THURSDAY, DECEMBER 18, 1879

BOSTON AND HARVARD

To the common remark that nowhere in the United States does an Englishman feel himself so much at home as in Boston; a student of science may add that nowhere else does he meet with so much to remind him of the intellectual activity and enthusiasm for science that mark the great centres of life in the old country. Boston can boast of one or two of the oldest and most active scientific societies in America, which for generations have gathered together and sustained an able succession of workers. In the neighbouring venerable Harvard it enjoys a perennial fountain whence it may draw for ever fresh stores of inspiration and encouragement. This influence of the University is everywhere apparent. Among those who take a lead in promoting science by discovery and exposition among the Boston citizens, Harvard men occupy always a foremost place. A stranger, however, with leisure and opportunity to note some of the more salient features in the scientific life of Massachusets soon comes to realise the pervading influence of one man. He sees it in the ordinary cultivated society of Boston, he meets with it at every turn in Harvard, he finds it uniting as a common bond of sympathy the younger scientific men of the state. The name of Louis Agassiz has become a household word in the community, and, among the scientific workers, sounds as a rallying cry to unite them for common sympathy and support. Great as were Agassiz's solid contributions to the literature of science, they form a monument to his genius not perhaps more honourable or enduring than the impetus which his example and ceaseless enthusiasm gave to the progress of science in his adopted country. To have written the immortal "Recherches sur les Poissons fossiles" and to have founded so vigorous a school of science at Harvard combine to give him a high place in the temple of fame.

It is delightful to hear in general conversation in Boston spontaneous recognitions of Agassiz's eminent services. Many stories are current of his indomitable courage in carrying out schemes for the advancement of his favourite studies, of his consummate address, which enabled him to win over into active assistance men who were disposed to be indifferent if not hostile. One interesting anecdote is told of a dinner party at which he was present, when Mr. Ticknor gave an account of an early meeting of the British Association. At the Geological Section there had been a paper on fossil fishes, and, said Mr. Ticknor, one speaker who evidently knew the subject profoundly, proceeded to show the audience the characters of the types of ancient fishes, and remarked that he had no doubt a specimen would yet be discovered exhibiting a certain structure, which he illustrated by a drawing on the board. Murchison, who was in the chair, thereupon pulled out from a drawer a specimen which had just come up from Scotland and had not yet been exhibited. It completely bore out the prognostication. Agassiz had been listening to the tale with undisguised interest, and when Mr. Ticknor turned round and pointing to him said, "There is the man," he started up flushed with excitement and exclaimed, "It was the proudest moment of my life." Such anecdotes affectionately preserved show how he lives in the memory of the community he strove so earnestly to benefit. The little misunderstandings which are always sure to arise in the pathway of a man absorbed in one great aim are now forgiven and forgotten. Men remember that it was not for himself but for the cause of science that he solicited and strove.

Among the younger men of science the influence of the teaching and example of Agassiz has been profound. It is not that they have adopted his views or even that they have chosen his branch of science. On the contrary many of them have espoused evolutionary doctrines against which he protested, and have taken to sciences remote in subject from his. But he infused into them a genuine love and enthusiasm for scientific progress. By this common sentiment they are united in a bond of sympathy which cannot but be very helpful to their own studies and to the advancement of science. One of the most interesting tokens of this community of feeling is the establishment of a club or society which has no name, no office-bearers, and no laws, but which has for its object the reunion of its members for social intercourse at stated intervals. It began its existence in a meeting of two or three of Agassiz's students, and now it has drawn into its circle most of the scientific zeal and ability of the younger men of the district. Nor is it wholly confined to the younger generation. At one of the simple but most excellent and jocund dinners of the club the writer of this notice found the genial and universally beloved veteran in botany, Dr. Asa Gray, as well as that long-tried explorer of the deep sea, Count Pourtales.

Nor among the benefits bequeathed to Harvard by Agassiz can we forbear an allusion to his son. With enthusiasm not inferior to that of his father and with an ample fortune for the furtherance of his views, the present distinguished keeper of the Museum of Comparative Zoology is gathering together at Harvard the most extensive and valuable collection of recent invertebrate zoology in the world. So far as exhibition space will admit, a large and varied series of specimens is displayed. Some departments are marvellously rich. The dredgings by Prof. A. Agassiz and Count Pourtales have supplied a large suite of living corals, some of them undistinguishable from Tertiary Mediterranean species. In one of the rooms is an altogether unique collection of crinoids from the Carboniferous Limestone of Burlington. A European accustomed to the usually fragmentary condition of palæozoic echinodermata can hardly at first believe that these exquisite specimens of many species and genera, with every plate and joint in position, come from so ancient a formation. As at Yale, cellars are crowded with treasures awaiting examination and display. The work-rooms attached to the Museum are likewise full of material in all stages of investigation, and bearing witness to the amount and value of the original research carried on here by Prof. Agassiz, Count Pourtales, and their assistants. The only regret a visitor can justly express is that the plan of the building has not secured a larger amount of internal light. The windows at the sides form the only entrance for light, and they are not large or numerous enough for the size of the rooms. Would it not be possible, in the contemplated additions to the Museum, so to modify the plan as to secure, at least for the exhibition galleries and floors, some amount of light from the roof?

Within the walls of the Museum Prof. J. D. Whitney has accommodation for geological work. He is engaged in the completion of the memoirs of his great Californian survey. He has recently issued the first part of an exhaustive monograph of the auriferous gravels of California, which is published in the *Memoirs of the Museum of Comparative Zoology*. One of the most generally interesting and important features in this essay is the cautious and masterly way in which the author states the evidence for the existence of human remains in the gravels beneath sheets of basalt, and at a depth of 130 feet from the surface. It is impossible to resist the cogency with which he marshals the facts and maintains the genuineness and high antiquity of the Calaveras skull. The second portion of the memoir, devoted to a discussion of the origin of the auriferous gravels and of the glacial phenomena of the Pacific coast and of North America generally, is awaited with much interest. Prof. Whitney, in the course of his prolonged researches in the west, made a large and important collection of rocks. These are now being carefully investigated by his associate, Dr. M. E. Wadsworth—a young petrographer, who in recently taking the degree of Doctor of Philosophy at Harvard, presented, as his thesis, a remarkable essay on rock classification, largely based on these collections. The Professor, with the devotion to geology which has characterised his long and distinguished career, carries on this work at his own expense. The results will be published in full in the *Memoirs of the Museum of Comparative Zoology*.

There is much more than the name of Cambridge to remind one of its namesake at home. Its quiet air of studious retirement, its quaint buildings and tree-shaded walks have much of the mother-country about them. One or two features of the place, however, are characteristically American. Thus in the great library at Gore Hall, most of the work of receiving and distributing books is done by young women, and done, too, with a noiseless decorum and celerity worthy of all praise. A magnificent Memorial Hall to those graduates of Harvard who fell in the late Civil War bears witness in its crowded lists of names that culture and courage may go hand in hand. The simple eloquence of these lists, where every class and division of the faculties is represented, brings home to the mind in a startling way the terrible realities of a war. May the occasion never arise for another range of tablets either there or here!

While Harvard is necessarily the great centre of scientific research, much admirable work is done in Boston in the way of practically expounding science. The Institute of Technology has for its primary object the education of the community in these branches of scientific knowledge conducive to progress in the arts and industries of life. In pursuance of this aim the methods of tuition are so practical and thorough that the results must be felt far beyond the industrial circles. Established mainly through the enlightened zeal of the present venerable President of the National Academy, Prof. W. B. Rogers, it began a few years ago to languish, but its founder has recently come back to its rescue, throwing himself into its affairs with all his old heartiness and kindliness until, freshened and stimulated by his influence, it is once more shooting up into lusty vigour. But besides this establishment, wholly devoted to scientific instruction, the Boston School Board has made the practical teaching of science an important part of education in the public schools. At an early age the pupils are led to take an interest in physiology by references to the experience of their own bodies, and thus the laws of health are firmly lodged in their minds. From simple beginnings they are conducted through successive years of progress and are well grounded in physics, chemistry, botany, and zoology, until before they leave, if they choose to go so far, they are found at work in laboratories repeating experiments, making analyses, or dissecting plants or animals. The thoroughness of the whole system, and the length to which such State-paid education goes (for it must be remembered that all this training is free), would make most members of our School Boards stand aghast, were any utopian to propose its introduction in this country.

A student of science from this side of the Atlantic besides finding himself at home among lovers of science in New England is astonished and gratified to find that if he has himself done anything to advance our knowledge of nature, his work is as well known there as at home. The welcome he receives is all the heartier from men who have long known him by name and have come already to regard him as in some measure a personal friend and fellow-worker. A brotherhood of this kind, so cosmopolitan, so genuine, and so kindly, carries with it an enduring helpfulness. One comes away from a participation in it strengthened and cheered, with wide enlargement of ideas and sympathies that seem to fill the mind with aspirations and to brace the whole frame for endless exertions to achieve them. Undoubtedly, in spite of all that demagogues may declaim, there is in American society of the more cultured kind a deep undercurrent of affection for the old country. It shows itself in many ways and sometimes crops up unconsciously and almost to the confusion of the native-born American as if he would rather be thought indifferent in the matter. The writer is tempted to conclude with an illustrative story told him by a Harvard friend to whom the incident occurred. Some years ago, just at the time that the famous pamphlet, "The Battle of Dorking," was making a stir in the States as well as here, this friend was in Kentucky with an acquaintance of his who, like so vast a number of his countrymen, had been engaged in the Civil War, and had lost heavily in friends and fortune. This man knew well what were the horrors of war, yet after he had finished reading the pamphlet, and was appealed to by his companion as to what he would do if the picture drawn in its pages were a reality instead of a fiction, he paused and after a little reflection replied, "Well, I think I'd have to go for the old country." There are many thousands of Americans who would have no objections to thrash England themselves, but who would not sit quietly and see the castigation bestowed by any other people.

A. G.

PLANTÉ'S "RESEARCHES IN ELECTRICITY"

Recherches sur l'Électricité. Par Gaston Planté. (Paris, 1879.)

M. GASTON PLANTÉ has published, under the above title, the elegant and important electrical researches which he has pursued with so much success during twenty years, and with many of which the readers of NATURE have been made familiar from time to time.

The basis of these experimental researches is the *secondary battery*, originally devised by Ritter, but which in M. Planté's hands has become developed into what is practically a new and important source of electricity. M. Planté, by employing for his secondary cells large plates of lead immersed in dilute sulphuric acid, charged by a small Bunsen's or Grove's battery, and by arranging the secondary cells in such a manner that they can be charged in multiple arc, and discharged in series, obtains during the ten minutes or so during which the discharge continues currents not only of as great electromotive force as would be obtained from a Grove's battery of a much larger number of cells, but also of much greater "quantity;" the internal resistance of these secondary cells being excessively small.

In studying the construction and operation of these secondary batteries, M. Planté has brought to light a large number of interesting facts. He finds that such batteries improve with use, the two lead electrodes gradually becoming spongy, thereby holding in loose combination larger quantities of the oxygen and hydrogen gases, respectively, than new plates of lead. He observes several highly suggestive analogies between this electro-chemical accumulation of the energy of the current, and the electrostatic accumulation of the Leyden jar. This analogy extends even to the existence of a residual charge. It appears that the electromotive force of such a cell well charged may be as high as 2·7187 volts, while the internal resistance may be as low as 0·05 ohm, and that the actual quantity of the primary current which may be realised after being thus accumulated amounts to 88 per cent. These data are given amongst the stores of information in the first section of M. Planté's work. The second section treats of the practical uses which have been made by M. Trouvé and others of the currents from secondary batteries, and which embrace a wide range of applications, chief amongst which is the application to surgical cautery by means of wires raised to a white heat, for which operation a powerful current of short duration only is required. Another suggestion, to employ such batteries as accumulators of the current supplying electric lights, has already been seized upon by more than one inventor, amongst others by Mr. Edison.

The third section of the work before us deals with sundry phenomena produced by the discharge of the powerful currents of large secondary batteries. To obtain these effects M. Planté has used batteries of from 200 to 800 secondary elements. Luminous liquid globules and delicate flame-like aureoles are produced at the surface of liquids when the current is led into them under certain conditions: even a globule of fused mica has been produced by the current, and wandered about in a manner suggestive of the alleged behaviour of the "balls of fire" sometimes accompanying violent thunderstorms. The discharge may even be employed to write upon glass which is etched away under the negative pole of the secondary battery. The many analogies presented by these experiments with some of the less understood of natural phenomena, globular lightning, auroræ, and wreathed lightning discharges, &c., are treated in detail in the fourth section. M. Planté considers the "Fire of Saint Elmo" to be a phenomenon of discharge of negative electricity, whilst he compares the globular lightning to the phenomena observed in the discharges at the positive pole of his batteries. One of the most curious of his speculations is that concerning the spiral nebulæ, which he compares with the spiral forms produced at the negative pole when dilute acid is electrolysed by a moderately strong current between copper electrodes in the presence of a powerful electromagnet. These "electrodynamic" spirals consist of streams of particles of oxide of copper whirled off from the end of the electrode and which, conducting the current, undergo a rotatory displacement under the influence of the neighbouring magnet. These spirals, which therefore indicate the lines of flow of the current, resemble the spirals obtained by the present writer in iron filings under the joint influence of a magnet and a current traversing it longitudinally, and which differed from those of M. Planté in indicating lines of magnetic induction, not lines of current flow. So strongly does the analogy of form weigh with M. Planté that he asks (p. 243) whether the nucleus of a spiral nebula is not truly an "electric focus," and "whether the spiral form is not probably determined by the presence in the neighbourhood of strongly magnetised heavenly bodies!" Another astronomical analogy is discovered by the author between the sun-spots and certain "crateriform perforations" which are produced in moistened paper beneath the positive pole of the secondary battery.

The fifth, and last part of the work, explains the construction and operation of the author's "rheostatic machine," which is a series of mica condensers which are charged in multiple arc from a battery of 600 or 800 secondary elements, and discharged in series in very rapid succession. This instrument is capable of producing almost continuously the effects of intense discharges of statical electricity, and promises to prove of great utility as an instrument of research.

We have preferred to give the reader a brief *résumé* of the contents of this delightful narrative of researches, rather than to criticise in detail the many salient points which it presents. Experimental researches of the present day are seldom conducted with such patient and ingenious endeavour as those now published in M. Planté's volume. The student of electrical theory will find in them but little that he did not know before. The phenomenal not the theoretical aspect of the question is ever uppermost; and in default of theory there is a tendency to ride *the analogies* too hard. But none can help admiring the beauty and originality of the experiments here recorded, nor doubt the very high value of the results obtained. There will, too, be many readers who will long that all treatises on experimental science were written in so clear, concise, and elegant a style as that of the author.

SILVANUS P. THOMPSON

NATURAL HISTORY OF THE ANCIENTS

Gleanings from the Natural History of the Ancients. By the Rev. W. Houghton, M.A., F.L.S. Illustrated. (London: Cassell, Petter, and Galpin, 1880.)

THIS interesting volume consists of a series of short lectures treating of most of the animals known to the early inhabitants of Egypt, Palestine, Assyria, Greece, and Rome, from the oldest historic period down to about the middle of the third century of the Christian era. Referring to his sources of information the author expresses his acknowledgments to the Biblical and Assyrian records and the classical writers of Greece and Rome. Alluding to Aristotle's work, "The History of Animals," he quotes Lewes's well-known remarks thereon, which, while he will not fully endorse, he yet on the whole agrees with.

The author warns the reader not to expect an exhaustive treatise on the subject; the avowed object, as the title indicates, being but gleanings picked up almost at random from a spacious field; indeed, a volume quite as large might be written on only those domestic animals known to the ancients. If not a complete history, these "Gleanings" are, however, very pleasant reading, deeply interesting to the intelligent student, and making him wish for more. In some cases a little more information would be useful, and we would venture to suggest to the author that in another edition he might with advantage add more details about the very early history of some of the best known of the animals which he has selected for notice. Thus the Egyptians were the only people amongst the ancients who habitually domesticated the common cat; with them it was a great favourite, and we would certainly have liked a little more of what the author could have told us about the cat as it is found in an Egyptian home; had it a pet name there? and is it not strange that the children of Israel do not seem to have come across it during their lengthened sojourn in that strange land? In another edition the references should be quoted at greater length; thus the general reader could scarcely be expected to know that the translation of Prof. Gubernati's interesting work on "Zoological Mythology" is referred to as "Guber. Zool. Myth."

The Egyptian dog is acknowledged by the author not to come up to the standard of modern European views of canine beauty; but he is not so severe on them as Mr. Mahaffy, in whose eyes the house-dogs appear to have been worthless curs, and the hunting-dogs more like those lanky creatures kept by some of the Irish peasantry for an occasional Sunday coursing match (Mahaffy, "Prolegomena of Ancient History"). The author states that the Egyptian monuments anterior to the date of Amosis (about B.C. 1500), of the eighteenth dynasty, give no representation of horses, but considers it would not be safe to conclude from negative evidence that the horse was not introduced into Egypt anterior to that date. Leaving the date of the papyrus Sallier to be settled by experts, but presuming it from Mr. Goodwin's Essay ("Cambridge Essays," 1858) to relate to events about the time of the Exodus, we find such allusions as "The horses of my lord are well," and "His ploughshare, which is of metal, corrodes, the horses die through the labour of ploughing;" the latter is very remarkable for being part of the complaint of an agricultural tenant; these would show that at this date—possibly the date of the years of famine—horses, were then employed in field work.

The common pig formed part of the farmyard stock of the Egyptians, and the author thinks that they were kept as probably useful in treading in the corn after it was sown, and he quotes Herodotus and Ælian as describing the process; neither author says anything about the pigs being muzzled when performing this useful part, but they are shown as such on a Theban sculpture referred to.

The section about the pigeons might be greatly expanded; there is next to nothing told us about the pigeon as known to the Egyptians and Hebrews, and though there is a woodcut from an Assyrian sculpture showing hare and birds, yet there is not a word in the text as to the hare being known to the Hebrews and Assyrians.

The second part of the volume on wild animals is nearly equally interesting as the first. In it we read of the lion, hyena, stag, wild bulls, boar, vulture, pelican, ostrich, and many other birds, as well as of several species of fish, known in the olden times.

