze medal, W. C. Graham, Eton College. The president, Sir Henry Rawlinson, K.C.B., then delivered his anniversary address, which was chiefly occupied by tributes to distinguished members who have died during the year, and to a statement of the most recent information respecting the Livingstone Search Expedition.

THE President of the Society of Telegraph Engineers has issued invitations for a *conversazione*, to be held in Lord Lindsay's Laboratory on June 6, at 9 P.M.

AT the meeting of the French Academy of Sciences on May 20, M. Tresca was elected a member of the section of Mechanics in the room of M. Combes, deceased.

THE Dutch Society of Sciences in Haarlem has awarded the great gold Boerhaave Medal to Mr. H. C. Sorby, F.R.S., and elected him a foreign member. This medal, of the gold value of 500 gulden (about forty guineas), has been established three years, and is to be given away every two years to those who during the last twenty years have made themselves particularly meritorious in different departments of Science, according to a fixed rotation, and this year was given for the branch of mineralogy and geology.

AT the last meeting of the Royal Society of Edinburgh, Prof. Turner was presented with the Neill prize and gold medal for the triennial period ending 1871, for his papers on the "Great Finner Whale," and on the "Gravid Uterus and the Arrangement of the Fœtal Membrane in the Cetacea." The Keith prize, for the biennial period ending May 1871, was awarded to Prof. Jas. Clerk Maxwell, F.R.S., for his paper "On Figures, Frames, and Diagrams of Forces."

THE *Medical Times and Gazette* states that M. Jules Simon, the Minister of Public Instruction in France, has accepted in principle the creation of a Faculty of Medicine at Bordeaux to replace that of Strasburg, and that a commission has been appointed to report upon the project in question. It is also in contemplation to establish a School of Medicine and a School of Pharmacy at Lyons.

THE *Revue Scientifique* of May 18th gives an account of the inauguration of the German University of Strasburg, with an interesting sketch of the history of the university under its original German rule, and subsequently to its incorporation into the French Empire by Napoleon I.

MR. FLOWER, the Professor of Anatomy at the Royal College of Surgeons, London, is anxious to collect and exhibit in the Museum of the College a complete set of skulls of all the varieties of the dog. The collection will be of great value as bearing on the question of the variability of the skeleton in domesticated varieties of the same species.

THE following excursions have been arranged by the Geologists' Association to take place in June:—Excursion to Guildford, Saturday, June 1, Directors, Prof. T. Rupert Jones, and Mr. C. J. A. Meyer. Upon arrival at Guildford the members will proceed to inspect the very instructive exposure of the Chalk and Lower Greensand in the neighbourhood of Guildford. The physiography of the district is also extremely interesting, and is well seen from several elevations which will be visited. Excursion to Bromley and Chiselhurst, Saturday, June 15, Director, Mr. J. W. Ilott. Leave Charing Cross for Shortlands Station. Visit the waterworks at Shortlands, and inspect section of well. Walk along railway to Bromley, and examine five sections of the Woolwich and Reading Series in the Palace Park and at the Brick Works. Walk through Sundridge Park, and inspect Sections of Shell Beds. Subsequently visit the Chalk Caves of Camden Park, and return from Chislehurst Station. Excursion to Hendon and Finchley, Saturday, June 22, Director, Dr. Henry Hicks. On arrival at Hendon Station proceed, under the guidance of Dr. Hicks, to inspect the Sections of the Glacial Drift in the neighbourhood of Hendon and Finchley. Return from Finchley Station. The long excursion of the session will be to Ludlow and the Longmynds in July.

DR. STIMPSON, the eminent director of the Chicago Academy of Sciences, has been engaged during the past winter in prosecuting deep-sea explorations in Florida. He first accompanied the United States Coast Survey steamer *Bibb*, when making soundings between Cuba and Yucatan for a submarine cable, but found the sea bottom very poor in animal life. We have previously mentioned that the bottom temperature in the deepest water was about 39·5° F., which may possibly account for the scanty fauna. The bottom consisted of sand and Globigerinæ mixed, in which scarcely anything occurred but shells, mostly dead. Some of the species were identical with those obtained by Mr. Gwyn Jeffreys at a similar depth off the European coast. On their way back from the cable work, the expedition made one haul of the dredge off the Cuban coast, near Havana, in 250 fathoms water, and obtained a superb specimen of the very rare *Pentacrinus Caput Medusæ*, the first ever obtained so near the American coast, and perhaps hardly represented as yet in any of the museums. After returning to Key West the doctor took charge of the dredging on board the Coast Survey steamer *Bache*, but ill-health prevented his prosecuting this to any extent.

Harper's Weekly states that Prof. J. D. Whitney, the accomplished State Geologist of California, has undertaken to collect the facts in regard to the late earthquake, and has proceeded, with this object to Inyo County, the centre of its most active manifestation. As Prof. Whitney has made a specialty of the study of earthquakes and the accompanying and resultant phenomena, we have no doubt that much light will be thrown upon this interesting topic.

WITH reference to the connection between electricity and earthquakes, the *Pall Mall Gazette* quotes from a Californian paper, the *Inyo Independent*, the following curious statements respecting the prevalence of electrical phenomena at the time of the recent earthquake in that State:—"A few days after the big shock, so called, at Cerro Gardo, very loud thunder was heard during a violent snowstorm. With the exception of the snow, the same thing occurred here, and perhaps at other places in the valley. This is remarkable, because almost unprecedented. Immediately following the great shock, men whose judgment and

veracity are beyond question, while sitting on the ground near the Eclipse Mines, saw sheets of flame on the rocky sides of the Inyo Mountains, but half a mile distant. These flames, observed in several places, waved to and fro, apparently clear of the ground, like vast torches. They continued for only a few minutes. In this office, one day last week, while one of the proprietors was running a large number of sheets of flat-cap paper through a job press, these sheets, after leaving the press, were affected by the movements of the operator's hand, as a strong magnet would affect iron filings. When his hand was near them, the whole pile, or at least a hundred of them from the top, seemed to float in the air, like tissue paper in a slight breeze. The top sheet would rise at each end up to the hand when held four inches above it, and thus by attraction be moved entirely away from the others. At times during the night sparks of fire were repeatedly emitted from a woollen shawl on being touched by the hand. At the Kearsarge Mill, located at an altitude of nearly 80,000 feet above the sea, the following occurrence was noted by Harry Clawson and P. J. Joslyn:—The former, while sitting with his knees within three inches of a cast-iron stove, felt a peculiar numbing sensation, and, supposing his limbs were 'asleep,' essayed to rub them with his hand. As soon as his hand touched his knee he felt a shock, and immediately after, and for a couple of seconds, a stream of fire ran between both knees and the stove. We will here state, on the authority of a man who had an opportunity of knowing, that the item going the rounds to the effect that no movement of the earth was observable 300 feet underground in the mines is not correct. At Cerro Gardo, and also at the Eclipse Mine, the rocking motion was distinctly observed, especially in the timbering. Small particles of rock were detached, and in both places the miners went to the surface in alarm; but at Cerro Gardo they soon resumed work as before."

TELEGRAMS just received from New York speak of a terrible disaster to the seal fishing fleet on the coasts of Labrador and Newfoundland. Four steamers and nearly forty sailing vessels are reported to have been wrecked among icebergs and the ice fields by a hurricane. The whole of the crews, which averaged ninety men, perished. Later accounts, however, state that the reports of the disaster to the fishing fleet were exaggerated. Only twelve vessels were lost.

A TERRIFIC hurricane visited Madras on May 2. It is described as being the most violent that has occurred there for many years, the devastation occasioned among the shipping being of a terrible character. Nine English vessels are spoken of as having become total wrecks, and the destruction of life is said to have been very great.

NATAL papers describe the great brilliance of the Aurora Australis witnessed both in that colony and in Cape Colony and the Free States on Feb. 4. The *Natal Colonist* of March 5 speaks of the southern aurora being not unfrequently visible there in broad daylight.

A REMARKABLE story from Newfoundland is detailed in a letter to the *New York Times* of April 15, to the effect that a Danish brig just arrived, which had left Disco on March 1, brought information that the *Polaris*, under Captain Hall, had been there for two days undergoing repairs and procuring a fresh supply of provisions. The account goes on to say that on the evening of February 8 the *Polaris* encountered extremely heavy weather, and while lying to, owing to the shallowness of the water, ran among ice snags, which caused a leak in the vessel, and made it necessary to proceed to Disco for repairs. Mysterious intimations were given of wonderful discoveries which had already been made by the *Polaris*, indicating the existence of a genial atmosphere and open seas in the extreme north. Plants indigenous to southern climes were detected in the ice, while a floating stick of wood proved to be northern birch. Throughout the whole of the month of February very little ice was seen, and the skies were literally alive with meteors of the most gorgeous description. On Christmas-day the ship was hemmed in by a heavy field of ice, but the weather was as pleasant as an Italian spring day. Such was the reluctance of Captain Hall to have the further discoveries which he is expecting to make shared by rival expeditions, that, according to the writer, he did not send word of his return to the Secretary of the Navy. The entire story bears little evidence of credibility, and will at least require further confirmation before it can be accepted.

CAPTAIN THOMAS LONG, so well known as the discoverer, in 1867, of Wrangell's Land, situated about seventy to one hundred miles north of Cape Yakan, in Siberia, has written a letter in reference to the plan of exploration by Mr. Octave Pavy, to which we have already referred. While indorsing the idea presented by Mr. Pavy, he takes occasion to claim it as his own, having, as he states, urged this route as long ago as 1867, the time of his first discovery. He does not think that Mr. Pavy will be able to pass through the channels between Spitzbergen and Greenland, or between Nova Zembla and Spitzbergen, as those passages have always been found blocked with ice, and it would be impossible to winter in the ice in such a raft as he has constructed. He thinks it possible that the North Pole may be reached from Wrangell's Land, but that it would be necessary for him to return for winter quarters; but to endeavour to return into the Atlantic with such a craft would be the height of folly. He believes that a vessel, properly fitted for the purpose, could make the passage from Behring Strait to the Atlantic in one year from the time of passing Behring Strait.

PROF. O. C. MARSH describes in the *American Journal of Science* for May four new species of fossil birds, three of them belonging to the genus *Graculavus*, probably closely allied to the cormorants of the present day, and occurring in the cretaceous deposits of New Jersey and of Kansas. The fourth is a species of *Palæotringa*, from the cretaceous greensands of New Jersey. The same paper contains a more elaborate description of the very remarkable new fossil bird named by him in January last *Hesperornis regalis*. This has numerous peculiarities, although it seems to resemble most closely the common loon of the United States. It was, however, much larger, as its complete skeleton would measure nearly six feet from the tip of the bill to the end of the toes. It occurs as a fossil in the gray shale of the upper cretaceous formations near Smoky Hill Fork, in Western Kansas.

WE learn from Rockhampton, Queensland, that on January 31 a fisherman named W. C. Easton discovered an alligator's nest on Eighteen-mile Island, eighteen miles above Rockhampton in the Fitzroy River. The mother was in the nest when Easton made the discovery, but she ran off, "bellowing like a cow after her calf," as Easton fired a shot from his double-barrelled gun into the river. She was about nine feet long. As Easton went up to the nest, a large carpet snake was about to enter it, but the snake, too, fled before his approach. On examining the nest, Easton discovered sixty-seven eggs, which he took away. The eggs were rather larger than a goose's egg, measuring 6½ inches in circumference one way, by 8½ inches the other; 3¼ inches in length, and nearly white, and in shape almost a true ellipse, but rather too long for their breadth. Mr. Easton placed four of the eggs under a hen, and twelve in straw, in the hope of rearing and domesticating some young alligators. The Fitzroy is the most southern river in which the alligator is found on the East Coast of Australia, and is just within the tropics.

*ON OPTICAL PHENOMENA PRODUCED BY CRYSTALS SUBMITTED TO CIRCULARLY POLARISED LIGHT**

ON a former occasion I exhibited some phenomena depending upon circular, or, as it was then also called, successive polarisation, and in particular I adopted and explained a method for producing circularly polarised light devised by Sir Charles Wheatstone. I propose on the present occasion to pursue the subject into some of its ulterior consequences. In terms of the wave theory, light is said to be circularly polarised when the vibrations are circular, as distinguished from plane polarisation, when they are rectilinear. And further, it is known from mechanical principles that a circular vibration may always be produced by the combination of two rectilinear vibrations, the amplitudes or extents of which are equal, and whereof one is in advance or in rear of the other by one or by any odd number of quarter-wave lengths. In the former of these cases the circular motion will take place in one direction, say right-handed, in the latter in the opposite, say left-handed. The contrivance used for producing circular polarisation this evening is known by the name of a "quarter undulation plate," and consists of a plate of mica split to such a thickness that one of the two rays into which plane polarised light is divided on entering it is retarded by an odd number of quarter-wave lengths behind the other.

The optical phenomena produced by crystals when submitted to polarised light are usually divided into two classes, viz. (1) those arising from the use of parallel light, and consisting of broad sheets of colour; and (2) those due to convergent light, and consisting of the rings and brushes, the general character of which is well known. I propose to take a few specimens from each class, and to examine the modifications which the known phenomena undergo when the light is both polarised and analysed circularly, *i.e.*, when one quarter-undulation plate is interposed between the polariser (Nicol's prism) and the crystal to be examined, and the second between the crystal and the analyser (Nicol's prism).

In the first place, it is known that if a plate of selenite be placed in an ordinary apparatus when the polariser and analyser are either parallel or crossed, there are four positions at 90° apart in which the plate will produce colour; and further, that if the analyser be turned through 90° the same result will be obtained, except that the colour will be complementary to that first seen. The intensity of the light at any given point is then given by the formula:

$$\cos.^2 s - \sin.\ 2i \sin.\ 2(i-s) \sin.^2 \frac{\theta}{2}$$

where i and s are the angles made with the original plane of polarisation by the principal sections of the crystal and of the analyser respectively, and θ is the retardation.