OUR BOOK SHELF

Bulletin des Sciences Mathématiques et Astronomiques. Deuxième serie, tome iii., avril 1879. (Paris.)

THIS number opens with abstracts of works by H. Lemonnier ("Mémoire sur l'Élimination," Paris, 1879); E. Schering ("Analytische Théorie der Determinanten," Göttingen, 1877); and an interesting note by S. Kantor ("Quelques Théorèmes nouveaux sur l'Hypocycloïde à trois Rebroussements"). Our present object is, however, to take notice of two long articles by M. G. Darboux, (α) "Sur un nouvel Appareil à Ligne droite de M. Hart" (7 pp.) (β) "Recherches sur un Système articulé" (42 pp.).

(α) is founded on a five-bar linkwork, described by Mr. Hart in the eighth volume of the *Proceedings* of the London Mathematical Society (p. 288), which M. Darboux looks upon as a construction of great interest. The writer explains Mr. Hart's method and slightly generalises it, getting the following results: (1) an ellipse and Pascal's limaçon can also be described by the linkwork; (2) a movement of a straight line which always remains horizontal whilst its several points describe vertical straight lines. By means of a duplication of the apparatus, "on pourra poser une table sur ces droites, et l'on aura ainsi la disposition la plus simple connue, permettant de réaliser un mouvement parallèle dont les applications sont évidemment très-variées."

(β) is a discussion of Mr. Kempe's "recherches très-interessantes" "On Conjugate Fourpiece Linkages" in the ninth volume of the *Proceedings* of the same Society (pp. 133-147). M. Darboux remarks that Mr. Kempe has considered one interesting case only, that, viz., "où les équations sont des identités et où par conséquent la déformation de la figure est possible." He praises the ingenuity of the method employed, and says that Mr. Kempe has arrived at a large number of solutions of a problem which, *à priori*, would be thought to have none. He then proceeds to attack the question in a more general manner, connecting the problem with the use of Mr. Hart's apparatus, referred to in his paper (α). "La marche qui j'ai adoptée repose d'une part sur l'emploi des *grandeurs géométriques* dans le plan et sur leur expression bien connue au moyen d'une variable complexe, et d'autre part sur les recherches que j'ai publiées récemment[1] et d'après lesquelles la théorie du quadrilatère articulé est identique à celle d'une cubique plane, que j'appellerai *cubique associée au quadrilatère.*"

Denoting the outer quadrilateral of Mr. Kempe's figure by $MNPQ$, and the inner by $M'N'P'Q'$, M. Darboux calls them respectively the quadrilaterals T, U, and the associated cubics he calls the cubics T, U, and taking $t, t', t'', t''', u, u', u'', u'''$ as the co-ordinates of a point in space with reference to the two cubics, he finds the conditions that a certain group (4) of equations between these co-ordinates shall be satisfied by an infinite number of values of the t's and u's. He regards these equations, when the movement of the figure is possible, as establish-

[1] P. 109 of the *Bulletin* for March, 1879.

ing a correspondence between the t points of the cubic T associated with the quadrilateral T, and the similarly determined u point, and proceeds to examine all the cases in which this correspondence is uniform, *i.e.*, when to a point of each curve corresponds a single point of the other curve. He then shows that all other cases may be reduced to this case of uniform correspondence. His conclusion, after a discussion of these equations of condition, is that *there are no other solutions besides those deduced from the uniform correspondence* cases. He establishes coincidences with most of the cases discussed in Mr. Kempe's paper, and arrives at one new case, viz., when Mr. Kempe's triangles reduce to straight lines coinciding with the sides respectively of T and U.

Our object has been to draw attention to what we look upon as a valuable pendant to the last-named gentleman's Researches in Linkworks.

Lecture Notes on Physics. By C. Bird, B.A., F.R.A.S. (London: Simpkin, Marshall, and Co., 1880.)

THE author says in his preface that the book "may be supposed to represent the notes, somewhat expanded, which the teacher would desire the class to take down and learn." If so, the "notes" before us would certainly merit a good deal of attention from the teacher's red-ink pen. Of its 178 pages, 68 are taken up with examination papers of the Science and Art Department. The various branches of physics are very unequally treated. Occasional blunders are frequent. Thus on p. 27 we are told that "Writing m for the refractive index, the critical angle for any medium is $\frac{1}{m}$." On p. 2 Laplace's correction of the velocity of sound for the adiabatic conditions is stated to be the ratio of the two specific heats of air, when it should be the square root of that ratio. On the very next page we are told that the amplitude of a sound-wave varies inversely as the *square* of the distance from the source, and that *therefore* the intensity falls off in the same ratio; whereas in fact the intensity is proportional to the square of the amplitude. Under the heading "Electrometers" we observe that the only instruments named are the quadrant pith-ball electroscope, the torsion balance (which is not even described), and the unit-jar! But one could hardly expect accuracy of an author who allows himself to talk about "force" being "converted into heat."

Diagrams of Zoology. Sheet I. and II., with handbooks thereto. By Dr. Andrew Wilson. (Edinburgh and London: W. and A. K. Johnston.)

THESE sheets are meant to serve as important adjuncts in the way of illustrating a series of lectures on the classes to be met with in the animal kingdom. They have been drawn and coloured under the direct superintendence of Dr. A. Wilson, and are accompanied by a handbook to each sheet which contains full descriptions of each figure. They will no doubt be found most useful for the purposes of science classes in our public schools, and in them illustrations of recently described forms will be found. For example, under the kingdom of the protozoa, we find no less than five figures representing that low form of animal life called by Hæckel *Protomyxa aurantiacea*, one of the Monera.

LETTERS TO THE EDITOR

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

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

The Exploration of Socotra

WOULD you allow me, on behalf of the Committee of the British Association for the Advancement of Science for the Exploration of Socotra, to state in your columns that we are anxious to find a competent naturalist to proceed to Socotra early next year, the gentleman whose services we had hoped to secure being unfortunately unable to undertake the task. The expedition will be but a short one, as it would be useless to remain in the island after April.

It would be desirable that the explorer should have some acquaintance with Arabic and some local knowledge of the surrounding districts.

P. L. SCLATER

11, Hanover Square, W.

Monkeys in the West Indies

IN reply to the inquiries of Mr. Watt (NATURE, vol. xxi. p. 132), I send you the following extract from the *Proceedings* of this Society for February 13, 1866.

"Mr. Sclater called the attention of the meeting to three monkeys recently received from the Island of St. Kitts, West Indies. Mr. Edward Greey, Fellow of the Society, having reported the existence of monkeys in a wild state in considerable numbers upon this island, had been urged by Mr. Sclater to attempt to obtain some specimens, in order that it might be ascertained to what species they were referable, as it had always been believed that there were no native Quadrumana in the Lesser Antilles. Through the assistance of Mr. John Carden, of St. Kitts, Mr. Greey had succeeded in obtaining a specimen of this monkey, and two others from the same island had at the same time been presented to the Society by Mr. H. B. Cameron, Superintendent of the R.W.I.M.S.P. Company, at St. Thomas's. The animals were undoubtedly referable to the common green monkey (*Cercopithecus callitrichus*, Geoffr.) of Western Africa, and must have been introduced years ago, as they were stated to be now very abundant in the woods of St. Kitts, and to cause great damage to the sugar-plantations."

As regards Trinidad, where true American monkeys (*Cebidæ*) are certainly found, it should be recollected that, zoologically speaking, Trinidad is not one of the Antilles, but a little bit of Venezuela, broken off at no very remote period.

Prof. Mivart and Mr. Bates are, therefore, correct in saying there are no *indigenous* monkeys in the Antilles.

P. L. SCLATER

Zoological Society of London, 11, Hanover Square, W.

Is Mount Unzen a Volcano?

IN a recent visit to the Simabara Peninsula, about twenty miles east of Nagasaki as the crow flies, an opportunity was afforded me of ascending "Unzen," a mountain which rises about 4,700 feet above the sea (by aneroid). If tradition is to be believed "Unzen" is an active volcano, the subterranean fires of which have been slumbering since the close of last century, when a disastrous earthquake, accompanied by a volcanic eruption, destroyed 53,000 of the inhabitants of the district. But I failed to find any trace of a recent volcano, which, wherever it may be, is certainly not situated in the higher peaks of the mountain, where popular belief has located it. From the sea-level up to the highest summit a porphyry is the ever-prevailing rock, which varies somewhat in different parts of the peninsula. True it is that from many points of view Unzen has somewhat the form of a truncated cone, but there the resemblance ends.

There are, however, three hot sulphur springs, which may help to explain the popular error on the subject. One of them is situated in the fishing village of Wobama, at the foot of the mountain, and close to the water; a strong odour of sulphuretted hydrogen scents the air, and the thermometer placed in the water rose to 112° F. Rather more than 2,000 feet above the sea are the hot springs of Kojeego and Unzen. In the former place the water bubbles up into a pool some ten or fifteen yards across, with a temperature of 182°, while at Unzen the hot springs are on a far more extensive scale, numerous springs bubbling away furiously over an area of several acres, which is completely destitute of vegetation. The ground is often so hot that with a thick pair of boots one cannot stand long on the same spot. The thermometer rose as high as 202°, which would be only about 6° below the boiling-point of water at that elevation, and a dense cloud of white smoke ascended into the air which was strongly impregnated with the same sulphureous odour. The chemical and thermal influences of these hot sulphur springs have produced a singular effect on the porphyry of the immediate locality; while the rock has a tendency to lamination, its disintegrated felspathic constituents whiten the whole surface, and the neighbouring hill-slopes overlooking the springs are as white as any chalk-cliffs from the same cause. This phenomenon is only to be found in the immediate vicinity of the hot springs.

It is with the hope that these few notes may be the means of eliciting further particulars, especially as regards the history of this so-called volcano of Unzen, that I venture to send them to NATURE.

H. B. GUPPY,
Surgeon H.M.S. *Hornet*
H.M.S. *Hornet*, Nagasaki, October 13

Astronomical Subject-Index

I AM preparing for publication, by the Royal Dublin Society, a review of the progress of astronomy during the present year, consisting of a classified index catalogue of books, memoirs, and notes on astronomical subjects published since the beginning of the year, and, secondly, of a short account of the contents of the more important papers in the various branches of astronomy.

Any person who has felt the want of such a "subject index" could assist materially in the undertaking by sending me, as soon as possible, the titles of such papers as seem likely to be overlooked on account of having been published in less widely-diffused periodicals or transactions. In particular I would be glad to hear of papers published quite recently in transactions or proceedings of learned societies, as these often are not distributed until some time after their publication.

J. L. E. DREYER
The Observatory, Dunsink, Co. Dublin, December 11

Distinguishing Lights for Lighthouses

A propos of your article on Sir William Thomson's letter in the *Times*, and the dangers to ships from bad systems of distinguishing the lights of different lighthouses, I send you the accompanying graphic account by my brother, Mr. J. P. Thompson, of a narrow escape from shipwreck which occurred to him during the autumn of the present year, and which illustrates the urgent need for reform in the adopted system.

SILVANUS P. THOMPSON

"All went well till off Ushant, when the wind began to rise, and by Saturday afternoon the Channel was heaved up by what was logged as a 'moderate gale' from the south-west. This kept freshening every hour, and at 7 P.M., when the lamps were being lit, the captain said we should have a very 'dirty night,' and he accordingly donned his oilskins and 'sou'-wester.' The atmosphere began rapidly to cloud, and at 9 o'clock you couldn't see more than a ship's length or two ahead. As we were in a crowded track of vessels, the watch look-out was doubled. . . . At 11 I was on deck again, and found all looking out eagerly for either the St. Agnes (Scilly) or the Wolf Light, the latter being near the Cornish coast. Of these lights the St. Agnes shows a white light at each revolution of a minute, whilst the Wolf is the same, but with a flash of red between. The sea was very phosphorescent, and this dazzled the eye when looking for lights. I was set as a look-out on the starboard quarter, and many times had to go aft for the captain to see how she lay by the compass abaft (she was being steered at the wheel in an iron wheel-house on the bridge.) . . . About midnight we sighted a light, and on timing it, found it to be a white light of a minute's revolution; we looked in vain for a red flash between the whites, as we knew we ought to be near the Wolf. But in the fog not a 'smell of red' could be discerned, although by the rate at which we passed it we must have been very near it. Supposing, then, that there was no red flash, this must be the Scilly light, and the captain accordingly steered more easterly, so as to fetch the Wolf. He nevertheless hardly thought we had got so far to the west as the Scilly, so he ordered a sharp look-out to be kept for breakers or land. At 3.30 I turned in again, but at 4 A.M. I suddenly heard the look-out cry out 'Land! breakers ahead!' and then I heard the captain run to the telegraph, and heard the bell ring in the engine-room, and the captain's sonorous voice calling 'All hands! square away the yards! 'bout ship!' I jumped up, and ran on deck, and there right ahead the fog had just lifted to show us we were almost ashore, heading straight on Penzance; so near, indeed, were we that I could have easily counted the houses. Happily the ship, answering her helm well, came round beautifully, and at the same time the fog closed again, hiding the shore and the dreaded rocks. So after all it *was* the Wolf light we had sighted, *but the fog had prevented us from seeing the red flash*. It was a narrow escape, though; and then we had to beat back in the teeth of the gale, and it took us six hours to beat back to the Land's End."

The First "Sin"

IT occurred to me lately, whilst reading in the September number of the *Contemporary Review*, an article by Lenormand called "The First Sin," that it may be possible to turn another page of that very interesting history of ideas, the reading of which appears to be one of the great tasks allotted to this century. Although it seems unlikely that the idea suggested to me by the article has not also occurred to others, I cannot discover that anything has been said about it, for the author seems strangely enough to lead one to the door, as it were, and leave one there without opening it; I should therefore like, if you will permit me, to lay it before your readers, and hear what they have to say about it.

My idea is this: that the tradition of a tree of life, and also of a tree of the knowledge of good and evil, both connected with a sin and a catastrophe, probably originated in man's first acquaintance with the effects of intoxication.

Lenormand himself connects that tradition with the worship of Bacchus (and also with the theft of fire in a piece of a tree by Prometheus, and with that of the apples of the Garden of the Hesperides). It seems strange, therefore, that he goes no farther, more especially as he himself points out that the representations of the tree on the monuments of different nations are always referable to those from the fruit or foliage or crushed branches of which an intoxicating liquor is derived; from the Soma tree, that is, and the palm and the vine.

There is no need to burden your pages with proofs and quotations, as any one interested in the subject can procure the magazine now at half price; I will merely add to my suggestion that, as the primitive notion of life must have been characterised by warmth and motion, and the first effects of the fruit of the tree would also be, probably, warmth and excitement, exhilaration and the temporary exaltation of some of the faculties, it would easily come to be looked upon as a "tree of life;" and that, the after-effects being bad and degrading, it would thereby become a tree of the knowledge of evil as well as good, and also the cause of a fall into a lower state of being.

May I add a suggestion concerning the serpent always connected with the tree, as on the early Babylonian cylinder figured on p. 91 of George Smith's "Chaldean Account of Genesis"? It appears to have represented the principle of evil very early, probably long before it was connected with the tree, and to have been at first the sea, which in a storm was the chaos out of which everything was formed, and which, as it seemed to swallow up sun, moon, and stars, and to bring forth the storm-clouds—those monsters with which the sun-god fought with his arrows the lightnings—came also, not unnaturally to represent the destructive principle. But how did it become a serpent? May it not have been the singular resemblance that the edge of the sea—as seen from a moderate height in a calm—bears to a huge serpent—now blue, now white, according to the amount of foam—winding and writhing about the earth, and eating out its rocks and shores, that caused its destructive attributes to be transferred to the serpent? A common name may have been the means. The resemblance is especially striking when the eye looks along the shore, as in the bend of a bay.

Another suggestion. Some years ago, when reading the description of the locality of the Battle of Beth Horon in Dean Stanley's work on Palestine, it seemed to me to point to the origin of the tradition of the sun and moon standing still at the command of Joshua, and I do not think it has been noticed. In any valley lying north and south, if one goes up the western hills as the sun sets to the valley, when one reaches the summit the effect of a new day and a fresh supply of sunlight is very striking. This sensation must have been strongly felt by the warriors of Israel, when, after pursuing their enemies up the pass, the still sunlighted valley beyond broke upon their sight; and I cannot but think that, figuratively expressed, as it would be, and with much exaggeration, in the triumphal song sure to have been made and sung after the victory, it may well have originated the tradition of a standing still of the sun; the moon would follow suit. The songs are said to be the oldest parts of the Bible, and "Jasher" or "The Upright" may have been the singer or recorder of the lost song of triumph.

J.

The "Encyclopædia Britannica"—The Nile

THE volume of the Nile is made a thousand times greater than the truth in the new "Encyclopædia," vol. vii. p. 706, art. Egypt, by an error copied from the last edition. The same mistake occurs in Rawlinson's "Herodotus," vol. ii. p. 7, Note GW.; in the Geographical Society's *Journal*, vol. xix.; in Fullarton's *Gazetteer*, and probably elsewhere, and some fables have been founded on it.

I observed the error myself some years ago, after being perplexed by it in some rainfall estimates, and mentioned it to the late Sir Gardner Wilkinson, who intended to have it corrected; but there has been no fresh edition of the "Herodotus," and it has escaped revision in the "Encyclopædia." As it illustrates a special danger, easily overlooked, in copying French figures, it deserves perhaps a few lines in NATURE to put it right.

In English notation we mark decimals with a point, and use commas to divide periods; but the French generally use commas to mark off decimals. The authority for the volume of the Nile is Linant's measurement, given by Clot Bey in the "Aperçu général sur l'Egypte," tome i., pp. 40, 41, and the figures are given as follows, in cubic metres of water discharged into the Mediterranean at full flood in twenty-four hours:—

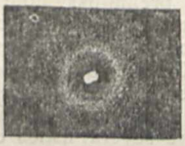
English authorities	705,514,667,440
Linant	705 514 667,440

The last three figures are decimals, and the quantity is in millions, not in thousand millions. ALBERT J. MOTT

December 14

Lunar Rings

ACCORDING to your suggestion I have followed up my experiments with lunar light on bromo-gelatine plates, and at midnight on November 28, for the third time at full moon period I



obtained on one plate three well-defined rings round the photographic image of the moon with 1 minute, 1½ minute, and 2 minutes' exposure.