If, however, the two quarter-undulation plates (say the plates A and B) be introduced, the light undergoes the following processes:—First, it is plane polarised by the polariser; secondly, the plate A being placed so that its axis is inclined at $\pm$ 45° to the original plane of polarisation, the light undergoes right or left-handed circular polarisation, and in that condition falls upon the crystal; thirdly, in their passage through the crystal C the rays are each divided into two, whose vibrations are at right angles to one another, and whereof one is retarded in proportion to the thickness of C; fourthly, the plate B being placed so that its axis is parallel or perpendicular to that of A, each of these sets of rays is circularly polarised, one set right-handed, and the other set left-handed; fifthly, these two oppositely circularly polarised sets of rays combine, according to known mechanical laws, on emerging from B into plane rays, in which the planes of polarisation of the different colours of the spectrum are turned through different angles. Hence finally by turning the analyser round we shall cross these various planes in turn and successively extinguish the different colours, leaving the complementary colours visible. The system of plates A C B consequently acts in this respect like quartz. It is, however, to be observed that if the plate B be turned from one of the two proposed positions to the other, the directions of motion in the two emergent circularly polarised rays, and consequently the planes of polarisation of the different colours, will be reversed; in other words, with the plate B in one position we shall imitate a right-handed, with the plate B in the other a left-handed, quartz. The intensity of the light at any point is then given by the formula:—

$$\sin.^2 \frac{\theta}{2} \text{ for one position,}$$

$$\cos.^2 \frac{\theta}{2} \text{ for the other.}$$

Again, if the plates A B retaining either of the positions before indicated, the crystal C be turned round in its own plane; then, since the light emerging from A and B is circularly polarised, it has lost all trace of direction with reference to the positions of the polariser and analyser, and consequently no change of tint will be observed. The same is abundantly clear from the formula written above, because the only term it contains depends upon the retardation within the crystal C. This experiment was made by Airy.

If the plates A and B have their axes directed 45° on either side of the axis of C, and the three plates be turned round as one piece, the colour will remain unchanged; while, if the analyser be turned, we have the colours shown in the regular order. If the plates A and B have their axes directed at 45° on the same side of the axis of C, and the pieces be turned round bodily as before, the colours change in the same order as above, and go through their cycle once in every 90° of rotation; and if the analyser be turned in the same direction the colours change, but in the reverse order. The explanation of this is to be found in the fact that when the plates A and B are crossed, the retardation due by A is compensated by that due to B; so that the only effective retardation is that due to the crystal C. But upon this depends the rotation of the plane of polarisation; if, therefore, the polariser and analyser remain fixed, the colour will remain unaltered. When the plates A and B have their axes parallel, there is no compensation, and the colour will consequently change. This experiment was made by Fresnel. The mathematical expressions for the intensity of the light in the two cases respectively are:—

$$\cos.^2\left(j+i+\frac{\theta}{2}\right), \text{ and } \cos.^2\left(j-i-\frac{\theta}{2}\right),$$

where i is the angle made by the principal sections of A with that of the polariser, and j that of the principal section of B with that of the analyser. The first expression is obviously unchanged when the angle between the polariser and analyser, viz. $\frac{\pi}{2}+i+j$, is unchanged.

It should be added that the rotation of the plane of polarisation, and consequently also the sequence of tints, does not follow exactly the same law in the above cases as in quartz.

We now come to the case of convergent light, that is, to the phenomena of crystal rings. And let us examine the effects produced by the same arrangement as before, viz., two quarter-undulation plates, A, B, one in front and one behind the crystal C. To quote from Mr. Airy:—"The first thing that strikes us in this combination is that there is nothing, except in the crystal, that has any respect to sides. For the only incident light is circularly polarised; the only light allowed to emerge is circularly polarised. The appearance, therefore, of the coloured rings, &c., must be such as conveys no trace of any plane of polarisation, and must not vary as the crystal is turned round. In the common exhibition of the coloured rings the principal trace of the planes of polarisation is in the uncoloured brushes. In uniaxal crystals they form an eight-rayed star, composed of two square crosses, inclined at an angle equal to that between the planes of polarisation, every ray of which separates complementary rings. In biaxal crystals they compose two pairs of rectangular hyperbolas, the angle between whose asymptotes is the same as that between the planes of polarisation, and whose branches divide complementary rings. The two crosses or two sets of hyperbolas unite when the planes of polarisation are parallel or perpendicular. But in the case under consideration the rings exhibited by crystals will not be traversed by any brushes. Uniaxal crystals will exhibit circular rings without a cross; and biaxal crystals will exhibit complete lemniscates, without any interruption from curved brushes." And it is further to be noticed, as the formula given above indicates, that the centres of the rings will be bright or dark according as the analyser stands at 0° or 90°.

To pursue this matter further. Suppose that, the arrangements remaining otherwise as before, the analyser be turned round; then in any position intermediate to 0° and 90° the rings

* Lecture delivered at the Royal Institution of Great Britain, May 3, 1872, by W. Spottiswoode, Treas. R.S.

will be contracted and extended in opposite quadrants until at 45° they are divided by two diagonals, on each side of which the colours are complementary. Beyond 45° the rings begin to coalesce, until at 90° the four quadrants coincide again. During this movement the centre has changed from bright to dark. If the motion of the analyser be reversed, the quadrants which before contracted now expand, and *vice versâ*. Again, if the crystal (say positive) be replaced by another (say negative), the effect on the quadrants of the rings will be reversed. This method of examination therefore affords a test of the character, positive or negative, of a crystal.

A similar process applies to biaxal crystals; but in this case the diagonals interrupting the rings are replaced by a pair of rectangular hyperbolas, on either side of which the rings expand or contract, and the effect is reversed either by reversing the motion of the analyser, or by replacing a positive by a negative crystal, or *vice versâ*. The experiment may then be made in biaxal crystals, by turning the analyser slightly to the right or to the left, and observing whether the rings advance towards or recede from one another in the centre of the field. In particular, if, polariser and analyser being parallel, the plate A have its axis in a N.E. direction to a person looking through the analyser, the plate B its axis in a N.W. direction, and the crystal be so placed that the line joining the optic axes be N.S., then on turning the analyser to the right the rings will advance to one another if the crystal be negative, and recede if it be positive. The mathematical expression for the intensity of the light at any point P is in this case

$$\tfrac{1}{2}(1 + \sin. 2j \cos. \theta + \sin. 2b \cos. 2j \sin. \theta),$$

where b is the angle between the principal section of C through P and the principal section of B, and j the angle between the principal sections of B and the analyser. This shows that when the polariser and analyser are parallel or crossed at 0° or 90°, and consequently $j = 45°$ or 135°, the expression is independent of b, *i.e.*, the intensity is the same throughout circles about the centre, but that when the polariser and analyser are crossed we have an expression of the form

$$\tfrac{1}{2}(1 \pm \sin. 2b \sin. \theta),$$

the sign of the second term depending upon the direction in which the analyser has been turned, and also upon the sign of θ, that is, upon the character (positive or negative) of the crystal.

The dispersion of the planes of polarisation effected by the passage of plane polarised light through a plate of quartz cut perpendicular to the axis may be rendered visible by interposing such a plate of quartz between the polariser and a uniaxal or biaxal crystal, when the analyser is at 90°, *i.e.*, when dark brushes are formed. In this case the brushes cease to be black, and are tinged throughout with colour. The analyser must, however, be turned back or forward, according as the quartz be right-handed or left-handed, in order that it may cross in succession the planes of polarisation of the different coloured rays, and so produce the most vivid effects. The dispersion of the brushes by a plate of quartz may, however, be studied by employing an additional polariser and quartz plate between the source of light and the whole system previously used. By turning this polariser round we extinguish each ray of the spectrum in turn, and tint the whole field with the complementary colour. The brushes will then appear to revolve about their centres as the tints vary continuously from one end of the spectrum to the other. If the polariser be turned still farther round, the tints which had changed continuously from red to violet, or *vice versâ*, change suddenly from violet to red, or *vice versâ*, and the brushes jump suddenly back to their original position.

This last optical arrangement may be employed to examine the more important phenomena of the dispersion of the optic axes produced, not by a quartz plate between the usual polariser and crystal, but by certain biaxal crystals themselves.

BOTANY

The Leaves of Drosera

In a recent note to the Paris Academy of Sciences, M. Ziegler writes as follows:—

The hairs on the leaves of Droseras exude at their extremity a small drop of glue, by which insects are caught. Whenever an insect becomes attached, the exterior threads bend over it, covering it like the fingers of a hand, and do not straighten again till some days after, when a fresh drop exudes for a fresh prey.

In studying these remarkable plants, I noticed that all the albuminoid animal substances, if held for a moment between the fingers, acquired the property of making the hairs of the Drosera contract. I also observed that such substances, when they had not been in contact with a living animal, had no visible action on the hairs. This shows that the simple contact of the fingers communicates to inert animal substances a property which they did not possess before.

These same animal substances thus prepared lost this singular property when they were moistened several times with distilled water, and dried each time in a water-bath. This is a convenient mode of preparing the substances for experiment.

The contraction of the hairs is not caused by animal heat, which the fingers may have communicated to the animal substances, for the hairs contracted equally when the substance had been cooled before placing it on the leaf.

The perspiration of the fingers cannot affect the phenomenon, for the property can be communicated to animal substances across fine waxed paper. And the result is not affected if the substances are first covered with a coating of wax, thus preventing any chemical action of soluble matters which the animal substances may contain.

A living animal thus communicating by simple contact new physical properties to an inert body, it was important to know whether, by increasing the amount of transmission, we should observe any change in the vital state of the animal. Some rabbits were enclosed in light wooden cages. These were of such a size that their sides were always in contact with the hairs of the animal at one part or other. To the outside of the cage were attached bags of cloth or paper, containing (for each cage) two kilogrammes of dried serum (albumen from blood). Other rabbits were placed in exactly similar cages, but without the albumen. Their food consisted of 25 grammes of hulled oats every twenty-four hours, with cabbage leaves at discretion.

At the end of some days, the rabbits that had been in contact with the albumen became diabetic in a high degree (though without saccharine matter); the urine was given in normal quantity, but the loss in ammoniaco-magnesian phosphate was very great, and these rabbits deteriorated and lost weight. The other rabbits, which had not been in contact with albumen, remained in their normal state, and even gained weight.

It was interesting to ascertain if the avidity of the Drosera for insects was insatiable, and to find what would be the effect on it of increasing the contact of a living animal. Some dozens were accordingly placed, with a small clod of earth and sufficient water, in light platinum capsules. These capsules were each placed in a sheath containing blood albumen, which had previously been held for half an hour in the hand. At the end of twenty-four hours all these Droseras had become quite insensible to insects and to organic animal bodies modified by living contact. The properties of these plants were reversed, and strange to say, their hairs were found to contract under the influence of organic matters which had previously been in contact with paper packets (of double or triple envelope) containing sulphate of quinine. Organic matters influenced in this purely physical manner by sulphate of quinine have no contractile action on the hairs of the Drosera in their normal state. The plants whose physical properties have been reversed by the influence of albumen in the above way, could be restored to their normal state by placing them for twenty-four hours with the platinum capsule on a packet of sulphate of quinine. This method may be adopted whenever, from any cause, the leaves have become insensible to insects. In every case the contraction of the hairs is always slow; it commences visibly in about a quarter of an hour, and is often not complete till after several hours.

Among vegetable matters seeds only are impressible in the way referred to, and the experiments mentioned (which were made with albuminoid animal substances) may be repeated with these.

Nature of Diatoms

In a recent essay by Prof. Adolf Weiss, of Lemburg ("Zum Baue und der Natur der Diatomaceen"), it appears to be demonstrated that the siliceous investment of these little plants has cellulose for its base. The silex is infiltrated to a variable extent in the different families, and the mode of its deposition can to a certain extent be ascertained by examination with polarised light. In opposition to the opinion hitherto generally admitted, Prof. Weiss shows that the siliceous coal is capable of

polarising light; and he has found also that it contains a certain amount of iron-oxide compounds, which are for the most part in an insoluble condition. He strongly objects to the view that the *Diatomaceæ* are one-celled organisms, but contends that each frustule is composed of numerous very minute but perfectly individualised cells. The different markings on the frustules—areolæ, ribs, crests, &c.—are in no way caused by the contour lines of the several cells of which they are composed. The size of the cells is very variable. In *Triceratium favus* they are as large as 0·008 of a millimetre, whilst in *Hyalosira delicatula* they do not exceed 0·00025 of a millimetre. Each cell is arched, and, as a rule, prolonged into a papilliform process at its centre. The papillæ are the cause of the moniliform or pearl necklace-like markings of diatoms when examined with high powers, and which appear as striæ with low powers. The large cavity between the two frustules is, he thinks, comparable to the embryo-sac of higher plants; and Weiss has succeeded in observing the development of new individuals in it. The product of this new individual indicates the alternation of generations in the *Diatomaceæ*.

SCIENTIFIC SERIALS

THE first number of *Zeitschrift für Ethnologie* for the current year (1872) opens with a paper by A. Bastian on "The Position of the Kaukasus in relation to the history of the migration of nations," in which the author points out the importance of studying the hydrography and orography of a country before we attempt to trace the origin of its inhabitants. Mountains and streams afford more stable evidence in regard to ethnological centres of origin than the ever-fluctuating combinations of language. Thus, for the history of our own Continent we can have no more important standpoint than the Kaukasian range, which forms the boundary line between Europe and Asia, from which rivers open the way into the Caspian and Black Seas. Herr Bastian next traces the various directions taken by successive waves of population after they reached the Steppes between the Don and the Dnieper, which long formed the meeting-place of the Scythio-Sarmatian races, and often witnessed the fierce encounter of rival hordes, whose defeat or success on that great battle-field of nations decided the fate of future races. The relation of the nomadic races of Asia to the Persian Empire is of special interest to us, since the latter by its control over the destinies of the western half of the Asiatic continent has exerted the most important influence on the ethnological history of Europe. In Asia the course of civilisation has followed the line of the Steppes; and the nomadic tribes who possessed horses have spread themselves through every pastoral district, amalgamating at times with the earlier settlers, but more generally organising themselves into hostile bands, whose leaders became the founders of equestrian dynasties, and raised thrones for themselves in Central and Western Asia. The author follows at length the progress of Parthian and Persian conquests and migrations, and, after considering the anatomical features and cranial dimensions and forms of the various races, which have given conquerors to the world, discusses the probable bastard or mixed origin of those inferior subjected races, who from time to time have risen against their masters, and asserted their right to freedom, as in the case of some of the Servian tribes against their Pannonian lords, and various Mestizoes or Creoles in Africa and America.—The remaining papers in this number are below the usual standard of the *Zeitschrift für Ethnologie*. We have a paper by Dr. E. v. Martens "On the Different Uses of the Conchilia," originally read to the Anthropological Society of Berlin, which is little more than a *résumé* of what G. E. Rumph, P. Bonanni, Johnston, and Mr. Woodward have given in their semi-popular works on subjects of conchological interest. Dr. Martens also contributes a translation of a paper on the geography, history, and statistics of the Island of Puerto Rico, by S. Bello, of Espinosa. We learn that while sugar and coffee constitute the riches of the island, all the tropical fruits abound, and the excessive annual rainfall maintains a vigorous and verdant vegetation. The hot moist climate is unhealthy, and dysentery, yellow fever (vomits), and remittent fevers of various kinds prevail. The population has, however, gone on steadily increasing during the last forty years, notwithstanding the diminution in the numbers of the slaves, amongst whom the deaths have of late years exceeded the births in the ratio of from 5 to 10 per cent. In 1839 the population was 319,000, in 1870 it had risen to 646,360; in the latter year the number of the slaves had fallen to 32,000, after being 42,227 in 1866, thus giving a diminution of 25 per cent. in four years.—M. de Quatrefages' history of Prussian aggrandisement, which first appeared in the *Revue des Deux Mondes* (1871), under the title "*La Race Prussienne*," has called forth an impassioned and indignant rejoinder in this number of the *Zeitschrift für Ethnologie*. We should be more disposed to concur in the line of argument adopted by the writer in refutation of M. de Quatrefages' too sweeping assertion that Prussians are Finno-Slaves with only a slight admixture of French and German blood in the higher classes, if he had not allowed personal rancour and national hate to over-weigh every consideration of courtesy, justice, and reason. We think an ethnological journal is not the place for international warfare.