The 1 minute exposure is fainter than the above woodcut, the 1½ minute the same in density, and the 2 minutes' exposure is denser and more defined; while six consecutive nightly observations previous to the 28th failed to give any vinculum or indication of refraction of light.

One of the six taken on the night of November 24 with *two hours'* continuous exposure gave a bright clean well-defined line 2½ inches long, gapped here and there by passing clouds, but not the slightest indication of blurr or dispersion was shown on the brightest parts of the line.

Whether the cause which produces these rings at full moon phase *only*, depends upon the greater effulgence of lunar reflection at that particular time; whether it is cosmical or atmospheric in its nature, or optical or chemical, there can be no doubt that there is refraction of the lunar light; the existence of a dark space between two luminous (or more correctly speaking actinised regions) as manifested by the above annular *periodical* impressions is a clear indication of the dispersion of light, but how, why, or where the decomposition takes place is not so obvious.

Sunderland, December 5 GEORGE BERWICK

Stag's Horns

IT is well known to be the universal belief in the Highlands that stags eat the horns they shed, and every gillie will tell you that no one ever picked up a horn. Can any of your readers inform me what really becomes of them?

There must be abundant opportunities of observing the whole process in places like Windsor Park, where red deer are kept in a domesticated state. G. W. H.

ON A NEW COPYING PROCESS

A VERY elegant process has recently been introduced into this country for copying and multiplying letters and documents. It is known by various names, according to the etymological skill of the makers. One calls it a "hektograph," another less pardonably calls it the "centograph," while yet another, to bridge the gap between ancient Greek and modern English, styles it the "printograph." But whether it is introduced by these names, or the polygraph, the compo-lithograph, or the velocograph, the principle is the same; though the details are slightly varied in each case. A slab of gelatinous material in a shallow tin tray forms the type. The letter is written with a special ink on any kind of paper, and when dry is placed face downwards upon the jelly, and allowed to remain a minute or more. On removal it is found that the greater part of the ink has been left behind on the jelly. It is only necessary to place pieces of paper on the latter, and on their removal they are found to be perfect fac similes of the original copy. The number of copies obtainable varies with the ink, the most potent being aniline violet, such as Poirrier's. With this a hundred copies may be produced. Others, such as Bleu de Lyon, Bismarck brown, or Roseine,[1] yield forty to fifty. It was with a view to determine the principles which govern this beautiful process, that I made an examination of the subject. The slab consists of gelatin and glycerine, with carbolic or salicylic acid to prevent fungoid growth, and in the "chromograph" a quantity of barium sulphate is added, which gives the slab a white, enamel-like appearance.

If a hot, strong solution of gelatin in water be prepared,[2] and then a certain quantity of glycerine stirred in, the whole mass will become solid in cooling. This might at first sight appear to be a solution of gelatin in water *and* glycerine; but such is not the case, the gelatin being quite insoluble in glycerine. When the aqueous solution solidifies, the gelatin still retains the water, but the large quantity of glycerine being dispersed through the mass, makes the whole into what is practically *a very fine gelatin sponge containing glycerine in its pores.*

The moisture-loving nature of the glycerine prevents the "sponge" from getting dry, while the insolubility of the gelatin in the glycerine prevents its becoming liquid. When the copy is placed on the jelly, the glycerine comes out to meet the ink, for which it has an intense liking. All the suitable inks are freely soluble in glycerine. Some, too, contain acetic acid either in the free state or in combination with bases as in rosaniline acetate. The acetic acid exerts a solvent action on the gelatin, so that it will be found that after taking off some impressions with an acetic acid ink, as the "multiplex," the jelly will be etched wherever the ink has come into contact with it. As long as any of the ink remains on the jelly, the glycerine will come out of the pores to keep it moist, but when the whole of the ink has been removed the flow of glycerine ceases, and the parts become quite dry. If the ink is not entirely removed by taking a sufficient number of impressions, and the jelly left, after a lapse of twenty-four hours the remaining ink will be absorbed by the jelly. It is necessary, therefore, that the copies should be taken off as soon as possible, so as to avoid the defect caused by the spreading of the ink.

Most of the makers suggest, that directly the slab is done with, the type should be washed off. The hektograph and most others require that the water should be warm, but the finely divided barium sulphate in the chromograph, renders the surface less tenacious, and the impression may be removed with cold water.

Where practicable, it is better in all cases to leave the slab for twenty-four hours, when the old impression will be quite absorbed, and not interfere with a new one.

This gelatin copying process has been received with so

[1] A very potent and easily prepared ink which will yield a hundred copies, may be made by dissolving rosaniline in a cold-saturated solution of oxalic acid. It must be allowed to dry spontaneously.

[2] 4 oz. gelatin dissolved in 6 oz. water, and 20 oz. glycerine, sp. gr. 1·26, previously warmed, stirred in. Any air bubbles in the gelatin are removed before the addition of the glycerine. A cheaper compound which answers equally well, but is rather darker, consists of Scotch glue 6 oz., water 8 oz., glycerine 20 oz. These quantities make a slab 10 × 13 × ¼.

much favour by the public, that it shows there is a great want for some rapid means of getting a limited number of copies of letters, &c.; and seeing that any number of colours may be used in the original drawing, Mr. Norman Lockyer has suggested that it would be of much use in laboratories, for the multiplication of original sketches of biological specimens, and even for spectra charts, and so save much of the time spent in making duplicate copies. The gelatin slab cannot be said to be perfect, as it is liable to be affected by atmospheric changes; but, bearing in mind the fact that the whole is simply a sponge filled with a compound capable of liquefying certain inks, it is reasonable to hope and expect that chromography is only the pioneer of a process, which shall possess all its advantages and none of its defects. R. H. RIDOUT

THE ANIMAL HEAT OF FISHES

THE belief that fishes are *cold-blooded*, that is, that they take on the temperature of the water which surrounds them, with no power to resist it, and that they develop little or no animal heat themselves, is still held by many even scientific observers. This belief is based partly upon the well-authenticated fact that fishes have been frozen and thawed again into life; partly upon the statements of many travellers who have found them living in water of a very high temperature (Humboldt and Bonpland recording the highest, 210° F.); and further, that a thermometer inserted into the rectum of some living fish freshly drawn from the water has been repeatedly found to indicate temperature corresponding very closely to that of the water itself.

During the past summer, and in connection with the operations of the U.S. Fish Commission at Provincetown, Mass., Surgeon J. H. Kidder, of the U.S. Navy, was detailed to make some systematic observations upon the subject of fish-temperatures with a view to setting the question upon a secure basis of actual experiment. Thermometers were made expressly for the purpose by Mr. John Taglialne, of New York, of unusual delicacy, registering about 10° F. each, and recording fifths of a degree. These were used in connection with Negretti and Zambra's deep-sea thermometers, and all the instruments were deduced to a single standard by frequent comparisons, so as to insure *relative* accuracy. The fish were taken with a line, and their temperatures observed at once, care being taken that no considerable change in temperature occurred during the time consumed in bringing the fish to the surface. The observed temperatures were then compared with that of the water as recorded by a Negretti-Zambra thermometer sunk to about the depth from which the fishes were taken. The first observations, made by inserting the thermometer into the rectum of the fish, agreed with the generally-received opinion, showing but little higher temperature than that of the surrounding water.

The mode of experiment was then somewhat modified. Considering the fact that the intestinal canal of a fish is in close contact with the thin and scarcely vascular walls of the abdomen, which is surrounded by the water in which the animal swims; and, further, that the arterial blood comes from the gills, where it has been spread out as thinly as possible and brought into the closest contact with the surrounding water—a process well calculated to cool it quickly to the same temperature—it follows that neither the interior of the rectum nor the arterial blood would appear to have the same value as representing the body-temperature in fishes that those parts possess in mammals and birds. It is rather in the venous circulation and the branchial artery that we should seek for the heat which must certainly be developed in the chemical processes of nutrition and waste, and in connection with active muscular movements. In the remaining experiments of the series—about ninety in number—the fish was therefore opened at once, and the bulb of the thermometer inserted into the cavity of the heart, or branchial artery, with the results indicated in the following table, which shows the averages:—

Fish.	Temp. of surrounding water.	Rectum.	Venous blood.	Remarks.
Cod	° 39–42	° + 0·98	° + 4·63	
Haddock	,,	+ 1·30	+ 5·30	Spawning.
Pollock	42	+ 2·40	+ 4·50	
Hake	,,	+ 2·40	+ 9·80	Spawning.
Bluefish	70–73 *	+ 0·25	− 1·55	
,,	,,	+ 0·50	+ 1·70	
Young mackerel † ...	65 *	+ 4·10 ‡	+ 5·25 §	
Do. do. (*Scorulus dekayii*) ‖	60 *	—	+ 2·30 §	
Sculpin	60 *	+ 0·80	+ 3·20	
Eel Pout ¶	—	+ 3·00	+ 6·00	
Flounder	42	—	+ 3·00	
Dogfish	42	+ 4·40	+ 12·00	Oviducts contained mature young.
Do. young from oviduct	42	—	+ 20·60	

It appears from these experiments that fishes do develop a measurable quantity of animal heat, which is more apparent during the spawning season, and much greater in elasmobranchs (as is to be expected from their more perfect digestive and assimilative apparatus) than in other fishes. It also appears that the measure of this animal heat is to be sought in the venous blood, and not in the intestinal canal or arterial blood.

The limits of this preliminary note will not permit us to go into an enumeration of the difficulties of observation or the measures taken to guard against the errors likely to attend them. Nor is the number of observations (ninety-five in all) sufficient to warrant the offering of these figures as a final statement of the *degree* of animal heat presented by the several fishes observed. All that can be said to be proved so far is the fact that fishes do manifest animal heat, and in considerable quantities, sufficient to warm again, to the extent of from 3° to 12°, blood that has been cooled in each circuit to the temperature of the surrounding water. Details will be given in the forthcoming report of the United States Fish Commission.

In the single instance of a lower temperature than that of the water, observed in five blue-fish, all taken on the same day, it may be that the individuals experimented on, being taken at the surface, had just come up from a much greater depth and colder stratum of water. There seems to be no conceivable provision by which a fish can maintain a temperature below that of the surrounding water, cooling by evaporation being out of the question. The young dogfish from its mother's oviduct showed a temperature 8° higher than that of the mother herself, for the obvious reason that its blood, not coming into contact with the water by its gills (the umbilical sac was still attached), was not cooled otherwise than mediately, through the blood of the mother.

NEW MODES OF SHOWING DIFFERENT CHARACTERISTICS OVER SMALL ARCS IN AZIMUTH FROM THE SAME LIGHT-HOUSE APPARATUS

WHERE a light on a rock or island has to illuminate constantly the whole horizon, the ordinary dioptric fixed apparatus is all that is required. But when, as at

* Surface-swimmers. † "Sinkers." ‡ Stomach, through œsophagus.
§ Temperature taken in blood flowing from heart, the organ being too small to admit the thermometer.
‖ This rare species, not seen in Massachusetts Bay for thirty years, appeared, young, at Provincetown last summer in considerable numbers.
¶ *Zoarces anguillaris.*
The sign "+" indicates excess, and "−" deficiency, as compared with temperature of water.

many places, there is a shoal at some distance from the lighthouse, or where a reef of rocks projects seawards from the shore, it sometimes becomes necessary to adopt means for keeping vessels clear of such dangers at night, as, for example, near Souter Point, where Mr. Douglass and Mr. J. T. Chance employed successfully the electric light for guarding a rock near the shore. What is wanted in such cases is to cover not only the danger itself but some area of the surrounding sea by a characteristic which is different from that of the main light.

If in front of a fixed light apparatus whose optical property is to parallelise the rays in the vertical plane while not interfering with their natural divergence in azimuth, there be placed an arrangement of straight horizontal shades or screens similar to the Venetian blinds which are used for house windows, the means will be supplied for easily producing different distinctions. The breadth of those blinds must be such as to subtend from the central flame the same angle as that over which the necessary distinction has to be shown at sea. By opening and shutting simultaneously and *gradually* the different leaves of the blind, there will be produced the same characteristics as those of an ordinary revolving or flashing light, according as the leaves are moved slowly or quickly and kept shut for a certain period, and these distinctions will be accompanied by the necessary gradual waxing and waning of the emergent rays. By simultaneously opening and shutting the leaves of the blind *suddenly*, and keeping them open so as to show a fixed light for a certain length of time, and then keeping them shut so as to produce darkness for a certain length of time, the effect of an intermittent light in which there is no waxing or waning of the rays will obviously be produced.

Should it be considered desirable to vary the appearance over the given arc so as to show a gradually increasing length of light period when a vessel is approaching the danger, the maximum period when it is opposite to it, and a correspondingly shortening period as the vessel leaves it, a single straight opaque mask placed outside of the apparatus, and revolving horizontally and with uniform speed on a vertical spindle will produce the result. For while the periods of *change* will remain the same over the whole arc the *duration of darkness* will gradually increase as the danger is approached, and gradually decrease after the danger has been passed. And if this vertical shade be made to rotate at a slow and uniform speed it will produce the effect of a revolving light, and if at a quick speed it will produce the effect of a flashing light, with this difference that the flashes *will recur with only an instantaneous interval of darkness*, and in both cases there will be a gradual waxing and waning of the rays.

By these very simple and cheap expedients a fixed light illuminating the whole horizon (by means of a flame of he ordinary size in relation to the focal length) can easily be made to show accurately over any limited angle in azimuth the effects of the different distinctions referred to, and these combinations will therefore supply a desideratum which is often much wanted in coast illumination. In some experiments which were made all these characteristics were successfully produced by the two modes described.

Where no light is required in any part of the horizon but in one small arc only, as, for example, in illuminating the middle of a long narrow Sound, all the rays proceeding from the lamp should be spread equally over that arc. A fixed holophote with an opaque disk revolving horizontally in front on a vertical spindle will, if condensing prisms are placed between the disk and the holophote, produce either a revolving or flashing light according to the speed of its revolution, but without any intervening period of darkness. If colour distinction be required and a revolving disk of glass be substituted for the opaque mask the characteristic effect produced would be that of a revolving red and white light *without any intervening dark period between the flashes*, which would gradually dissolve into each other from red to white and then from white to red.

Edinburgh, October 22 THOMAS STEVENSON

A FEAT IN TRIANGULATION

A NOTEWORTHY advance in geodesy has recently been accomplished by the junction of the network of measurements covering a large portion of the surface of Europe, with the African continent. The entire triangulation of Algeria was completed by French engineers some time since, and extended to the edge of the Sahara, in lat. 37°. M. Perrier, who had directed in a great measure the triangulation of Algeria, has for the past eleven years been seeking the means of joining the network in that country with the perfect trigonometric system covering the surface of Spain, France, and England. The importance of such a junction is easily appreciated when we consider what notable changes in the accurate conception of the shape of the earth and of the length of meridians has been effected by measurements on a much smaller scale.

For such an undertaking the most careful and painstaking preparations were requisite. As the result of his reconnaissances between 1868 and 1872, M. Perrier found that from all the trigonometric points of the first order between Oran and the frontiers of Morocco, the loftier crests of the Sierra Nevada on the Spanish coast opposite, were visible in exceptionally clear weather. Arrangements were subsequently made with the Spanish Geographical Institute for the mutual and contemporaneous execution of the proposed plan. A corps of Spanish officers, under the direction of the well-known General Ibanez, was detailed for this purpose, while the French Minister of War placed a division of officers from the *État-Major* under the command of M. Perrier. The leaders chose for stations in Algeria the summits of Mount Filhaoursen and Mount M'Sabiha, west of Oran, and in Spain the summits of Mount Tetica and Mount Mulhacen, the latter of which is the most elevated point in the kingdom. The directions and distances between these four points were computed as carefully as possible, and preparations were then made for the final and determinative observations. At the Algerian stations the nature of the country and its inhabitants necessitated the use of a numerous force of soldiery as well as of means of transport.

In order to insure the accuracy of the observations, which required the passage of signals over a distance of 270 kilometres, it was decided to make use of solar reflectors and powerful lenses. The efficacy of such apparatus for even greater distances had already been tested by M. Perrier; still for the measurements in question they appear to have utterly failed to answer the expectations based upon them, not a single solar signal being visible from any station. Fortunately, the success of the observations did not rest entirely upon this one system of signals. Preparations had likewise been made for the employment of the electric light, and on the summit of each mountain one of Gramme's electro-magnetic machines worked by engines of 6-horse power had been placed in position.

On August 20 last, all the stations were occupied, and the electric lights were displayed throughout each night. Then the patience of the observers was submitted to a lengthy proof. The mists rising from the Mediterranean totally prevented the exchange of signals, until after a delay of twenty days, one after another the electric lights became visible even to the naked eye. Perrier compared the intensity of the light on Tetica nearly 270 kilometres distant, to that of α in Ursa Major, which rose near by. The observations were continued from September 9 to October 18, when this task for which such extensive preparations had been made, was completed in the most satisfactory manner. With its completion we come into possession of trigonometric measurements of the most exact nature, extending from lat. 61° in the Shetland Islands, to lat. 34° on the southern frontier of Algeria.

The extension of this network southward and eastward in Africa, desirable as it is for the elucidation of many nice points in geodesy, is unfortunately scarcely possible in the immediate future, and science must rest content with gaining a foothold in the great continent.

T. H. N.

A NEW STANDARD OF LIGHT[1]

IN the pamphlet before us we have a proposal for a new form of standard light, and the author has shown some considerable skill in drawing out his method of producing it. We cannot do better than quote his opening paragraph as showing the requisites of a standard that the author deems necessary. He says :—

"No exact measurement of any quantity, even with the most accurate and sensitive test measures available, can reasonably be expected unless the standard by which the unknown quantity is to be gauged is perfectly constant in itself; or if nature does not permit of such a desirable state of things, the causes to which the variation of the standard are due should be known, and in addition also, their quantitative effect on the standard, in order to be able to introduce a correction whenever accuracy of measurement should permit, and circumstances necessitate it."