Annalen der Chemie und Pharmacie, viii. Supplementband, 2 Heft.—The first 100 pages of this number are occupied by an important theoretical paper "on a periodical law of the chemical elements," by Dr. Mendelejeff; the author has arranged the elements into eight groups and into twelve series; there seems to be a most curious regular progression, both in the atomic weights, the atomicities, and in the chemical proportion of these groups. To take for example the third series of elements, starting from group 1 to 7, we find the following:—Sodium^{i} 23, Magnesium^{ii} 24, Aluminium^{iii} 27·3, Silicon^{iv} 28, Phosphorus^{v} 31, Sulphur^{vi} 32, Chlorine 35·5, it will be seen that the first named is a very positive element, and that the positive character gradually changes through the groups until in the seventh we have a powerfully negative body; the atomic weights and atomicities of the elements also increase in a regular manner. In the other series the same kind of relation seems to exist; the author has left spaces in his table for elements not yet discovered, but for which he gives hypothetical atomic weights. The next paper is by Gorup Besanez "on the dolomite springs of the Jura," and is followed by another "on a new class of platinum compounds," by Schutzenberger; by the action of carbonic oxide on platinous chloride at high temperatures three distinct compounds have been obtained, the first containing one equivalent of carbonic oxide to one equivalent of platinous chloride, the second two equivalents of carbonic oxide, and the third one and a half equivalents of carbonic oxide to one of platinous chloride. Linnemann and Zotta have found that by heating glycerine with calcic chloride, small quantities of phenol are formed, and at the same time there is produced glyceric ether. Phenol is also obtained from glycerine by the action of zincic chloride or potassic bisulphate.

IN the *Journal of the Franklin Institute* for April we have the continuation of several papers already commenced, viz.:—Mr. Joseph Harrison's article on the locomotive engine, and Philadelphia's share in its early improvement; of Mr. J. S. Smith's account of the Keokuk and Hamilton Bridge; of Mr. J. F. Henry's paper on the flow of water in rivers and canals; and of Mr. J. Richard's article on wood-working machinery. The only new article of any length is by Lieut. Dutton on the principles of gun construction, and there are the usual paragraphs of Items and Novelties.

THE *American Journal of Science and Arts* for April commences with Prof. Marsh's account of the discovery of additional remains of Pterosauria, with descriptions of several new species, *Pterodactylus occidentalis*, *P. velox*, and *P. ingens*, of which full measurements are given, the last probably measuring nearly 22 feet between the tips of the fully expanded wings.—Prof. A. E. Dolbear describes a new method of measuring the velocity of rotation; and Prof. Dana continues his history of Green Mountain geology, dealing this month with the quartzite.—From Mr. F. B. Meek we have descriptions of two new starfishes and a crinoid from the Cincinnati Group of Ohio and Indiana, which he proposes to name *Palæaster* (?) *Dyeri*, *Stenaster grandis*, and *Glyptocrinus Baeri*.—Prof. Abbe gives an account of his observations on the total eclipse of the sun in 1869; and Prof. Twining of various observations on the aurora of Feb. 4.—Mr. Verrill's series of papers include this month recent additions to the molluscan fauna of New England and adjacent waters, with plate.

In the May number is a valuable epitome of recent geographical work in the United States, deduced from the report of the Corps of Engineers, U.S. Army, the route of the Northern Pacific Railroad, and the map of transportation routes in Minnesota and Dakota.—Prof. W. A. Norton contributes a paper on molecular and cosmical physics, in which he propounds several new theorems: the subject is to be continued.—As the commence-

ment of a series of papers entitled "Contributions from the Physical Laboratory of Harvard College," Prof. Trowbridge has a paper on the electro-motive action of liquids separated by membranes.—Prof. Marsh describes, under the name of *Hesperornis regalis*, his exceedingly interesting gigantic fossil swimming bird discovered in the cretaceous strata, which he considers to belong to the Palmipedes, and to be most nearly allied to the Columbidæ, but differing widely in many respects from that group and from all other known birds, recent and extinct. Both in this and the previous number are the usual interesting paragraphs of information arranged under the various natural sciences.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, May 21.—Mr. R. Hudson, F.R.S., vice-president, in the chair. The Secretary read a report on the additions that had been made to the Society's menagerie during the month of April, amongst which was a young female Baird's tapir (*Tapirus bairdi*) from Nicaragua, and a red-billed flying squirrel (*Pteromys magnificus*) from the Himalayas.—A letter was read from Dr. G. Bennett, of Sydney, N.S.W., giving particulars of the habits of a pair of *Didunculus strigirostris*, and of other birds living in the Botanic Gardens at Sydney. Dr. Bennett also mentioned that a pair of the red-billed curassow (*Crax carunculata*) had built a nest in one of the trees in the same gardens, and had hatched out two young birds, which at the time he wrote were doing well.—Sir Victor Brooke, Bart., read a paper on the royal antelope and allied species of the genus *Nanotragus*.—Mr. A. H. Garrod read some notes on the anatomy of the Huia bird (*Heteralocha gouldi*) as observed in a specimen that had lately died in the Society's gardens, and showed that this form must be referred to the family *Sturnidæ*.—A communication was read from the Rev. J. E. Semper, containing observations on the birds of St. Lucia, to which were added some notes on the species by Mr. P. L. Sclater.—A communication was read from Dr. J. E. Gray on the sea bear of New Zealand (*Arctocephalus cinereus*) and the North Australian sea bear (*Gypsiphoca tropicalis*).—A communication was read from Dr. A. Günther, F.R.S., containing a note on *Hyla punctata* and *Hyla rhodoporus*.—Mr. P. L. Sclater read a paper on the species of Quadrumana collected by Mr. Buckley in Ecuador, amongst which was a specimen of *Ateles fusciceps* Gray, from the western valleys of the Andes.—Dr. Murie read a paper on the osteology of the Tody (*Todus viridis*). He showed that this form comes under the group of *Coccygomorphæ* of Huxley, and does not belong to the Passeres (*Coracomorphæ*). Its nearest allies are the mot-mots and kingfishers, but it must stand as a group of itself (*Todidæ*), notwithstanding which it shows some osteological and other points of resemblance to fly-catchers (*Musicapidæ*).