The want of a standard of light has long been felt in physical researches, and the British Association has acknowledged the impossibility of obtaining scientific measures with the ordinary standards, and has appointed a committee to consider the question of fixing such a standard of white light, that a unit of light may be capable of accurate definition. It must not be forgotten that up to quite recent times the principal necessity for a standard at all has arisen through the introduction of gas into our dwellings and streets, and it has only been necessary to adopt one which should give the comparative illuminating powers of any variable qualities of gas. In fixing such a standard the points to be looked at were (1) that the standard should be capable of easy and exact reproduction ; (2) that the colour of the light should be approximately the same ; and (3) that in varying states of barometric pressure and temperature, proper corrections in the results of the comparisons should be feasible. It will be seen further on that a fourth desideratum should be introduced for scientific work. Perhaps on no subject has more attention been paid to small details than in the production of a standard candle, and as a result, when burnt under proper conditions, it gives fairly correct values of the illuminating power of gases.

In the record of Mr. Schwendler's experiments with the standard candle as against his new standard of light, we have some startling variations in the light of a standard candle, but we feel sure that, had the proper conditions been observed, there would never have occurred such a tremendous difference as 72 per cent. We are more convinced that ordinary precautions could not have been rigidly observed when we find that some of the comparisons were made after the candle had been freshly lighted. In gas photometry it is well known that the standard candle should burn at least a quarter of an hour before it can be considered to have settled down to a steady light. The standard candle, however, is not a nice unit of light; and two years ago Mr. Vernon Harcourt introduced to the notice of the British Association a gas standard which seems to meet every requirement. By making a mixture in a small gasholder of one part of the most volatile spirit from American petroleum which distilled at 50° C. with 600 of air, or seven of the vapour with twenty of air, he produced a gas which, whilst almost insoluble in water, was permanent at all ordinary temperatures and pressures, and which was of a known composition and easy of manufacture. A jet of such a gas could be compared with the ordinary coal-gas, and any variations affecting the one would equally affect the other. The colours of the standard and coal-gas lights are also approximately the same. It seems that a standard of such a character meets the requirements for comparing the illuminating value of different coal-gases. Mr. Schwendler proposes to use the light radiated from platinum foil, when raised to incandescence by an electric current, as a new standard, and we agree that a solid instead of a gaseous body as the source of illumination is a step in the right direction. The standards made, however, appear to have been used for determining the illuminating value of the light produced by dynamo-electric machines under varying conditions of speed of armature and resistance in circuit, and it is in reference to this that we will first judge of its probable effectiveness, since for gas measurements the standards already existent suffice. Some dynamo-electric machines are advertised as generating the light of 50,000 candles, and we will suppose for the moment we are comparing such a light with Mr. Schwendler's standard.

Now it may be safely said that a standard candle, farther away than twenty feet from the photometer, would give too small a light to be practically of use as a standard, whilst if approaching the photometer within one foot the magnitude of the illuminating source would seriously affect any accurate results. In the first case the electric light would have to be about 4,500 feet away from the photometer and in the last about 220 feet. For ordinary photometric work even the least of these distances would be objectionable. The platinum standard employed by Mr. Schwendler is only about ·7 of a standard candle, and these distances would have to be increased nearly 20 per cent.

For practical measurements of this description a candle-power of fifty candles is a far preferable value, which it would be difficult to attain by the method proposed. In this case we have the distances reduced, and if the electric lamp is fixed at a distance of 100 feet, we have the movable standard ranging between twenty feet and three to four feet, and the readings become easy and are not subject to be seriously affected by the magnitude of the illuminating source ; in fact, the errors of observation then become of larger magnitude than any error arising from this cause. Another point which we have to note is that as far as the colour of the light from the platinum standard is concerned, it possesses very little advantage over the ordinary gas or candle flame, and it would be impossible, or at all events incorrect, to give the illuminating value of a light such as of that produced by the electric arc in terms of the new standard ; some recent experiments have demonstrated that the red light emitted by one square mile of the hollow crater in the positive carbon is equal to about the red light radiated by 40,000 standard candles, whilst the mean green light of the former is equal to the mean green light of about 135,000 of the latter, and until such a time as the relative physiological values of green and red light are accurately known it will be impossible to give any true estimate of the illuminating power of the electric light by ordinary photometric comparisons. Both in magnitude and colour, then, the proposed platinum standard of light seems to fail for measuring light produced by high temperatures.

We now turn to the details of the lamp itself. We have, firstly, a U-shaped piece of thin platinum foil cut out about 20 mm. in total length, each limb of the U being about 3 mm. in breadth, the tops of which are clipped in thick metal clips. The usual arrangements are made for passing a current through this foil, the amount being registered by a galvanometer in circuit. A

[1] On a New Standard of Light. By Louis Schwendler. From the *Journal* of the Society of Bengal, vol. xlviii. Part ii., 1879.

glass shade is also employed for steadying the light, by keeping off convection currents. There seems to be an objection to this form of lamp for accurate scientific work, where it may be necessary to use an *image* of the source of illumination. For instance, in certain spectroscopic comparisons of different lights only a small portion of the image of the incandescent platinum would fall upon the slit. Now the first difficulty that would be met with would be as to the part of the platinum that would emit a standard light. Near the contacts the heat would be conducted away so rapidly that the colour of the light would be of a different tint.

Again, presumably near the middle of the limbs of the U-shaped foil the temperature would be slightly higher than at the outsides; in fact, no two portions of the foil would be exactly at the same temperature.

For work, then, of this class, the standard seems to fail in an important particular.

The writer of this notice made many experiments on this point some years ago, and it was this objection that led him to abandon the idea of a platinum standard light of a form somewhat similar to that of Mr. Schwendler.

For a standard perfectly suited to scientific work, perhaps the following definition will be found tolerably exact:—It should be a body (solid or liquid), some known area of the surface of which can be kept at a high constant temperature. It seems probable that a combination of a body of good with one of a bad conductivity will eventually be found to offer suitable materials for a really trustworthy standard.

It would be unjust to conclude this notice without paying a testimony to the great value of the experiments which have been carried out by Mr. Schwendler in this research. It is quite possible that a modification of his platinum standard may be constructed which will eliminate the defects which are to be found in it. It is certainly a step in advance of the gas or candle standard for everything beyond merely technical work, but it is not of the same accuracy as other scientific units. W. A.

FLOW OF VISCOUS MATERIALS—A MODEL GLACIER

THREE or four years ago an experiment was arranged by Mr. D. Macfarlane and myself for the purpose of showing the flow of a viscous mass and for illustrating glacier motion. The experiment then commenced gave rise to others of a similar nature. These experiments have proved so interesting that I venture to describe some of them to the readers of NATURE.

Shortly after his discovery of the true nature of glacier motion, the late Principal Forbes was much pleased when one of his students, now the Rev. C. Watson, of Largs, showed him a quantity of shoemakers' wax which had been gradually flowing down on the bottom of a vessel accidentally left on an incline. Forbes was delighted with the wax, and considered it an admirable illustration of viscous flow. This was told to me in conversation some four years ago, and it occurred to me that a pretty illustrative glacier might be made with shoemakers' wax, and we proceeded to construct it. The model glacier has been shown year after year to the natural philosophy class in Glasgow, and has proved interesting and instructive beyond expectation.

A little wooden ravine was constructed, with a number of steep declivities and precipices and some more gentle slopes. There is one place, also, where the ravine is narrowed by projections inwards, which nearly meet each other. At the upper end of the ravine there is a flat part, on which ordinary shoemakers' wax is piled—as where snow collects at the upper end of the natural ravine; and from this collecting-ground the material flows down steadily through the ravine, giving on a small scale a most perfect display of the flow of a semi-solid material. At the beginning of each winter session a supply of shoemakers' wax is given at the top, and during the session the flow goes on slowly and steadily; hardly perceptible from day to day, but progressing from week to week, and from month to month. Every one knows what a brittle substance shoemakers' wax is at ordinary temperatures. A lump of it allowed to fall on the ground flies into a thousand pieces. Watching this brittle apparent solid flowing down an inclined plane, brings very vividly before the mind the real nature of the glacier's flow. To imitate on the small scale Forbes's celebrated experiment of planting a row of stakes in the glacier, in order to compare the flow in the middle with the flow at the edges—the experiment which really established the fact of *viscous* flow—I have sometimes put a row of dots of white paint across our pitchy glacier. In a few days the more rapid motion of the middle portion, and the less rapid motion of the parts near the edges, is made apparent. There are others of the glacier phenomena which are also beautifully imitated by the shoemakers' wax. Little crevasses are sometimes formed, though not very often owing to the great effect of temperature on the plasticity of the material; and the cross-markings that are noticeable at the foot of a glacier are brought out extremely well.

Last year Sir William Thomson commenced a new and curious experiment on shoemakers' wax as a viscous material. A large circular cake of it about eighteen inches across and three inches thick was made. This was put into a shallow cylindrical glass vessel, which was filled with water to keep the temperature from varying with any great degree of rapidity. Below the cake a number of corks were put, and on the top there were put some lead bullets. The result has been that in a year the corks have floated up through the wax, and are coming out at the top; the bullets have sunk down through the wax, and have come out at the bottom; and this, it is to be observed, has gone on while the wax was at all times in such a condition as to be excessively brittle to any force suddenly applied, such as a blow from a hammer, or such as would be occasioned were the cake of wax to be allowed to fall on a stone floor. J. T. BOTTOMLEY

THE SCOTTISH ZOOLOGICAL STATION

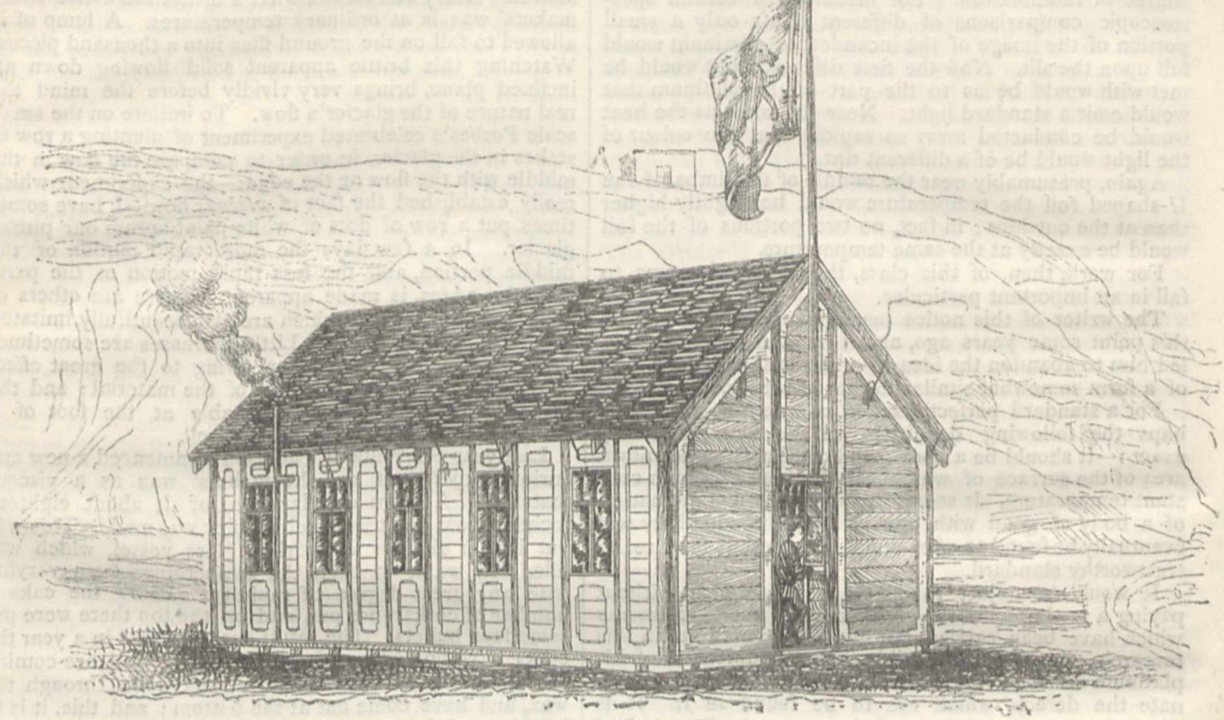
SOME months ago the opening of a zoological station on the Scottish coast was mentioned in these pages. This station—the first enterprise of the sort in Britain—has been established in connection with the University of Aberdeen, and under the directorship of the Professor of Natural History, Dr. Ewart, who was, this year, assisted in the conduct of the station by Mr. Patrick Geddes.

The site chosen was the little fishing station of Cowie, about half a mile north of Stonehaven, and fifteen miles south of Aberdeen. But one of the chief advantages of the station is that it is not a fixed building of brick or stone, but a movable one of wood, which can be taken, if necessary, to a new place every year, and, after the season's work, taken down and packed up for the winter.

The annexed cuts give an excellent notion of the appearance and internal arrangements of the place. It is a wooden structure (Fig. 1) about 32 feet long by 16 wide, supported on low wooden piers and having a thin wooden roof covered over with sailcloth. In each of the longer sides are five windows, in one of the shorter sides the door, in the other two windows. Inside (Fig. 2), a partition divides the building into two parts—a larger, the laboratory proper, with eight out of the ten side windows, and a smaller, the library and director's room, with two of the side and both end windows.

In the library there is a bench or working-table (Fig. 2, *T*) running round three sides, with shelves (*S*) above, for books, apparatus, and bottles. In the laboratory there is a table (*T*) to each window, intended to accommodate two students, and provided with sliding-shelves (T') for holding the worker's books of reference. Between every two tables is a shelf, of the same height as the table, with two drawers (D), one for each student, and above them

Fig 1.

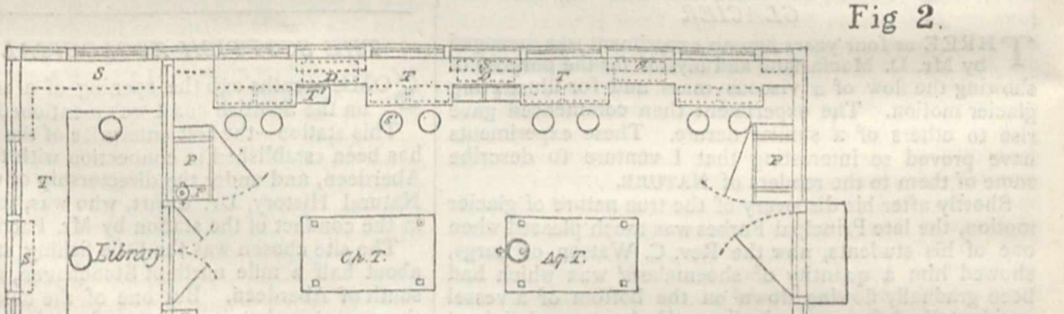


The Scottish Zoological Station—Elevation.

are other shelves (S) for holding bottles for specimens. The tables are fixed bracket-wise to the wall, and are remarkably firm and free from vibration.

In the middle of the room are two large tables, one ($Ch. T$) intended for chemical work, and provided with a sufficient supply of reagents, spirit-lamps, test-tubes, &c.;

Fig 2.



The Scottish Zoological Station—Plan. $Aq. T$, aquarium table; $Ch. T$, chemical table; D, drawers; F, filter; L, wash-hand basins; P, presses; S, shelves; S', stools; St, stove; T, working tables; T', sliding shelves.

the other ($Aq. T$) bearing a large cask kept replenished with fresh sea-water, and several bell-jar aquaria of various sizes for living specimens. These latter were a great object of attraction to the numerous visitors to the station.

At each end of the room is a large press (P), used for stores; on one of these stands a filter for fresh water (*F*), and on the other side of the library door is a small table (*L*) with washing-apparatus. The whole building is warmed by a stove (*St*).

The station is neatly painted outside, and is rendered a very conspicuous object, both from sea and land, by the royal standard of Scotland, which floats from a flagstaff over the door.

Besides microscopes, dissecting-dishes, bottles, aquaria, books, &c., the station is well fitted with dredges, trawls, and canvas buckets for shore-collecting, and also provides wading-shoes, tarpaulins, and sou'-westers.

There are two boats attached to the establishment, a small fishing-smack and a "tub." But as these were often unable, owing to unfavourable weather, to sail beyond the mouth of the bay, a small steamboat is urgently needed to complete the efficiency of the station.

An Aberdeen fisherman was hired for the season, to take charge of the boats and to act as general factotum.

The Station was formally opened by Mr. Romanes on August 8, but the work actually began on the 3rd, and was continued until September 25. Altogether there have been sixteen workers, mostly Aberdeen students, the rest visitors from London and elsewhere. Several of these went out shore-collecting every day, a few dredged when practicable, and two dredging expeditions were made in H.M. gunboat *Netley*, the second of the two being a great success.

The fauna of the Aberdeen coast is not a remarkably rich one, but still a very respectable number of specimens was obtained in one way or another. I am indebted to Mr. A. W. Russell, M.A., of Marischal College, for a list of all the species collected; the list is too long for transcription, but may be abstracted as follows:—

	Genera.	Species.
Porifera	3	5
Hydrozoa	13	16
Actinozoa	6	8
Turbellaria	5	5
Hirudinea	1	1
Chætopoda	14	23
Echinodermata	13	20
Pycnogonida	2	2
Crustacea	12	30
Polyzoa	9	10
Tunicata	5	7
Mollusca	40	57
Pisces	5	7
	128	191

It is definitely decided that, next summer, the Station is to be pitched at Cromarty Firth, a far more promising locality than Stonehaven Bay. By that time it is hoped that the funds, which are wholly derived from voluntary contributions, will be in a sufficiently flourishing condition to admit of the purchase of a steamboat.

It would not be a very great matter, one would think, for our English universities to follow the example of Aberdeen, and to provide themselves each with such an establishment on some part of the English coast; and the benefit to their students, who get to think of nudibranchs, echinoderms, and cœlenterates as opaque, dull-coloured things in bottles, would be simply incalculable.

In the meantime I can, from experience, cordially recommend all English students of biology who are minded to begin research, as well as those who wish for nothing more than a thoroughly pleasant holiday and an opportunity of studying their science from the too-neglected "natural history" side, to spend two or three weeks of the long vacation at the Scottish Zoological Station.

T. JEFFERY PARKER

THE FOSSIL LOVERS

MISS ANN GELICA kindly sends us her reply to Bret Harte's Geological Madrigal, which she assures us is addressed to her. To enable the reader to understand the young lady's reply we prefix "Dear Bret's" verses:—

A GEOLOGICAL MADRIGAL
(*After Shenstone*)

I have found out a gift for my fair,
  I know where the fossils abound,
Where the footprints of *Aves* declare
  The birds that once walked on the ground;
O, come, and—in technical speech—
  We'll walk this Devonian shore,
Or on some Silurian beach
  We'll wander, my love, evermore.

I will show thee the sinuous track
  By the slow-moving annelid made,
Or the Trilobite that, farther back,
  In the old Potsdam sandstone was laid.
Thou shalt see, in his Jurassic tomb,
  The Plesiosaurus embalmed;
In his Oolitic prime and his bloom,—
  Iguanodon safe and unharmed!

You wished—I remember it well,
  And I loved you the more for that wish—
For a perfect Cystistidian shell
  And a *whole* holocephalic fish.
And O, if earth's strata contains
  In its lowest Silurian drift,
Or Palæozoic remains
  The same,—'tis your lover's free gift!

Then come, love, and never say nay,
  But calm all your maidenly fears,
We'll note, love, in one summer's day,
  The record of millions of years;
And though the Darwinian plan
  Your sensitive feelings may shock,
We'll find the beginning of man,—
  Our fossil ancestors in rock.

My Reply to Dear Bret's Madrigal

Thy epistle, dear Bret, I've received,
  And trust thou'lt not think me too bold,
If I frankly acknowledge I'm grieved
  At the thought that to thee I've been cold.

How sweetly thou managest wooing!
  What a way to my heart thou hast found!!
Abandoning billing and cooing,
  Thou tell'st me where fossils abound.

For ever henceforward I'm thine,
  To view Ornithichnites I'm sighing;
(Don't delay,—for a ramble I pine),
  To find them *in situ* am dying.

Tridactylous, struthious, and huge;
  With phalanges nicely indented,
Entombed when Dame Nature with rouge.
  The marl and the sandstone beds painted.

If thou wilt but extract me a femur,
  With matrix just near the trochanter,
I'll abandon all maidenly tremor,
  And at once name the day, thou enchanter.

I'll only make one stipulation:—
  That, avoiding hotel, inn, and tavern,
We improve the time-honoured lunation,
  And our honeymoon spend in a cavern.

There I'll labour, content in the fetter.
  To find, happy thought! if I can,
A dear second husband and better,
  A petrified pithecoid man.   A. G.

NOTES

LORD RAYLEIGH has been elected to the Chair of Experimental Physics at Cambridge, in succession to the late Prof. Clerk Maxwell.

A COMMITTEE has been appointed to receive subscriptions for the purpose of commemorating the retirement of Dr. Andrews from the vice-presidency of the Queen's College, Belfast, by a bust or portrait to be placed in the College, and a prize or scholarship to be founded in the same institution in connection with chemical science.

WE hear with regret that the Epping Forest Committee have rejected Mr. Alfred R. Wallace, whose candidature for the post of Superintendent of the Forest was supported by so many eminent men of science and also by a large number of the local inhabitants. The successful candidate is Mr. Alexander McKenzie, a landscape gardener, who may doubtless prove an able superintendent; but it is unfortunate that a man of Mr. Wallace's ability and knowledge should have failed to obtain a post which he could so well have filled for the benefit of the nation.

DR. PERCY has resigned the lectureship on metallurgy at the Royal School of Mines.

THE Rev. John Brown Maclellan, Vicar of Bottisham, Cambridgeshire, has been elected Principal of the Agricultural College, Cirencester, in place of the Rev. John Constable, who has resigned owing to ill-health. Mr. Maclellan is a distinguished classical scholar, having taken high honours in that department at Cambridge. He is the author of a work on "The Fourth Nicene Canon and Election and Consecration of Bishops," and of "A New Translation of the New Testament." We have failed to discover the special qualifications of this scholarly vicar for the position of head of an Agricultural College, which if anything is scientific. Of course the institution is a proprietary concern, and the Council has a right to do as it likes. By the by although this College has a charter, it has no right to the title of "Royal" which it assumes.

M. JANSSEN has been unable to see the sun for a number of days, owing to the almost constant prevalence of cloudy weather; but he states that, according to the results of his latest observations, the number of spots on the sun is very small, as well as the number of faculæ. He supposes that this last circumstance may be connected with the rigour of the present winter, although he is not in a position to state whether these faculæ are on the surface of the sun or produced by some change in the intervening medium. The construction of M. Janssen's observatory at Meudon has been interrupted by the inclemency of the weather. It will be resumed next spring. Meanwhile M. Janssen is completing his system of observation. An automatic instrument worked by a weight will take six photographs of the sun every twenty-four hours with a 9 inch refractor. The construction of a large refractor for observing celestial bodies is also proceeding.

OTHER three days' *Thunderer* gun experiments were made during the past week; the experiments will be resumed in a fortnight.

THE Belgian State-prize of 5,000 francs (200*l*.) which is awarded by the Royal Academy of Sciences every five years for scientific work was this year awarded to the director of Brussels Observatory, M. Houzeau, in recognition of his latest work, "Uranométrie générale, avec une Étude sur la Distribution des Étoiles visibles à l'Œil nu." There is another prize of 2,500 francs (100*l*.) awarded annually by the king, which was to be given away for the second time this year, and specially referred to architecture, but no worthy recipient could be found, although no less than ten different works had been submitted to the committee of judges.

THE University of Göttingen has become the possessor of a magnificent herbarium, containing over 40,000 specimens of plants from all parts of the world. It was left to the University by the late director of the Göttingen Botanical Gardens, Prof. Grisebach. There is no doubt that it is by far the largest collection of plants ever brought together by any single individual.

THE late Herr von Nathusius has left a very valuable library, consisting almost exclusively of works on natural history and agriculture, and numbering some 5,000 volumes. Besides this there is an osteological collection of some 2,500 animal skulls, 300 skeletons and parts of skeletons, a collection of some 20,000 pictures illustrative of animal life, and finally, a collection of about 8,000 samples of wool. Everything is in perfect condition, and arranged in the most scientific manner. The collections being of great value for agricultural museums, the Prussian government intends to purchase them for the Museum at Berlin. Their value is estimated at 60,000 marks (3,000*l*.), and a present they remain still at Hundisburg, near Magdeburg, the seat of the deceased statesman.

THE death is announced of M. Claude Etienne Minié, the inventor of the carbine of that name. He was born in Paris in 1804.

A FORTNIGHTLY scientific contemporary makes the following extraordinary announcement concerning the late award of medals by the Royal Society:—"The Copley Medal to Prof. Rudolph J. E. *Clamins*, of *Rome*, for his researches upon heat; the *Davey* (*sic*) Medal to M. P. E. Lecoq de Boisbaudran, for his discovery of gallium; a Royal Medal to Mr. William Henry *Perkins*, F.R.S., for his long-continued and successful labours *in geology and physical geography*"! Was there ever such a nice "derangement of epitaphs?" The italics are ours.

THE frost having continued in Paris, the Seine was frozen on December 9. The maximum of cold was observed about one o'clock in the night from 8 to 9. $-24°$ C. has been observed at Montsouris in the shade, $-25°$ at La Varenne St. Maur, $-27°$ at Versailles.

IT has been suggested by the *Temps* meteorological editor, that the whole of Europe and a large part of Asia and Northern America being covered with snow, the appearance may be analogous to the red spot discovered on Jupiter by astronomers, and this may be considered as an indication that some unusual cooling influence prevails on the whole solar system.

MRS. CHAPLIN AYRTON has received the degree of M.D. from the Medical Faculty of Paris. She presented an elaborate thesis "On the General Dimensions and the Development of the Body among the Japanese."

THE Thames Embankment system of electric lighting has been extended to the Victoria Station of the Metropolitan District Railway. The station, we learn from the *Times* report, is 350 feet long, 50 feet wide, and 40 feet high. There are two platforms, each 15 feet wide, the railway space between them being 20 feet wide. There are ten lights in all, of which five are placed over the down-platform, dividing the length into spaces which are unequal owing to the interference of constructive details. Over the up-platform are four lamps, which alternate with the five on the other side so as to afford an equable distribution of light. The tenth lamp is placed centrally over the foot-bridge which connects the up- and down-platforms. The lights are produced and maintained by the same steam-engine which is maintaining the forty lights on the Embankment and the ten on the bridge. The engine is, therefore, now maintaining a total of sixty lights—a point of considerable importance. Of still greater importance, perhaps, from a scientific poin of view, as the *Times* remarks, is the distance to which the present machinery is transmitting the current. The distance marked on the map of the District Railway between their station at Charing Cross and that at Victoria is 2,383 yards, or 1·354 mile. The length of wire between the two stations, however, owing to curves and losses necessarily attending the laying, connecting, and fixing, is about 1·65 mile. The whole circuit is thus equal to a length of 3·30 miles. The ten lights are on two circuits, and are maintained by the two spare circuits of the Gramme machine which supplies the ten lights on Waterloo Bridge. The loading wire is similar to that used on the Embankment, being a cable of seven strands of No. 19 B. W. G. copper wire, highly insulated. The wires are laid through the tunnel of the railway, being fixed against the walls. There is a switch arrangement at the Victoria Station, so that the lights are started and extinguished on the spot, and are thus locally under control. This new development of electric lighting means something more than that sixty lights are now being successfully maintained from a single engine of twenty horse-power nominal. It means that very considerable distances have been bridged over, and that, other things being equal, the application of electricity for illuminating purposes can be carried to distances from the source of power previously unbelieved in and by some unthought of.

MR. THOMAS FLETCHER, the well-known maker of scientific apparatus, of Museum Street, Warrington, must be a man of considerable public spirit, as well as enterprise. From a circular letter he has sent us we learn that a few friends interested in scientific matters, have decided to meet every Thursday evening for the winter months, at his house, with the object of discussing new or interesting scientific matters. The meetings will be informal, simply a social gathering of those interested in the progress of science. If the movement is appreciated by a larger number than can conveniently be accommodated, the question of forming a scientific club will afterwards be raised. The laboratory will, for the evening, be converted into a smoke room, and any apparatus will be at the service of all. Both these privileges will, we are sure, be largely appreciated. These meetings, Mr. Fletcher is careful to state, will be so arranged as to be little or no cost to himself, and therefore they will, so far as room permits, be open to all interested in matters likely to be brought forward, all being at perfect liberty to come and bring any friends. We heartily wish success to Mr. Fletcher's efforts to foster a love of science in Warrington.

VARIOUS statements have recently been published regarding the probable time of completion of the St. Gothard tunnel; few of them are correct. On Oct. 31 last, at 8.15 A.M., the boring machine on the northern side reached the centre of the tunnel at a depth of 7,460 metres. The meeting of the boring machines, however, cannot possibly take place before February next year. At the beginning of November there were still 717 metres of rock to be removed, and 50 metres per week is considered to be a fair average. On October 1 last the borings were some 261 metres short of the original programme, and on that day only 7,821 metres (total) of the tunnel were complete (instead of 11,579 metres, as stated in the original programme). A serious obstacle has quite recently been encountered in some soft strata, the enormous pressure of which has up to the present resisted all attempts at successful penetration. The most solid beams are bent like reeds after a little time, and a resistance-wall of 1 metre thickness was completely crushed. Another of 2 metres' thickness is now being constructed. The boring machine is useless in these strata, and only hand labour can be employed.

THE works for the railway across the Isthmus of Tehuantepec have been commenced. The line will be 150 miles long.

THE director of the zoological station at Trieste, Prof. Claus, of Vienna, has issued a report on the work done at the station since its opening in 1875 up to the end of 1878. It appears that no less than twenty-two zoologists have worked at the station (including ten Austrians and seven Germans), besides thirty-four students of zoology. Apart from a large number of smaller communications issued by the station, thirty-eight important scientific publications owe their origin to work done at that institution.

AT Magdeburg a grand agricultural exhibition will be held from May 28 to June 6, 1880, in celebration of the fortieth anniversary of the foundation of the Magdeburg Agricultural Society.

FOR the International Piscicultural Exhibition which will be opened at Berlin on April 20, 1880, a great number of specimen-collections have been already promised. Complete illustrations of the state of pisciculture in the various countries will be sent from Sweden, Norway, Italy, Holland, China, Japan, Canada, and the Malay Islands. Several crowned heads and the free cities of Hamburg and Bremen will award prizes to the exhibitors.

THE Paris Municipal Council has not yet taken any final decision on the question of gas *versus* electricity. At all events the Commission will propose to use Jablochkoff lights for illuminating the Place de l'Opéra, and new experiments will be tried in the green room of the opera for deciding whether the Jablochkoff or Werdermann light will be selected for the interior.

DETAILS of the Temesvar earthquake of November 21 last are now to hand. It appears that two separate shocks were felt, a violent one at 12.5 A.M., and a weaker one shortly before 2 A.M. Numerous chimneys, vaults, cellars, &c., fell in in the town as well as in the surrounding villages. A third shock followed at 5.45 P.M., and a fourth one a little later. On the following days the shocks continued and were also noticed at Szakalhaza, Vukova, Stamora, Blazsova, Lippa, and other places in the district.

Two shocks of earthquake are reported from Switzerland: one at Geneva on December 4, at 5.34 P.M., Greenwich mean time; the other at Berne, Bale, Aarau, and Schaffhausen, on December 5, at 2.32 P.M.

MANY of our readers will be glad to know that Messrs. Macmillan and Co. have published a translation of Pasteur's "Études sur la Bière," under the title of "Studies on Fermentation," by Messrs. Frank Faulkner and D. Constable Robb. The original work we noticed at length in NATURE, vol. xv. pp. 213, 249.

A DANGEROUS and infectious disease among bees is reported from Italy. It is caused by a microscopical fungus, and spreads with alarming rapidity. However, winter is not a favourable season for its propagation, and salicylic acid solution is said to be an infallible remedy against the disease.

IN the course of some excavations now going on in the bed of the Rhone, near Geneva, many interesting objects, assigned by archæologists to the age of polished stone, have been brought to light, the most curious of which is a scraper of jade, highly finished, and in a condition as perfect as when it left the hands of the workman. The question arises, the *Times* correspondent states, and is being warmly discussed by the learned in lacustrine lore, how this instrument, made of a mineral which exists in a natural state only in Asia, can have found its way into the Rhone gravel at Geneva. Was jade ever an article of trade between the West and the East in prehistoric times, or is this scraper a solitary specimen brought by Aryan wanderers from the cradle of their race on the Hindoo Koosh? As yet no satisfactory solution of the problem has been suggested.

THE *School of Mines Quarterly* is the title of a journal published under the auspices of the Chemical and Engineering Society of the School of Mines, Columbia College, New York, the first number of which has been sent us. It contains several good articles on chemical and engineering subjects. There seems no keeping pace with the scientific enterprise of our friends on the other side of the water.

FRIEDLÄNDER AND SON, of Berlin, have sent us their new Catalogue of Standard Publications in Astronomy and Geodesy, brought up to the present time.

A FOURTH edition has been published of Mr. Thomas Christy's useful *brochure* on "Hydro-Incubation in Theory and Practice, a Guide to Commercial Poultry Farming." We have referred to the previous editions; the whole of the matter in this edition is stated to be new.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus erythræus*) from India, presented by Mr. F. G. Lightfoot; a Bonnet Monkey (*Macacus radiatus*) from India, presented by the Rev. E. C. Ince; a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Mr. F. E. Colenso; a Black-headed Jay (*Cyanocorax nigriceps*) from South America, two Brant Geese (*Bernicla brenta*), European, purchased.

OUR ASTRONOMICAL COLUMN

THE COMET OF 1652.—The observations of this comet made by Hevelius between December 20, 1652, and January 8, 1653, it is remarked by Pingré, were probably the most precise, and certainly the most complete, of all; generally the observations were very rough. They were mostly collected, he adds, in a short dissertation published at Padua in 1653, which would appear to be that by Argoli, entitled "Andreæ Argoli Brevis Dissertatio de cometâ ann. 1652, 1653 et aliqua de meteorologicis impressionibus." Halley's orbit, the only one for this comet which figures in our catalogues, was calculated upon the observations of Hevelius.

Zach found another series of observations, which Pingré probably had not seen, and which upon reduction and discussion may prove to be second only to those of the Dantzic astronomer in merit; indeed, he thought they might be even more precise. These observations were made by an ecclesiastic residing at Rome, an Englishman, one calling himself, or being called by others, *Riccardo de Albis*, a name which, Zach suggests, is probably to be read *Richard White*, and he conjectures that he was probably a Jesuit of the Anglican College, where we know that another English Jesuit, LeMaire, Boscovich's assistant in geodetic work, also observed. The observations were sent from Rome in January, 1653, by a certain Raffaelo Magiotti to his good friend Candido del Buono at Florence, with a commission to present them to Prince Leopold of Tuscany, brother of the reigning Grand Duke Ferdinand II. Magiotti mentions that he had procured the observations with difficulty since De Albis himself intended to print them, *con molte puntualità*. Whether he did so or not does not appear; his name is not mentioned in the cometographies, and though Lalande enumerates some twenty publications referring to the comet of 1652, there is none under the name of De Albis. We are told that he observed with a good quadrant, but there is no reference to telescopic sights, though Zach says, with two such opticians as Campani and Divini at this time in Rome, it may well have been that he had telescopic aid.

The observations in question appear in Angelo Fabroni's little known "Lettere inedite di Uomini illustre," as a supplement to his greater work published at Pisa in 1768. They were made between December 21 and January 3, "hora 2 post occasum solis," and consist of distances from conspicuous stars. It may be of interest to reduce the observations of this scientific Englishman, and to calculate an orbit upon them; a strict copy was given by Zach in Lindenau and Bohnenberger's *Zeitschrift für Astronomie*, vol. iv.