Linnean Society, May 24.—Anniversary meeting.—The following were elected Officers and Conncil of the Society for the ensuing year:—President, Mr. G. Bentham, F.R.S.; Treasurer, Mr. W. W. Saunders, F.R.S.; Secretaries, Mr. F. Currey, F.R.S., and Mr. H. T. Stainton, F.R.S.; Council, Mr. A. W. Bennett, Mr. R. Braithwaite, M.D., Mr. G. Busk, F.R.S., Mr. J. Gwyn Jeffreys, F.R.S., Dr. J. D. Hooker, F.R.S., Mr. M. A. Lawson, Mr. H. Lee, Mr. R. McLachlan, Mr. J. Miers, F.R.S., Mr. D. Oliver, F.R.S., and Rev. Thos. Wiltshire.

Photographic Society, May 14.—Mr. James Glaisher, F.R.S., president, in the chair.—A paper "On Photographic Pictures" was read by John Hubbard, in which the manner of elaborating his photographic studies was gone into at some length. His entire method of operating was described, which, however, differed little from that in ordinary use.—Lord Lindsay exhibited a series of transparent pictures of the last eclipse, five positives from every negative being shown, so as to afford an exceedingly clear representation of the phenomenon.—Major Tennant, R.E., also forwarded a series of eclipse pictures for exhibition to the members.

BRISTOL

Observing Astronomical Society.—*Sun.*—Mr. T. W. Backhouse writes that "there was a fine group of solar spots in the sun's northern hemisphere last month. On the 24th at 5^h there was a largish spot at the preceding end of the group, which on the 23rd, at 3^h, either was small or did not exist at all. On the 26th, about 4^h, its penumbra was 51,500 miles long, and its umbra 28,000, but it never became such a conspicuous umbra as the one which had all along been the largest in the group. On the 28th, at 4^h 15^m, the penumbræ of the two were united, and 88,500 miles long, while at 20^h I found the penumbra to be 92,000 miles in length. It was then so close to the limb that I could not measure it accurately, the height being extremely foreshortened."—*Jupiter.*—Mr. H. W. Hollis, of Newcastle, Staffordshire, reports that on January 14, 9^h, the disc of the planet appeared very sharp, and he counted twenty-two different bands of colour. "Those visible in the equatorial parts of a beautiful, delicate, pinky brown. I am certain that the belts are visible up to the very edges of the disc, but there is an apparent increase of brightness for a considerable distance round the edge of the planet—probably an effect of contrast—which obliterates the extremities of the belts, unless carefully looked for. Several well-marked and beautifully-defined irregularities in the belts showed the rotation most clearly even in half an hour's watching. Jan. 23, 8^h 15^m.—Satellite I. just entered on disc of Jupiter, and appears as an intensely white spot. 9^h 20^m.—Shadow of I. on centre of disc, black, and sharply circular; the satellite itself cannot be seen." Mr. T. W. Backhouse, of Sunderland, observed the transit of Satellite I. on Jan. 14. At 13^h 54^m it "appeared as a faint white spot." On Feb. 3, 6^h 7^m, he examined Satellite III., and its shadow when in transit. The satellite itself was, at the time mentioned, nearly half across Jupiter, on a darkish belt. "It is much darker than the darkest part of the planet." At 7^h 30^m it was "still very plain, but only the same shade as the darkest part of Jupiter. It was smaller than its shadow, which was very black." *T. Coronæ Borealis.*—Mr. T. W. Backhouse says:—"A change has taken place in this star. On its fading the second time it became stationary in brightness about the middle of the year 1867, since which time, up the beginning of this year, it continued the same, but with frequent slight fluctuations, which however ceased, so far as I could judge, at the end of 1869. I have suspected fluctuations since 1869, but they were doubtful. On January 14 this year I looked at the star and found it about its usual brightness, or perhaps a little fainter, but certainly not fainter than it had been at times previously. I did not look at it again till March 5, when I found it much fainter than I ever saw it before, perhaps half a magnitude less than usual, and it was the same on the following day." *Nebula in the Pleiades.*—Mr. H. W. Hollis has looked for this nebula with his 8 in. achromatic, but cannot find it. He says:—"There is something peculiar about all the brighter stars of this group, which for months past have appeared to me as if surrounded with nebulous light. Can the nebula have been distributed amongst them?" *Meteors.*—The Rev. S. J. Johnson, of Crediton, witnessed the appearance of "a splendid meteor at 7^h 37^m April 6. Its course was in a straight line downwards from about 15° above the N.W. horizon to about 5°. Colour, white with a greenish tinge. Duration, about 5". Seen against a dark sky, this meteor would have equalled, if not exceeded, the brightness of Venus or Jupiter. I was looking for Mercury at the time." On April 19, 11^h 10^m, Mr. William F. Denning, of Bristol, saw a brilliant meteor. It passed slowly down the N.N.E. sky. It was starlike in appearance, and left no train of light. *Mercury.*—The Rev. S. J. Johnson observed Mercury both with the naked eye and telescope on the evenings of March 25 and April 5. A power of 100 on a small telescope brought out the phase.

CAMBRIDGE

Philosophical Society, April 29.—Mr. Paley, "On certain effects of Light on Portland Stone." The author said that he doubted from the mode in which this occurred whether the blackness of stone seen in towns was due simply to smoke; the black scraped from the stone was unaffected by soap or solution of soda, and presented under the microscope an appearance quite different from that of ordinary soot.—By Prof. Miller, "On Faye's method of comparing Mètres à Traits, and an improvement of it suggested by Prof. Miller."—By Mr. Bonney, "On certain lithodomous Burrows in the Carboniferous Limestone of Derbyshire." The author said that doubts having been thrown upon the accuracy of his statement of the occurrence of these burrows in Miller's Dale, he had again visited the spot, had found his description correct, and had discovered a large number of these burrows in Miller's Dale and in Tideswell Dale. From the positions in which he found them, he was more than ever convinced they were the work of *Helices*.

May 13.—"On a Method proposed by M. Fizeau for comparing a a *mètre à bouts* with a *mètre à traits*," by Prof. Miller.—"On the Section exposed at Roslyn Hill Pit, Ely," by Mr. Bonney. The author stated that there were two hypotheses which accounted for the singular collocation of boulder clay, cretaceous rocks, and Kimmeridge clay in this pit; the one attributing it to a fault, the other to a boulder-like mass of cretaceous beds which had been dropped there in the Boulder clay time. He exhibited plans and sections, and pointed out that the faulting would be of such a singular and exceptional kind that this hypothesis appeared to him in the highest degree improbable. The choice remained between regarding the cretaceous beds as brought on by an ice-raft, or the result of a slip from beds subsequently removed by denudation, and on the whole he preferred the former of these.

EDINBURGH

Royal Society of Edinburgh, May 20.—Prof. Sir Robert Christison, Bart., president, in the chair.—The Keith Prize for the Biennial period ending May 1871 having been awarded by the Council to Prof. James Clerk Maxwell for his paper "On Figures, Frames, and Diagrams of Forces," which has been published in the Transactions, the medal was delivered to him by the President at the commencement of the meeting.—The Neill Prize for the Triennial period ending 1871 has been awarded by the Council to Prof. Turner for his papers "On the Great Finner Whale," and "On the Gravid Uterus and the Arrangement of the Fœtal Membranes in the Cetacea," which have been published in the Transactions.—The following communications were read:—"Some Helps to the Study of Scoto-Celtic Philology," by the Hon. Lord Neaves, V.P.—"Some Observations on the Dentition of the Narwhal (*Monodon monoceros*)," by Prof. Turner.—"On the Occurrence of *Ziphius cavirostris*, got from Hillswick, Shetland, in the Shetland Seas, and a comparison of its cranium with that of *Mesoplodon Sowerbyi*," by Prof. Turner.—"On the Maternal Sinus System of the Human Placenta," by Prof. Turner.

HALIFAX, NOVA SCOTIA

Institute of Natural Science, December 11, 1871.—The vice-president, Dr. Gilpin, in the chair. The vice-president read the concluding paper of a series on the mammals of Nova Scotia, including the moose deer. Dr. Gilpin described its peculiar form, differing from all mammals by the length of its cannon bones (metacarpal and metatarsal), whilst in the shortness of its neck, its great height, its prehensile lip, it had a singular analogy with the equatorial form of the elephant, the giraffe, and the tapir, yet it more resembled certain large wading birds. It might be called a wading mammal, in summer resorting to the swamps and shallow lakes, in winter its long cannon bones allowing it to walk in the deep snow. It thus becomes straddling and weak-footed. In comparing its hind leg with that of the greyhound and hare, the swiftest animals known, its form would be found exactly opposite. He described its nuptial suit in September (its rutting season) of glossy black, and golden tan legs, and its wintery livery of shaggy grey hair. Its identity with the elk of Sweden was discussed, and from observations in the R. C. Surgeons' Museum, Sir John Richardson, and especially from Captain Hardy, R.A., who compared his sketches, notes, and measurements, of the moose of Nova Scotia, personally, with a pair of young elks from Sweden at Sandringham, Dr. Gilpin concluded them to be identical. Allowing them to be identical, then, as their fossil bones have been found in the Upper Tertiary formations in America, and not yet in the Old World, the moose must be held as the primitive type. Dr. Gilpin thought that, with the carriboo, its form must have existed contemporarily with many forms now extinct; that, perhaps, it was one of the earliest existing fauna that succeeded the glacial epoch in Nova Scotia, and that from some cause now existing this earliest fauna may be destined to be the last. From the almost entire identity of the boreal marine fauna, the marine birds, and the fish, the more we study the arctic forms, the more we are impressed with the conviction that we must look to the north for the common type of many of our temperate and equatorial forms. The shaggy elephant of Lorna, and the rough musk ox of the Pole, and the hairy-coated carriboo, may each have been the primal type of the naked-skinned elephants and buffalos of Asia and the satin-skinned African deer, whilst the coatis may equally have been the type of all foxes and dogs to the hairless race in Turkey. In a conversation that ensued it was maintained that two varieties existed in the province, but Dr. Gilpin considered them not permanent varieties. To show the numbers still extant, the game book of a gentleman present gave, from the year 1863, twenty-seven, whose death he had been in at, and ninety-seven which he had seen altogether.

CALIFORNIA

Academy of Sciences, San Francisco, November 6, 1871.—Dr. T. Blake, president, in the chair.—Mr. Harford stated that he had examined some Indian graves on San Miguel island, from two of which he had obtained a number of relics. The pits were about 25 ft. long, 5 ft. deep, and situated at an elevation of about 80 ft. above the sea. In one of the pits there were from 75 to 100 skeletons, most of the skulls showing marks of violence. No order had been observed in the burial, children and adults, male and female, all lying together. The other pit seemed to be of a much older date, as the bones were in a more advanced state of decay, and only stone beads or trinkets were found there, whereas in the other principally glass and shell beads were found. Large shell heaps were of common occurrence on the island, showing that at one time they must have been inhabited, although no Indians had been known to live on the island since the settlement of the country by the Spaniards.—Prof. Davidson, of the United States Coast Survey, remarked that as a rule in the entrances to the harbours and rivers on our coast the channels all tended to the N.W., the northern headlands showing bold rocky bluffs, the southern points, on the other hand, forming long low sandy beaches. He said his own observations had been confirmed by information received from Lower California, thus showing that there is a strong inshore northerly current along the entire coast.

December 4.—The president, Dr. Blake, in the chair. Prof. Whitney exhibited a collection of fossils made by Mr. J. E. Clayton in Nevada, near the 116th meridian, and not far from the mining settlement of Eureka. These fossils are very interesting as representing the Primordial or Potsdam period of the Silurian, and exhibiting the same combination of genera and species of the *Lingulidæ* family of the brachiopods, and the *Paradoxidæ* family of trilobites, which is so characteristic of this group farther east. Indeed there are no families represented in these specimens but these two. The trilobites are very imperfect, much broken, and crowded together in great numbers in the rocks. The same *Agraulos* (*Arionellus* of Barrande, and *Crepicephalus* of D. Owen, Meek, and Hayden), which occurs in the Big Horn Mountains, about longitude 167°, is found in this lot from the 116th meridian. There is also a *Conocoryphe* (Conocephalites); but the *Agraulos* is much the most abundant. The brachiopods appear to be represented by at least two genera, *Lingulepis* (Lingula) and *Obalella*. The lithological character of the rock in which these fossils occur is of importance, as it is not a sandstone, but a limestone. The Primordial or "Potsdam sandstone" fossils have not, previously to this discovery, been found to the west of the Big Horn mountains, so far as appears from any published documents. The discovery is therefore an interesting one, and will furnish a valuable datum-point for working out the geology of the Great Basin.—Mr. Montrange read a paper on White Island on the coast of New Zealand. Whakari, as the Maoris call it, is White Island, is situated in the Bay of Plenty, on the east coast of New Zealand (North Island). Hours before reaching it, one sees the large crest of vapour which crowns its summit. It is of very difficult access, and very few even of the oldest settlers have ever visited it. The whole of the island is one perpetually active crater, which, like the mollusc that secretes its little shell, has built up its huge cone, three and a half miles in circumference at the base, 860 feet high, of scoriæ and indurated ashes. The walls of the cone are straight, cut at intervals with deep longitudinal furrows; the crater is inside, on the eastern side.—Prof. Marsh, of Yale College, who was present at the request of the President, made some remarks on the results of his trip from Nebraska and Dacota across the continent to Eastern Oregon. He stated that the extensive fresh water deposits that had been found in Nebraska and Dacota were again met with in Eastern Oregon, extending, in fact, across the continent. The Oregon beds were as rich in new and interesting fossil remains as those on the eastern sides of the Rocky Mountains. During his trip across the continent, he had selected a large number of vertebrates, amongst which were thirty or forty species, which he considered entirely new. The family *Equidæ* were represented by several new species, furnishing important material for tracing the

development of the group through its intermediate forms. Another interesting fact in connection with these fresh water deposits is, that whilst the fossil fauna of Eastern Oregon abounds in species identical or analogous with those of Nebraska and Dacota, yet extensive fresh water deposits were met with in Wyoming and the centre of the continent in which the fossil fauna was of an entirely distinct character, although belonging to the same geological epoch, the Miocene.