In the same communication will be found some observations by a Roman patrician, one Arcieri, with "a good telescope of 9 palms, by Eustachio Divini." He saw the comet for the first time on December 19, "instar nubeculæ rotundatæ et candicantis, e cujus centro quiddam subricundum instar prunæ emicabat, ejusque diameter visiva erat 10 circiter minutorum." On December 21, its diameter was fifteen minutes. It seems to have been well seen on the following night, when we read "Porro cauda illius (quæ rarissima quidem erat, tenuissimaque) in oriente vergens, æquabat longitudine spatium pene 8 graduum, et dimetiens visiva excreverat jam ad 20 fere minuta." On December 23 it appeared much more obscure, but on December 24 at the fourth hour of the night the tail was brightest, the head being one degree from the Pleiades. Five nights later it was distant "circiter 30 minutis à capite Medusæ versus Plejadas, multum imminutus obscuratusque, nullumque caudæ vestigium apparebat." On January 1 it was as bright as a star of the fourth magnitude, and two nights later was hardly equal to one of the fifth.

Pingré remarks that in the judgment of Hevelius and Comiers this comet almost equalled the moon in size. It was nearest to the earth on December 19, when its distance was 0·13 of the earth's mean distance from the sun, so that it approached our globe as close as its orbit admits.

METEORS ON OCTOBER 19.—M. E. Block, of Odessa, records a notable shower of meteors on the morning of October 19, between 3h. and 5h.; he says he had not previously seen so many meteors. In an interval of ten minutes he counted fourteen which passed through the field of his comet-seeker, two degrees in diameter; the radiant was at β Aurigæ, or in about R.A. 88°, Decl. 45°. This radiant agrees nearly with No. 92 in Major Tupman's list.

GEOLOGICAL NOTES

UPPER DEVONIAN ROCKS OF THE NORTH OF FRANCE.—In a recent communication to the Geological Society of the North of France, Prof. Gosselet has brought forward some important new data, obtained from some fresh railway-cuttings between Féron and Semeries, as to the classification and palæontology of the Upper Devonian rocks. Arranging the Upper Devonian into an inferior group—the *Frasnien* comprising the zone of *Rhynchonella cuboides* and that of *Cardium palmatum*, and a superior group—the *Famennien*, in which are placed the Schistes de Famenne, the Psammites de Condros, and the Calcaire d'Etrœungt, he proceeds to show that in sections exposed in the railway-cuttings with a perfect conformable succession of strata and of fossils, the zone of the Psammites de Condros, so well marked elsewhere in the north of France and Belgium, is absent. He regards this arenaceous series to be represented in the district between Avesnes and Fourmies by argillaceous shales. It is easy to recognise at least an upper and lower member in the Famennian group. The former is distinguished by the prevalence of Carboniferous forms, particularly *Spirifer laminosus*, the latter by the rarity of Carboniferous forms and by the abundance of *Cyrtia Murchisoniana*. Every fresh section which tends to elucidate the relations of the Devonian rocks to the formations below and above them possesses a special interest for British geologists.

TERTIARY QUARTZITES OF THE ARDENNES.—Dr. Charles Barrois has laid before the same Society an interesting paper on the extension of the Lower Tertiary beds of the Paris basin across to the Palæozoic plateau of the Ardennes. He shows that the lower members, consisting of sandstones and conglomerates, can be traced by their fragments for a long distance to the north-east, and that these fragments, like our own Grey Wethers or Sarsen stones, are portions of deposits which have been gradually broken up and weathered in place. The existence of these boulders has long been recognised and they have been variously explained, being sometimes considered as drifted blocks. Dr. Barrois, however, demonstrates their true origin by tracing them step by step to their source in the Grès Landéniens. He makes some suggestive remarks regarding the superficial alteration of some of these rocks. In the centre they are undoubted sandstones, but towards the exterior they become progressively harder till they pass into true quartzite. He even obtained specimens of sandstone covered with a mere coating of quartzite two centimetres in thickness. He observed that in proportion as they are traced eastward, that is, into tracts where they must have been longer exposed to atmospheric influences, the alteration penetrates further into them. A microscopic examination failed to afford him any clue to the process of alteration. The quartzite when examined in thin sections appears as a true quartz-sand, the grains of which are so minute that no interstice can be seen between them. It is an excessively compact rock, in which a matrix is hardly appreciable.

PYRENEES MARBLE.—In another paper Dr. Barrois gives information regarding the *Marbre Griotte*, now so largely worked for ornamental purposes in the Spanish and French Pyrenees. This rock, usually regarded as Devonian, and placed on a parallel with the red limestone of Westphalia and Nassau, is shown by him to rest unconformably on Devonian strata in the Western Pyrenees, to be covered by a *Productus* limestone of true Carboniferous date, and to contain in itself a fauna which, by its crustacea (*Phillipsia*), and more especially by its *Goniatites*, must be regarded as Carboniferous. He therefore concludes that the Griotte limestone or marble constitutes the basement member of the Carboniferous system of the region in which it occurs.

PETROGRAPHY IN SPAIN.—The progress of petrography is well illustrated by the appearance of an essay on the evolution of volcanic rocks in general and of those of the Canaries in particular, by Don Salvador Calderon, of Arana, just published in the *Annals* of the Spanish Society of Natural History. He reduces all the rocks of the Canary Islands into two grand categories—a sanidine-amphibole group and a plagioclase-augite group. Thus, out of a paste of augite and plagioclase he conceives that all the rocks of the second category may have been formed, with the addition of other accidental minerals, and by a variation in the proportions. So that at the end of the one series he places a nepheline-basalt containing sanidine, and he traces a gradation from this rock through the disappearance of the sanidine, the successive appearance of hauyne and olivine, and the final predominance of the latter mineral, till he reaches the felspathic basalts, dolerites, and modern lavas. He discusses the evolution of volcanic rocks under four periods:—1. The Lava period, in which section he treats of the vitreous fluidity of lava, the influence of temperature, pressure, and water in the formation of the rock, and the possibility of an arrangement or liquation of the component elements of the lava while still melted within the volcano. 2. The Refrigeration period. Here he discusses the crystallisation of the lava, noting particularly the results of the evaporation of the interstitial water, the formation of the "micro-fluctuation" structure, the development of porphyritic crystals, and the effects of sublimation. 3. Changes in the rocks after solidification; divided into (1) mechanical, which include fractures on the great scale, cracks in the paste of the rocks, fissuring of the crystals, and the formation of cavities and globules; (2) physical, embracing the phenomena of devitrification; and (3) chemical, under which are placed serpentinisation, zeolitisation, natrolitisation, &c. 4. The Decomposition period. Under this heading the author, citing the researches of Durocher, Bischof, and Delesse on the permeability of rocks by meteoric water, and the changes thereby produced, gives a brief account of the nature of the alterations of some of the more prevalent minerals in the rocks of the Canary Islands and elsewhere. The paper is illustrated by a few drawings of microscopic structures.

GEOGRAPHICAL NOTES

FURTHER details are to hand concerning the sojourn of the Russian, Lieut. Tjagin, and a colony of Samoyedes in Novaya Zemlya during last winter and summer. The object of Tjagin's stay on the island was to complete the arrangements for a station for the help of shipwrecked sailors, and to carry out a series of meteorological observations for a whole year. Tjagin arrived at the harbour of Karmakul on August 15, 1878. By September 13 the necessary buildings of wood were completed, and the meteorological instruments installed, and by October 3 all the Samoyedes were collected about the station. The autumn of 1878 was dull, rainy, and cold. The mean temperature was about 4° Centigrade. The first frost was on September 26. The first snow fell on the 28th, and the sea froze on October 10. Ice-crust and drift-ice were seen on the sea in the middle of October, and the harbour of Karmakul, as well as all the small bays, were covered with ice on November 13. But Moller Bay did not freeze during the whole winter, except among the islands which lie thick along the coast. The melting of the snow began with the first thaw, about the middle of May, and the first green was seen on the cleared spots near to the snow-heaps. On June 14 the islands were covered with verdure and flowers, but the harbour of Karmakul and the little bays were not free from ice till July 16, and the small lakes July 22. The mean temperatures were in November, $-9^{\circ}\cdot 8$ C.; February, $-17^{\circ}\cdot 8$; March, $-11^{\circ}\cdot 8$. During the five winter months the mean was $-12^{\circ}\cdot 2$. In January the temperature sank to $-32^{\circ}\cdot 1$, and rose in November to $+0^{\circ}\cdot 8$, and in January to $+0^{\circ}\cdot 2$. The movement of the atmosphere varied from complete calm, rare mild winds from south-west and north-west, strong winds from east-south-east, rising to raging storms, which greatly impeded hunting operations. The quantity of snow which fell was inconsiderable; it snowed seldom, but the strong land winds drove the snow from the distant hills and the neighbouring heaps towards the west, and often covered the houses up to the roof on one side, while on the three other sides the snow was blown clean off the ground. Tjagin returned to Archangel on August 17 with two orphans belonging to one of the Samoyedes who died during the winter. He maintains that wintering in Novaya Zemlya is quite practicable, especially for Samoyedes. The practicability of erecting a refuge station with provisions has also been proved. But a store of provisions is absolutely necessary, as it seems impossible to obtain by hunting anything like a sufficient quantity of animal food during the winter.

DETAILS have reached this country of the expedition led by Mr. Alexander Forrest into the unknown north-eastern part of Western Australia. Forrest left the Beagle Bay, south of King's Sound, on April 20 last, with seven companions and twenty-six horses, proceeded to the mouth of the Fitzroy River in 17° 41′ lat. S., and 123° 36′ long. E., investigated this unknown river as far as its sources in a mountain ridge 2,000 feet high, in 17° 42′ lat. S., and 126° 10′ long. E., then followed a tributary to its source in a mountain chain (in 18° lat. S., and 127° 40′ long. E.), crossed these mountains and discovered a large river in 128° 10′ long. E., which he followed for nine miles. The eastern boundary of the colony was reached in 16° 50′ lat. S., and 129° long. E. Here almost all provisions failed the travellers, yet they proceeded on North Australian ground to the Victoria River, and reached Catherine Station of the overland telegraph (forty-four miles south of Port Darwin) on September 18, in a very exhausted condition. Fifteen out of the twenty-six horses had perished, and three more had been killed and eaten. Mr. Forrest reports that he discovered 20,000,000 acres of excellent pasture land, of which a large proportion would be well adapted for growing sugar cane, rice, coffee, &c. Water was everywhere in abundance, except on the last twenty-two miles of the march. The numerous natives the party encountered all behaved in a most friendly manner.

A TELEGRAM from Col. Prshevalski has been received *viâ* Pekin. It appears that the traveller and his party reached Shatshkoo at the end of June, after marching through the Shami desert, which in its centre rises to an elevation of 5,000 feet. The oasis of Shatshkoo, situated at an altitude of 3,500 feet, is very fertile. On the south it is bounded by a mountain side which begins at Lake Lob-Nor, and is covered with eternal snow in many places. The travellers intended remaining on the mountains until the end of July, and then to proceed to Hlassa.

WE have received from the U.S. Survey copies of several new maps of recently surveyed regions, beautifully finished. They are the Yellowstone National Park, on a scale of two miles to one inch; parts of Western Wyoming, South-eastern Idaho, and North-eastern Utah, and part of Central Wyoming, on the scale of four miles to one inch; a drainage map of portions of Wyoming, Idaho, and Utah, on the scale of eight miles to an inch.

HEFT I. for 1878-9 of the *Mittheilungen* of the Hamburg Geographical Society, is entirely devoted to Africa. Dr. G. A. Fischer, of Zanzibar, contributes a valuable original paper on the Wapokomo Land and its inhabitants; Herr A. Woermann, a Hamburg merchant, discusses the products of West Africa from a commercial point of view; Dr. Hubbe-Schleiden, in a learned and elaborate paper, discusses the Negro's capacity for culture.

IN the December number of *Petermann's Mittheilungen*, Dr. Junker describes in considerable detail the results of his journeys in 1877-8 to the west of the White Nile, from Lado to about 29° E. long., and south to 3° 15′ N. lat., results of great importance for a knowledge of a scarcely known region.

NEWS from Zanzibar announces the safe arrival of the united Belgian expedition at Ugogo.

SUN-SPOTS AND THE RAINFALL OF PARIS

In a paper on this subject by Mr. C. Meldrum, F.R.S., read at the Meteorological Society of Mauritius, after some preliminary remarks, the author said :—

The rainfall observations made at the Observatory of Paris formed perhaps the longest series on record. They were commenced in 1689, and, with the exception of twenty-six years, viz., 1697-98, 1755-72, and 1798-1803, they had been continued to the present day.

From 1689 to 1870 there had been, according to Dr. Rudolph Wolf and Prof. Fritz, seventeen years of maximum and seventeen years of minimum sunspot. Now it would be seen from the following table showing the years of maximum and minimum, and (as far as possible) the rainfall in each of them at the Paris Observatory, not only that more rain had fallen in the former than in the latter, but that throughout that long period there had, as far as could be ascertained, been only two exceptions to the rule that the maximum were wetter than the minimum years.

Min. years.	Rainfall.	Max. years.	Rainfall.	Dif.
	mm.		mm.	mm.
1689	513·0	1693	613·5	+100·5
1698	?	1705	372·7	?
1712	573·3	1717	478·8	− 94·5
1723	229·9	1727	370·0	+140·1
1733	210·2	1738	400·0	+189·8
1745	337·3	1750	564·5	+227·2
1756	?	1761	?	?
1766	?	1770	?	?
1775	534·4	1779	560·1	+ 25·7
1784	442·5	1789	500·2	+ 57·7
1798	?	1804	703·1	?
1810	437·0	1816	545·6	+108·5
1823	457·0	1829	559·8	+102·8
1833	502·9	1837	547·5	+ 44·6
1843	542·2	1848	575·2	+ 33·0
1856	565·3	1860	655·2	+ 89·9
1867	565·1	1870	417·8	−147·3

From the above table it followed :

1. That the mean rainfall of the thirteen minimum sunspot years in the second column was 454·6 mm., and of the fifteen maximum years in the fourth column 524·3 mm., giving a mean annual excess of 69·7 mm. in favour of the latter.

2. That the results in the fifth column, of direct comparisons of the rainfalls in thirteen minimum with the rainfalls in thirteen maximum years, gave a mean excess of 67·7 mm. in favour of the latter.

3. That comparing the rainfall in each minimum year, from 1689, with that of the *following* maximum year, there were only *two* minimum years (1712 and 1867) in which the rainfall had not been less than in the maximum year.

4. That comparing the rainfall in each maximum year, from 1693, with the rainfall in the *following* minimum year, there was, as far as was known, only *one* maximum year (1705) in which the rainfall was not greater than in the minimum year.

5. That, as a rule, therefore, the rainfall of a maximum sunspot year was greater than that of either the preceding or following minimum year ; a circumstance which seemed to indicate a tendency, at least, to a periodic variation in the rainfall of Paris.

The most important feature was, not that on the whole the rainfall of the maximum had exceeded that of the minimum years, but that the excess had occurred in eleven out of thirteen cases. This frequent repetition of the same phenomenon pointed to a periodicity. A mere excess of rainfall in the maximum years, as a whole, could not have done so ; for such an excess might have happened if only a much smaller number of the maximum years had been wetter than the preceding or following minimum years. But that was not the case. From 1723 down to 1867 there was not, as far as the observations went, an instance in which the rainfall of a maximum year did not exceed that of the previous and next minimum year.

To the possible objection that the years of maximum and minimum sun-spots of the seventeenth and eighteenth centuries had probably not been so well determined as those of the nineteenth century, it could be replied that the results for the nineteenth century, also, showed that the rainfall had been greater in the maximum than in the minimum years. From 1804 to 1867 there had been six maximum and six minimum years. Now in every case the rainfall of the former exceeded that of the latter, and the mean excess was 86·1 mm.

Since 1867 there had been only one maximum year, viz., 1870, and the next minimum year was not yet known. It was true that the rainfall of Paris in 1870 had been comparatively small, and it was not improbable that it would be less than that of the next minimum year ; but if such should be the case it would be the only exception to the general rule since the commencement of the century, if not since 1705.

The total rainfall at the Paris Observatory in the seven maximum years, since 1800, was 4,004·2 mm., and in the six minimum years 3,069·5 mm. A rainfall of 934·7 mm., therefore, would be required in the seventh minimum year to restore the balance ; and there was very little chance of this, the greatest recorded rainfall, since the observations had been commenced, having been 703·1 mm. in the maximum year 1804, and the least 210·2 mm. in the minimum year 1733.

The average duration of the sun-spot cycles was, according to Wolf, 11·1 years. The last five complete cycles, starting from a minimum year, were from 1810 to 1867. Taking in each of these cycles the three years of most and the three years of fewest spots, and comparing the rainfall of Paris in the former triennial periods with that in the latter, it was found that the rainfall in each minimum period was less than that in the following maximum period. The figures were as follows :—

Minimum periods.	Rainfall.	Maximum periods.	Rainfall.
	mm.		mm.
1810—12	1531·5	1815—17	1561·4
1822—24	1453·2	1828—30	1718·2
1832—34	1380·1	1836—38	1700·0
1842—44	1455·3	1847—49	1602·7
1854—56	1522·8	1859—60	1658·7
1865—67	1751·7	1870—72	1628·5

It would be seen, however, that the rainfall in the minimum period 1865-67 exceeded that in the maximum period 1870-72 of the cycle which had commenced in 1867 (and the end of which was not yet fully known), the rainfall of 1866 having been abnormally great. But as the rainfall in the three years 1871-73 (1817·9 mm.) when the sun-spots were still numerous, had exceeded that in the three years 1865-67, the usual excess in the maximum periods may have only been somewhat retarded.

By forming, in the manner described on previous occasions, a mean cycle out of the five cycles from 1810 to 1867, and comparing the rainfall of Paris with the sun-spots for each year, the following mean results were obtained :—

Years of mean cycle.	Rain variation.	Spot variation
	mm.	
1	− 2·3	− 32·3
2	− 20·3	− 19·2
3	− 22·2	− 1·1
4	+ 15·3	+ 30·2
5	+ 47·5	+ 40·0
6	+ 40·0	− 29·8
7	+ 12·6	+ 11·3
8	− 17·0	− 1·2
9	− 23·3	− 12·8
10	− 22·7	− 21·1
11	+ 2·0	− 23·6

The above table showed that both the spots and the rain were above (+) or below (−) their respective averages in the same years of the mean cycle, except the last, and that they both attained their maximum in the same year, namely, the fifth. The discrepancy, with respect to *sign*, in the eleventh year, was owing to the years 1854 and 1866 having been abnormally wet.