PARIS

Academy of Sciences, May 13.—M. Chasles presented a further series of theorems relating to the theory of the obliques of a curve—M. L. Cailletet communicated a note on the influence of pressure upon the bands of the spectrum, in which he describes the increased resistance offered by compressed gases to the passage of the electric spark and its influence on the luminous phenomena produced, and stated that whilst the luminous intensity of the bands of the spectrum is increased by pressure, when the latter is extreme they disappear entirely, the spectrum becoming continuous.—M. Melsens forwarded a memoir on lightning conductors with multiple conductors; and M. Decharme a note on the spontaneous ascensional movement of liquids in capillary tubes, compared with the flow of the same liquids in the same tubes under a constant artificial pressure.—A note was read by M. Arnould Thenard on the decomposition of carbonic acid under the influence of electricity.—M. Balard presented a note by M. Amagat on the dilatation of moist gases.—M. Lamy commented on a recent note by M. Personne on the presence of selenium in sulphuric acid of French manufacture, and indicated that its existence had been known for the last ten years.—M. Wurtz also presented a note by M. Scheurer-Kestner upon the same subject.—A note was read by M. J. Boussingault on the determination of carbon combined with meteoric iron.—M. C. Robin communicated a note by M. H. Byasson on the hydrosulphate of chloral (sulphuretted chloral).—M. Bouchut presented some investigations on the action of the bases and alkaloids obtained from opium.—M. Robin presented a note by M. J. P. Megnin, on the development of the unarmed cestoid worms, in which he described his observations on an undetermined species allied to *Tænia perfoliata* (Goeze), *T. plicata* (Rud.), and *T. mamillaria* (Mehlis), discovered by M. Baillet and himself in the horse and mule. He seems to think that all the stages of development of this parasite are passed in the same animal.—M. Clos presented a note upon a portion of the leaf in certain plants, to which he gives the name of *prelimb*.—The Minister of Foreign Affairs communicated a report received from the French Consul-General at San Francisco, relating to an earthquake which occurred in the county of Inyo on March 30.—A note on the silicified plants of Autun, with observations on the structure of *Dictyoxylon*, by M. B. Rénault, was presented by M. Brongniart.—A letter from M. Palmieri on the late eruption of Mount Vesuvius, dated May 5, was read.

VIENNA

Academy of Sciences, January 4.—Prof. L. Gegenbauer, of Krems, forwarded a second memoir on the evaluation of definite integrals.—Dr. F. C. Schneider noticed the production of a detonating iodine-compound by treating oxyiodide of mercury with solution of iodide of potassium containing iodine. The detonating compound was formed as a crust over the residue of oxyiodide and upon the sides of the glass in which the mixture had remained for a fortnight; its violently explosive qualities were discovered on an attempt being made to remove it by means of a glass rod.—M. J. Schlesinger deposited a sealed note on the formula for the rapidity of outflow of water from tubes.—Prof. von Oppolzer announced the re-discovery on December 20, 1871, of the lost planet Ægina (91).—Dr. Sigmund Exner presented a memoir entitled "Further Investigations on the Structure of the Olfactory Mucous Membrane in the Vertebrata," in which he showed that the branches of the olfactory nerve in birds, mammals, and in man, terminate in the same way as was previously described by him in the frog. The author regarded the glands of the olfactory region as tubular, and not acinose.—Dr. A. Boué communicated a reply to M. Blaek's remarks on his catalogue of northern and southern lights, and M. H. Fritz forwarded a note relating to the same subject.

January 11.—Dr. L. J. Fitzinger communicated a memoir on the natural family of the Pangolins (*Manes*), and M. S. Adler some mathematical demonstrations connected with the game of dominoes.

January 18.—A memoir by D. A. Seydler on the path of Dione (106) was read.—Dr. F. O. Sofka communicated six short papers on various mathematical and physical subjects.

BOOKS RECEIVED

ENGLISH.—Introduction to the Study of Palæontological Botany: J. H. Balfour (A. and C. Black).—Fruit Trees, 2nd edition: W. Wardle (Lockwoods).—Nature: A. Walker (Longmans).—The Fallacies of Darwinism: C. R. Bree, M.D. (Longmans.)

AMERICAN.—Annual Record of Science and Industry for 1871, edited by S. F. Baird.—The Lens, edited by S. A. Briggs, vol. i., No. 2.

DIARY

THURSDAY, MAY 30.

ROYAL SOCIETY, at 8.30.—The Bakerian Lecture: On the Structure and Development of the Skull of the Salmon: W. K. Parker, F.R.S.—On Ammonia in the Urine in Health and Disease: Dr. Tidy and Dr. Woodman.—The Structure and Functions of the Rods of the Cochlea: Dr. Pritchard.—Examination of the Gases occluded in Meteoric Iron from Virginia: Dr. J. W. Mallet.

SOCIETY OF ANTIQUARIES, at 8.30.—Ballot for the Election of Fellows.

FRIDAY, MAY 31.

ROYAL INSTITUTION, at 3.—Old and New Art: E. J. Poynter.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—On the Chemical Action of Light: Prof. Roscoe, F.R.S.

GOVERNMENT SCHOOL OF MINES, at 8.—On Geology: Dr. Cobbold, F.R.S.

MONDAY, JUNE 3.

ROYAL INSTITUTION, at 2.

ENTOMOLOGICAL SOCIETY, at 7.

ANTHROPOLOGICAL SOCIETY, at 8.—On the Artificial Enlargement of the Earlobe in the East: J. Park Harrison, M.A.—On the Westerly Drifting of Nomads—the Fins: H. H. Howorth, M.A.—On Tumuli at Sapolia, Russia: Baron de Bognschefoky.

VICTORIA INSTITUTE, at 8, Anniversary Meeting.

TUESDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—On Development of Belief and Custom E. B. Tylor, F.R.S.

ZOOLOGICAL SOCIETY, at 9.—On Dinornis (Part XIX.) containing a description of a Femur, indicative of a new genus of large wingless bird (*Dromornis australis*, Owen) from a post-tertiary deposit in Queensland, Australia: Prof. Owen, F.R.S.—On the Anatomy of the Two-spotted Paradoxure (*Nandinia binotata*): Prof. Flower.

SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.—On the Political Condition of Egypt before the Reign of Rameses III.: Dr. August Eisenlohr.—Some Mathematical Observations on the Dimensions of the Base of the Great Pyramid, and the Royal Coffer: Solomon M. Drach.—The XXXVII. Aamu in the Tomb of Chnum-Hotep, at Beni Hassan, identified with the Family of Israel: Daniel H. Haigh.

WEDNESDAY, JUNE 5.

GEOLOGICAL SOCIETY, at 8.—Notes on Sand-pits, Mud Volcanoes, and Brine-pits, met with during the Yarkand Expedition of 1870: Dr. G. Henderson.—On the Cervidæ of the Forest-bed of Norfolk and Suffolk: W. Boyd Dawkins, F.R.S.—The Classification of the Pleistocene Strata of Britain and the Continent by means of the Mammalia: W. Boyd Dawkins, F.R.S.

MICROSCOPICAL SOCIETY, at 8.—Remarks on the Homological Position of the members constituting the Thecated Section of the Rotatoria: Chas. Cubitt.—On a Micro-pantograph: Isaac Roberts.

THURSDAY, JUNE 6.

ROYAL INSTITUTION, at 3.—On Heat and Light: Prof. Tyndall, F.R.S.

SOCIETY OF ANTIQUARIES, at 8.30.

LINNEAN SOCIETY, at 8.

CHEMICAL SOCIETY, at 8.

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