From the maximum year 1816 to the maximum year 1870 there had also been five complete cycles, which, omitting fractions, gave the following results :—

Years of mean cycle.	Rain variation.	Spot variation.
	mm.	
1	+ 20	+ 23
2	+ 14	+ 14
3	+ 5	+ 5
4	− 10	− 6
5	− 10	− 19
6	− 19	− 32
7	− 9	− 37
8	− 1	− 25
9	− 2	+ 2
10	− 1	+ 31
11	+ 24	+ 45

Although in both tables the rainfall variation was not so regular as the sun-spot variation, yet there was a remarkable parallelism. At all events, both tables showed that the rainfall was greatest when the spots were most numerous, and on the whole, least when they were fewest.

From the several results now obtained it was concluded that any relation that might subsist between the rainfall of Paris and sun-spots was direct, instead of inverse, and that excessive rainfall in the present minimum period, or year, would be merely an exception to the general rule.

M. Flammarion was careful to state that the recent wet weather and paucity of sun-spots might have been only a coincidence. Were the far more frequent cases (during nearly two centuries) of comparatively wet years and seasons when solar maculation was greatest, and of comparatively dry years and seasons when it was least, also mere coincidences? Various considerations had led to the conclusion that they were not.

The circumstance that the sun's physical state, as indicated by the changes that took place in and above the photosphere, was subject to periodic variations, afforded ground for supposing that corresponding variations took place on and near the earth's surface. As a matter of fact, it was now universally admitted, although long contested, that terrestrial magnetism and auroras were subject to variations corresponding directly with those of the sun. Would it, then, as M. Flammarion had asked, be at all surprising to find that meteorological phenomena were subject to similar variations?

Supposing it were fully proved that the rainfall of the whole globe varied directly as the amount of sun-spots, it could not be expected that the law would invariably hold good everywhere. At any given place there were exceptions to every meteorological cycle. For example, on an average, the diurnal temperature increased from near sunrise to an hour or two after noon, and then decreased; but in many parts of the world there were frequent exceptions, and these were so great that the coldest and warmest hours might respectively occur at any time of the day or night. Yet there was a daily cycle of temperature corresponding with the position of the sun. Again, there was a diurnal oscillation of the atmospheric pressure, which, within the tropics, was very regular, though now and then disturbed or entirely masked, but which, in many extra-tropical countries, could not be determined except by taking means of hourly observations carried on for many days. Hourly barometric observations made on ten or more successive days, or cycles, in high latitudes, might not show a trace of the mean diurnal oscillation, which nevertheless existed.

It could not be said, then, that because the rainfall of a place did not invariably increase and decrease as the sun-spots did, there was no rainfall cycle corresponding with the sun-spot cycle. On the contrary, considering the capriciousness of the climate of Paris, it was somewhat surprising that a mean of the rainfall for only five cycles gave such results. There were many five consecutive days on which hourly observations would not give more favourable results for determining the daily march of the pressure of the atmosphere. But while there were 365 cycles of the diurnal oscillation of the barometer in one year, the same number of eleven-year rainfall cycles, if such cycles existed, extended over 4,051 years; so that it was easier to discover the former than the latter by observations at a single station. If the rainfall of Paris and the sun-spots had been observed and compared for as many sun-spot cycles as there were cycles of the diurnal oscillation of the barometer in one year, an eleven-year cycle of the rainfall might now be as well established as the diurnal cycle of the atmospheric pressure or the diurnal cycle of the temperature of the air. But the number of sun-spot cycles during which observations of the rainfall had as yet been made were few. Was it necessary, then, to wait thousands of years before it could be known whether or not there was an eleven-year rainfall cycle? It was believed that such was not the case. The problem might be solved in a much shorter time.

If the total annual precipitation over the whole globe were accurately known for eleven years, and if it were found that it was not a constant quantity, but increased from a minimum in the first year to a maximum in the fourth or fifth, and then decreased to a minimum in the eleventh, there would be a strong probability that this variation was due to some cause operating from without, and that that cause resided in the sun. For to what could such a phenomenon be attributed but to a variation in the action of the great central luminary upon which the production and condensation of aqueous vapour depended? And if continued observation of the total precipitation over the globe showed repetitions of the same variation during several periods of which the mean length was about eleven years, it would be somewhat difficult to avoid the conclusion that the sun's radiant energy was subject to a corresponding variation, even if no trace of such variation had as yet been discovered.

Suppose, now, that in the course of time it were found that there was a periodic variation of the physical state of the sun, and that this variation had the same duration and characteristics as the previously known variation in the amount of aqueous precipitation, would it not be concluded that the latter variation was intimately connected with the solar variation, although the nature of the connection might be a mystery?

Similarly, it might be argued that if the sun, upon which aqueous precipitation depended, was subject to variation, precipitation would be subject to a corresponding variation.

Since, then, it was an established fact that the sun, as shown by a periodic increase and decrease of spots, faculæ, and eruptions, extending over a period of about eleven years, was subject to variation, it might reasonably be inferred that there was a similar variation in aqueous precipitation. And if actual measurements of the total annual amount of precipitation over the globe during *one* sun-spot cycle showed a variation similar in every respect to the solar variation, it would be concluded, not only that there was a rainfall variation, but that probably it was intimately connected with the sun-spot variation.

Theoretically, then, the object should be to ascertain the annual rainfall of the globe. If this could be done for a few sun-spot cycles, the question of a corresponding rainfall cycle would be settled. But the total annual precipitation could not be ascertained; for, in addition to other obstacles, some parts of the earth's surface were inaccessible.

It was more than probable, however, that, supposing a rainfall cycle existed, observations made at numerous points, in both hemispheres, would detect it in a comparatively short time. If, for example, in the course of a few sun-spot cycles, the rainfall in many remote parts of the world, and under every variety of climate, afforded strong evidence of corresponding cycles, if the evidence became stronger as the number of observing stations increased, and if a mean of all the results showed a rainfall variation closely agreeing with the sun-spot variation, it would be difficult to resist the conclusion that the rainfall had a periodicity connected in some way or other with the solar periodicity.

Now, taking only the four sun-spot cycles from 1824 to 1867, so as to avoid objections to earlier observations, it had been found, as shown at former meetings of the society, not only that the rainfalls of the British Islands, the Continent of Europe, America, India, Mauritius, the Cape, and Australia, had, as far as could be ascertained, been greatest when the sun-spots were most numerous, and *vice versâ*, but that a mean of all the observations taken at 138 stations gave the following results, when compared with the sun-spots for the same four cycles:

Years of mean cycle.	Rainfall variation.	Spot variation.
	in.	
1	− 2·0	− 38·2
2	− 0·9	− 22·7
3	+ 0·8	+ 5·7
4	+ 1·9	+ 33·3
5	+ 1·9	+ 41·9
6	+ 1·8	+ 30·7
7	+ 1·1	+ 13·1
8	+ 0·2	− 1·5
9	− 0·5	− 12·1
10	− 0·8	− 21·7
11	− 2·0	− 28·0

The above table showed that the rainfall and sun-spots were, with a single exception, both below or above their respective means in the same years, and it would be seen that as the one increased or decreased, so did the other.

The *separate* results for Europe, America, India, and the stations in the Southern Hemisphere were similar. Those for Europe, for example, derived from observations taken at ninety-nine stations, were as follows :

Years of mean cycle.	Rain variation.	Spot variation.
	in.	
1	− 0·7	− 37·2
2	− 1·7	− 22·8
3	− 0·6	+ 4·4
4	+ 0·8	+ 33·0
5	+ 1·2	+ 43·8
6	+ 1·8	+ 32·9
7	+ 1·7	+ 14·3
8	+ 1·4	− 2·9
9	− 0·3	− 16·6
10	− 1·1	− 24·7
11	− 0·1	− 24·0

Similar results were obtained by taking the sun-spot cycles *separately*. Those for the cycle 1856–67, were as follows :—

Years of cycle.	Rain variation.	Spot variation.
	in.	
1	− 2·2	− 39·7
2	− 1·8	− 39·9
3	− 0·8	− 16·9
4	+ 0·9	+ 24·3
5	+ 1·9	+ 56·9
6	+ 2·5	+ 57·6
7	+ 2·0	+ 38·1
8	+ 0·6	+ 12·4
9	+ 1·0	− 13·9
10	− 1·5	− 34·1
11	− 0·4	− 45·0

The observations at many single stations, when treated by themselves, gave similar results. Those for Edinburgh and Bombay from 1824 to 1867, and for the Cape of Good Hope from 1843 to 1867, were as follows :—

Years of mean cycle.	Rain variation.			Spot variation.
	Edinburgh.	Bombay.	Cape.	
	inch.	inch.	inch.	
1	− 2·8	− 9·0	− 2·3	− 37·2
2	− 1·8	− 5·8	− 2·2	− 22·8
3	+ 0·7	+ 1·3	+ 0·4	+ 4·4
4	+ 2·4	+ 7·3	+ 3·1	+ 33·0
5	+ 3·3	+ 3·5	+ 2·6	+ 43·8
6	+ 2·8	+ 2·4	+ 3·2	+ 32·9
7	+ 0·5	+ 3·8	+ 4·3	+ 14·3
8	− 0·4	+ 0·7	+ 0·8	− 2·9
9	− 1·0	− 1·9	− 2·8	− 16·6
10	− 2·5	− 0·3	− 3·9	− 24·7
11	− 1·7	− 1·9	− 3·3	− 24·0

It had also been found that the levels of the principal rivers of Europe, and those of the great American lakes, had on the whole varied with the amount of sun-spots.

Such were a few of the results for the four sun-spot cycles from 1824 to 1867. Now it was important to remark that the evidence had increased as the rainfall observations had increased. Hence, with the large number of observing stations now spread over the world, it was inferred that a few more sun-spot cycles would settle the question of a corresponding rainfall cycle, if it was not settled already.

Another way of testing the matter in a comparatively short time was to compare, as far as possible, the daily, weekly, or monthly rainfall of the globe with the sun's-spotted area; for the amount of sun-spots varied much in the course of a year.

The results for the sun-spot cycle which commenced in 1867, and which probably was now closing, were not yet fully known, but there was reason to believe that they would be similar to those obtained for former cycles. It could already be stated that a mean of a large number of observations made in all parts of the world showed that the rainfall in the years 1870–72 had been greater than that in the years 1865–67, and judging from the severe droughts that had occurred in India, China, Japan, Australia, South Africa, South America, &c., since 1876, it was not improbable that the rainfall of the last three years had been less than that of the years 1870–72. In 1877 and 1878 the Nile, at Cairo, was lower than it had been for many years, showing that in the regions drained by it there had been a deficiency of rain. There had also of late years been a gradual decrease in the depth of water in the upper portions of the Amazon, so that navigation had sometimes been impeded, and this was supposed to be due to a general diminution of rainfall in the interior of South America. Moreover, various parts of the United States had lately been suffering from drought.

It would appear, then, that the circumstance that the rainfall of Paris had for a long period been greater in the years of maximum than of minimum sun-spots, was not a mere coincidence, but the result of a general law, and a similar remark applied to the rainfalls of many other public observatories.

There were, as might be expected in the case of so fickle an element as the rain, great local exceptions to the general law, though not greater or more frequent than exceptions to the general laws of other cycles; but, as far as had yet been ascertained, the rainfall of the globe varied directly as the sun-spots varied, the deficiency at some places in the maximum years being more than made up by the excess at others, and the excess in the minimum years reduced by a proportionately greater deficiency elsewhere.

Great fluctuations occurred near the epochs of maximum and minimum, but at a large majority of stations the rainfall in the three years of most sun-spots was almost invariably greater than that in the three years of fewest sun-spots.

The general rainfall cycle for the whole globe might be conceived to be made up of a number of local cycles differing more or less among themselves and from the general cycle, according to local conditions, and in some places the general cycle might be reversed.

From this point of view, it was possible that, although the recent rainy weather in Western Europe, at a time when there were few or no sun-spots, was a deviation from the general law, yet it was not an exception to the particular modification of it which prevailed in that part of the world. As a matter of fact, the rainfall of Western Europe was considerably above the average in 1844–45, 1845–55, and 1866–67, that is at intervals the mean length of which was eleven years, and at times when there were few sun-spots. But Western Europe was only a small part of the earth's surface; and from such a deviation, it could not be inferred that the rainfall, *generally*, was above the average in the minimum years.

In Mauritius there had been continuous observations only since 1852. Since that time the rainfall had on the whole been considerably less in the minimum than in the maximum years, but it would take some time to eliminate the effects of local causes.

SCIENTIFIC SERIALS

Zeitschrift für wissenschaftliche Zoologie, 33 Bd., 1 and 2 Heft, October 29, with seventeen plates.—F. E. Schulze, researches upon the structure and the development of the sponges; eighth notice.—On the genus Hircinia of Nardo, and on Oligoceras, a new genus, Plates 1 to 4. The genus of Nardo equals Stematumenia of Bowerbank; Sarcotragus, O. Schmidt; Filifera, Lieberkühn; and Polytherses of Duchassaing and Michelotti. The structure of the filaments—algæ of some authors—is fully discussed. The new genus Oligoceras is established for a new species (collective) from Lesina, which, though a fibrous sponge, is almost destitute of fibrous material.—Prof. E. Selenka, on the germ lamellæ and the arrangement of the organs in the Echinidæ, Plates 5 and 7.—Prof. A. Weismann, Contributions to the natural history of the Daphnidæ, No. 6 and 7, with Plates 8 to 13.—Prof. P. Langerhans, on the worm fauna of Madeira, with Plates 14 to 17.

Gegenbaur's morphologisches Jahrbuch, 5 Bd., 4 Heft.—Reinhold Hensel, on the homologies and varieties of the teeth formulæ of some mammals.—Carl Rabl, on the development of the embryo in Planorbis, with Plates 32 to 38, and woodcuts.—A. Rauber on the formation of form and the disturbance thereof during the development of the vertebrata, first section, introductory remarks, Plates 39 to 41.

Cosmos, November.—Prof. O. Caspari, Darwinism and philosophy, with respect to the homonymous writings of Gustav Teichmüller, of Dorpat.—Baron Dellingshausen, the metaphysical foundation for the mechanical theory of warmth.—Dr. Wernich, on dying and on being killed in the lower forms of life.—Dr. Speyer, protective resemblance in some native insects (end) with woodcuts, communicated by Dr. Fritz Müller.—On Christian Conrad Sprengel; being sketches by two of his pupils.—Smaller contributions literary and critical.

Revue Internationale des Sciences, November 15, contains:—M. Vulpian, introduction to the physiological study of poisons.—Prof. Donders, on science and the art of medicine, being the introductory address to the International Congress of Physicians held this year at Amsterdam; this admirable address will well repay perusal.—M. Villot, the experimental method and the positive limits of natural history.—F. Lataste and R. Blanchard, on the peritoneum in Seba's python.—M. Hallez, on the classification and on the phylogeny of the turbellarians.—Proceedings of the Anthropological Society of Paris.—Bibliographical Bulletin.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 27.—"On the Changes in Pepsin-forming Glands during Secretion," by J. N. Langley, M.A., Fellow of Trinity College, Cambridge, and H. Sewall, B.Sc., Fellow of the Johns Hopkins University, Baltimore, U.S.A. Communicated by Prof. Michael Foster, M.D., F.R.S.

The Œsophageal Glands of the Frog.—In a frog three to four days after food, the alveoli of the œsophageal glands are, in the living state, granular throughout. The outlines of the cells are not visible.

Shortly after food is given, the granules thin away at the peripheries of the alveoli, and thus render the alveolar outlines more obvious. This thinning proceeds so rapidly that in a few hours there is a well-marked clear zone in the outer part of each alveolus, the part nearest the basement membrane.

Later the clear zone becomes larger, the granular zone becoming smaller, but as the clear zone enlarges it ceases to form in section a ring, it dips down into the granular zone at intervals.

Nuclei are not seen either in the resting or the digesting gland.

The points mentioned above as observable in the fresh tissue, can also in the main be observed in glands treated with osmic acid; the border granules, however, stain more deeply and readily than the central granules. The mucous cells are fewer in the active than in the resting glands; it is only in the fresh state that they appear granular.

The granules we consider as stored up cell-products, which, on suffering molecular re-arrangement during the secretion, give rise amongst other substances to the proteid ferment.

We cannot agree with Nussbaum's view that the depth of staining with osmic acid is a trustworthy index of the amount of ferment present in the cells. On his view, it appears to us, the border, rather than the central, granules should be connected with the ferment.

The Gastric Glands of the Newt (Triton tæniatus).—In the newt, the glands were observed through the muscular coat of the stomach with a rapid capillary circulation still going on.

Twenty-four hours after feeding, the glands of the fundus are thickly granular throughout; about three hours after feeding, the maximal change takes place; it corresponds in the main to that already described for the œsophageal glands of the frog.

The glands recover their granular appearance comparatively quickly; in six hours after feeding, the granules have usually again crept up to the periphery; they then increase in number throughout the cells up to about the twenty-fourth hour. Later than this they diminish somewhat; in six days the peripheries of the glands have become more sparsely populated.

In *Triton cristatus* the digestive changes are of the same nature, but much less pronounced.

The Gastric Glands of Stickleback.—In the gastric glands of the hungry fish the granules thin away somewhat from the centre to the periphery; the lumina are inconspicuous. Three to five hours after feeding, the lumina are much larger, the granules are aggregated about it, leaving a peripheral clear rim, the glands are more unequal in size, some having lost more granules and diminished more in size than others.

The Gastric Glands of Mammals.—In the glands of the fundus of the stomach of all mammals investigated, viz., dog, cat, rat, and rabbit, the chief cells are, in rest, crowded with conspicuous granules; the border cells are either without conspicuous granules or are finely granular.

During digestion the granules in the chief cells diminish.

The stomach of the rabbit has certain structural peculiarities; the principal of these is that a large portion of the greater curvature contains glands, in which the chief cells are not coarsely granular. The glands of the greater curvature contain scarcely more pepsin than the glands of the smaller curvature and pylorus. But in the smaller curvature and pylorus there are few if any border cells, whilst there are many in the greater curvature.

Hence the border cells are not directly connected with the formation of pepsin.

The glands of the fundus contain a very much larger amount of pepsin than the glands of the greater curvature; that is, where there are coarsely granular chief cells there is a large amount of ferment.

Further, during digestion the fundus-glands contain less ferment than in hunger—a fact observed first by Grützner—and it is during digestion that the chief cells have fewest granules.

Hence the conspicuous granules in the chief cells are directly connected with the formation of ferment.

Since in passing from the fundus to the greater curvature we meet all stages of granularity in the chief cells, and since the chief cells of the greater curvature do not differ in any essential point from the pyloric gland cells, we conclude with Heidenhain that the pyloric gland cells and the chief-cells of the fundus are fundamentally the same. We consider, however, the chief cells of the fundus to be a highly differentiated form of the pyloric gland cells, a form more especially designed for the production of pepsin, and probably other solids of the gastric secretion.

December 11.—"Thermo-Electric Behaviour of Aqueous Solutions with Mercurial Electrodes," by G. Gore, LL.D., F.R.S.

In this research the author has examined, by means of a new form of apparatus, the thermo-electric properties of a number of liquids in relation to mercury. The liquids include those of acid, neutral, and alkaline reaction. The results obtained are arranged in a table or series, with the solution at the top, in which hot mercury was the most positive at 180° F., and that at the bottom, in which it was most negative, the amount of deflection of the galvanometer needle with each solution being stated.

Another table is also given, in which the solutions are arranged according to the relative degrees of electro-motive force of the currents obtained from them. This series was arrived at by employing two similar apparatus with different solutions in each and ascertaining the difference of strength of their currents by passing the two currents simultaneously in opposite directions through the coils of a differential galvanometer, the amount of difference of deflection produced by each two consecutive pairs being given.

The results obtained from this research have not revealed any very striking phenomena nor disclosed any relation to chemical action or property, but are reasonably explicable upon the hypothesis that the rise of temperature of the liquid is attended by a change of molecular arrangement of the solution, of such a kind as to enable a portion of heat to be converted into an electric current.

The most peculiar phenomenon observed was, that if a solution of a salt, made with distilled water freed from dissolved air, was divided into two equal parts, one of which had been heated and cooled without loss of water or other constituent, previous to making an experiment, the non-preheated portion gave a stronger current than the other, probably in consequence of a change of molecular arrangement of the solution produced by the heating. The method may therefore be employed for detecting molecular differences in conducting liquids having the same chemical composition.

In the class of cases in which the differences of molecular arrangement were the least and the currents the most feeble, the direction of the currents was the most uniform. This is in accordance with the common truth in science, that the smallest phenomena are the most constant.

The author has ascertained by separate experiments of a different kind that mercury, when sufficiently agitated with solutions neutral to test paper, of salts of the alkali metals, renders some of those liquids feebly alkaline; the effect, however, is so slight, requires such extensive and long-continued contact of the substances that it appears consistent with the view that chemical action is not the cause of the currents in these thermo-electric experiments.

"Quantitative Spectroscopic Experiments," by Prof. G. D. Liveing, M.A., F.R.S., and Prof. James Dewar, M.A., F.R.S.

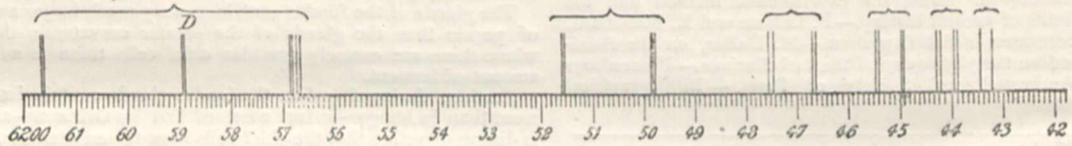
"On the Spectra of Sodium and Potassium." By G. D. Liveing, M.A., F.R.S., Professor of Chemistry, and J. Dewar, M.A., F.R.S., Jacksonian Professor, University of Cambridge.

The authors notice that as seen in the electric arc in one of their lime crucibles, there are in each spectrum several lines hitherto undescribed, which make the whole very regular and symmetrical. The authors have generally used carbonates of the metals, sometimes chlorides.

The pair of lines (5155, 5152) are sharply defined, and have no other line close to them; but the bright green pair, or fifth group (4983, 4982), are diffuse lines, usually seen as one band, but noted by Lockyer to be a double line, and have a third line on their more refrangible side. The authors feel sure that there ought to be a fourth line in this group, but have never been able to detect it.

The sixth group consists of a pair of lines sharply defined. The first only of this pair is described by Lecoq de Boisbaudran. The seventh group is a pair of lines with diffuse edges, which the authors have seen reversed as fine dark lines in the middle of diffuse blue bands. The first only is described by Lecoq de Boisbaudran. By putting some titanic oxide into the crucible the titanium line 4666·5 was seen between the sodium lines, and the authors have no doubt that it is sodium which gives the winged appearance to the corresponding ray in the solar spectrum. The eighth group is a more sharply defined pair, the ninth a diffuse pair, the tenth group again a more sharply defined pair,

Dia. 1 Spectrum of sodium in the arc



and the eleventh group a very diffuse pair, sometimes seen as a continuous band dividing as the sodium evaporates. The twelfth group is a diffuse but narrow band, which the authors have not seen divided, and the thirteenth group a diffuse broad band nearly bisected by the iron line 4325.

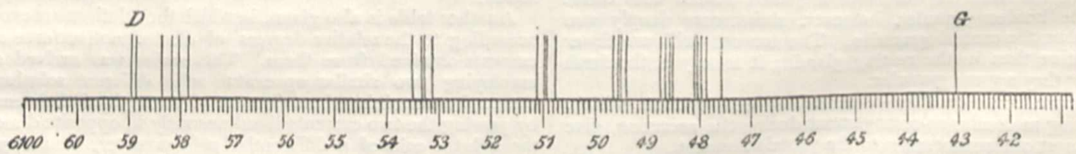
The successive groups become fainter and more diffuse as they are more refrangible, at the same time the distance between successive groups diminishes. Their positions are shown on the accompanying diagram to a scale of wave-lengths. It is worthy of note that every alternate group is much more sharply defined than the others. Moreover, it is only the diffuse groups (3) (5) (7) which show reversal except the first group, in the orange, which, however, is more difficult of reversal than the others. The whole series, exclusive of D, looks very like repetitions of the same set of vibrations in a harmonic progression; the first (visible) term consisting of the six vibrations represented by the orange pair (6160, 6154) and the four lines of group (3); the next term of the five lines of the fourth and fifth groups, one of the six vibrations being now too faint to be seen; the next three terms, of each of which only four lines are visible, consisting of the six and seventh, the eighth and ninth, and the tenth and eleventh groups, and the last term of the two faint bands of the twelfth and thirteenth groups.

Simple harmonic relations can be found to subsist between some of the groups, for instance, the wave-lengths of the fifth, seventh, and eleventh groups are very nearly as $\frac{1}{15} : \frac{1}{16} : \frac{1}{17}$, but the whole series cannot be represented as simple harmonics of one set of six vibrations with any probability. The smallest numbers, which are nearly proportional to the reciprocals of the wave-lengths of groups (1), (4), (6), (8), (10), (12), are 81, 97, 105, 110, 113, 115; and these numbers are only approximately in the same ratios as the reciprocals of wave-lengths.

Lines closely corresponding to all these lines except the faint ones of the 3rd and 5th groups, and the last two groups are found in the solar spectrum.

The potassium spectrum as seen in the arc, leaving out of account the two pairs of lines in the red and that in the violet, consists of a series of groups of four lines each, succeeding one

Dia. 2. Spectrum of potassium between D & G



another at shorter intervals and becoming fainter as they are more refrangible. They all are more or less diffuse, markedly more so on their less refrangible edges. They are shown on the accompanying diagram to a scale of wave-lengths.

The first and least refrangible group of this series consists of the four lines to which Lecoq de Boisbaudran assigns the wave-lengths 5831, 5812, 5801, 5783. The second of these lines (5812) is much less strong than the others as seen in the spark. In the arc they are all nearly equal in brightness, but the authors have not seen the second line reversed. Six groups of four lines each follow.

The sixth group has lines of about the wave-lengths 4808, 4803, 4796, 4788.

The seventh group is too faint and diffuse to be distinctly resolved. The wave-length of the least refrangible edge is about 4759.

None of the last three groups are seen by Lecoq de Boisbaudran, and they are too diffuse for exact measurement; on the other hand, he gives several other lines which are not noticed in the arc.

As in the case of sodium the repetition of these quartets of lines at decreasing intervals with decreasing brightness and sharpness as they proceed from the less to the more refrangible, gives the impression of a series of harmonics; but the wave-lengths do not seem to be in a simple harmonic progression, though simple harmonic relations may be found between some of the groups.

Linnean Society, December 4.—Prof. Allman, president, in the chair.—Mr. W. Carruthers exhibited a bottle of Pteropods (*Spirialis retroversus*) obtained in abundance by Dr. J. Grieve in the Gareloch, Ross-shire, Scotland, in July. A letter from Dr. Grieve was read, wherein he states that these mollusca swam rapidly to the surface, rising with a perpendicular fluttering motion, and having reached the top they raised their wing-like appendages above their heads, and thus upholding them motionless, would then drop quietly to the bottom. Some of the pteropods would occasionally stop half way, and paddle back to the surface to repeat the falling motion; seldom or ever did they swim along the surface. Dr. Grieve did not witness the creatures use their wings (epipodia) as feet to walk or crawl along the bottom, as A. Agassiz has stated to be the case.—Dr. Maxwell Masters gave a communication on certain relations between the morphology and the functions in the leaves of conifers (see *Science Notes*).—Prof. P. M. Duncan next read a paper on a synthetic type of Ophiurid. This specimen was dredged by Dr. Wallich in the *Bulldog* expedition, 1860, fifty miles north of Cape Valloe, East Greenland, and from a depth of 228 fathoms. On casual inspection this brittle-star might be regarded as an Amphiuran, but the spinulose disk and hooked side-arms oppose this notion. Again, resemblances to species of *Ophiothrix* suggest themselves, but the large scaling of the disk, absence of tooth papillæ, and the presence of accessory pieces around the aboral edge of the upper arm-plates, are distinctive characters, and which to a certain extent are indicative of Ophiolepian affinities, but the dental apparatus does not conform. Thus in shape and dental characters it (*Polyopholis echinata*) approaches *Amphiura*; spinules and arm-hooks are those of *Ophiothrix*; and the accessory plates resemble those of *Ophiolepis*. Provisionally the author places it among the family Amphiuridæ, and he remarks that, though rare, such forms cast doubts on the value of the characters employed in the classification of the Ophiuridæ.—Mr. C. B. Clarke followed with a paper on Indian Begonias. This is supplementary to the author's account of the group in Sir J. D. Hooker's "Flora of British India." It treats of the classification of the whole genus (*i.e.*, order) except *Hillebrandtia* and *Begoniella*, and it is maintained that it (the group) can be naturally divided into the six subgenera employed in the "Flora of British India." The author discards the differences in the stamens and styles for subgeneric characters, and employs exclusively the structure and dehiscence of the fruit.—The following gentlemen were elected Fellows of the Society:—Messrs. Samuel Wright (St. Neots, Huntingdon), George Malcolm Thomson (Dunedin, N.Z.), J. Otto Tepper (Adelaide), Henry B. Spotton, (Ontario), John Cameron (Bot. Gard., Bangalore), Major Collet (Kurrum Field Force), and Sir Samuel Wilson (Victoria).

Chemical Society, December 4.—Mr. Warren De La Rue, president, in the chair.—The following papers were read:—On the comparative value of different methods of fractional distillation, by F. D. Brown. When fractional distillation is carried out on a large scale, either or both of two well-defined processes can be used: in the first "washing" the mixed vapours are passed through several layers of liquid obtained by their own partial condensation; in the second "cooling" the mixed vapours are partially condensed by allowing radiation to take place or by passing them through a coil kept at a given temperature; in both processes the liquids of highest boiling-point are kept back, and a better distillate is accordingly obtained. The author concludes that there is an essential difference between washing and cooling. The best distillate is obtained by keeping the still-head at the lowest possible temperature compatible with the passage of vapour into the condenser; he has contrived an apparatus to carry out this principle, and has obtained with it very satisfactory results.—On the influence exerted upon the course of certain chemical changes by variations in the amount of water of dilution, by M. M. P. Muir and C. Slater. The authors find that the amount of chemical change which ensues when solutions of calcium-chloride and sodium-carbonate are mixed decreases as the dilution increases, but when solutions of strontium-chloride and sulphuric acid, or barium chloride and potassium oxalate are mixed, various irregularities in the amount of chemical change are noticed as the dilution increases. These irregularities the authors have studied in detail; they conclude that they are due to the entire system being brought into a state of strain, the principal forces of which this stress is compounded being the force tending to produce cryohydrates and other hydrated molecules, the force tending to split up these molecules and the force tending to separate, and so to impart greater mobility to the chemically active molecules of the system.—On the influence of temperature upon the decomposition of barium chloride by potassium oxalate in aqueous solution, by M. M. P. Muir.—On α and β phenanthrene carbonic acids, by Dr. F. R. Japp. The author, since preparing the alpha acid with Dr. Schultz, has obtained a purer specimen melting at 266°; from a syrupy liquor left in the preparation of the calcic phenanthrene sulphonate, the author obtained the beta acid melting at 250°–252°; he also prepared the sodium and barium salts and studied the oxidation products of the acid. He discusses the constitutional formula of phenanthrene, and concludes that this substance consists of three benzene nuclei, one of which shares four adjacent carbon atoms with the two others.—On some derivatives of phenylacetic acid, by P. Philipps Bedson. The author has separated para- and ortho-nitro-phenylacetic acids, their bromo derivatives, a dibromo body, and a β bromonitro-phenylacetic acid, with its amido derivative.

Geological Society, November 19.—Henry Clifton Sorby, F.R.S., president, in the chair.—Edmund Knowles Binns, and John Dawson, were elected Fellows of the Society.—The following communications were read:—Supplementary note on the vertebræ of *Ornithopsis*, Seeley (= *Eucamerotus*, Hulke), by J. W. Hulke, F.R.S., F.G.S.—The author in this communication describes several cervical and trunk vertebræ of this remarkable Dinosaur. The former are characterised by great length; the anterior articular surface is strongly convex, and the posterior correspondingly hollow. In place of the side chamber characterising the trunk vertebral centra, is a long shallow pit. An upper and a lower transverse process are given off from an upper and a lower plate, which project from the side of the centrum above the pit, and these are connected by a short, forked cervical riblet. The neural arch is dwarfed, and there is no spinous process, and no zygosphenal and zyganteal mechanism. The structure of these vertebræ indicates a long, mobile, and light neck. In the trunk the convexity of the anterior articular surface lessens in passing from the neck to the loins, the anterior ball gradually subsiding till the great articular surface becomes plane, the posterior surface retaining, however, a slight hollowness. The trunk vertebræ have superadded to the ordinary articular processes a mechanism comparable to zygosphene and zygantrum, which must have given great fixity to this part of the vertebral column, contrasting strongly with the flexibility of the neck. The longitudinal side chambers reach their greatest development in the vertebræ referable to the fore part of the trunk; they lessen toward the loins, and are absent from the neck, which is regarded as conclusive of their pneumaticity, and against their having been occupied by cartilaginous and fatty tissues, which might have equally occurred through the whole length of the vertebral column, and not been limited to a particular region in close vicinity to the lungs. The whole construction affords a notable illustration of immense bulk attained with the use of the smallest quantity of bony tissue, which occurs in the form of very thin sheets or plates. The transverse and spinous processes are strengthened by flying buttresses. The vault of the neural canal is beautifully groined, whence the original name *Eucamerotus*. The author then pointed out the family resemblances between the Isle of Wight Wealden form and the new Colorado Dinosaurs, which have many points in common, but are both generically and specifically distinct from *Ornithopsis*. — On the concretionary patches and fragments of other rocks sometimes contained in granite, by J. Arthur Phillips, F.G.S. There are two classes of inclusions, (1) the result of the abnormal aggregation of the minerals constituting the granite itself, containing generally more plagioclastic felspar, mica, or hornblende than it, with some other distinctions: most probably concretions formed contemporaneously with the solidification of the mass; (2) fragments of included schistose or slaty rock, often not very highly altered, caught up from the rock-masses through which the granite has forced its way.—Certain geological facts witnessed in Natal and the border countries during nineteen years' residence, by the Rev. George Blencowe. Communicated by the Rev. H. Griffith, F.G.S. Shales and sandstones are the prevalent rocks from the coast for about twenty-four miles inland. Here is a protrusion of granite; beyond the sandstones come ferruginous shales, with scattered boulders of trap on the surface. The northern third of Natal is white sandstone, formed into hills and ridges by denudation, with a long trap-capped plateau near Helpmakaar. Coal-seams occur in the sandstones. There are frequent vertical pipes in these sandstones which, the author thinks, mark the site of trunks of trees, round which the sand-beds had accumulated. Rorke's House and Isandhlwana are near the above plateau. Near the former is an extinct mud volcano. A remarkable "vitreous shale" is found near the Buffalo; isolated pinnacles of it occur at the spot where the few survivors of the fight crossed that river. A range of mountains, with mural escarpments, remnants of an ancient plateau, rising to a height of some 2,000 feet above another plateau which is 5,000 to 6,000 feet above the sea, extends for about 500 miles from the north of Natal to near Cradock in the Cape Colony; they are sandstone horizontally stratified, capped by trap. Some other geological features are described. The Transvaal consists of undulating hills of soft limestone, a sandstone range, and a country rich in metals,—iron-ore, cobalt, nickel, copper, and gold occur, as well as plumbago.

Zoological Society, December 2.—Prof. Newton, F.R.S., vice-president, in the chair.—A letter was read from Mr. E. L. Layard, F.Z.S., advocating the desirability of a fixed scale of colour for use among naturalists, in describing the plumage and pelage of birds and other animals.—A letter was read from Mr. R. B. White, C.M.Z.S., of Medellin, U.S., of Colombia, S.A., on a mode of protecting plantations from the ravages of an ant (*Atta cephalotes*).—A communication was read from Dr. G. E. Dobson, C.M.Z.S., containing notes on some species of chiroptera, from Zanzibar, with descriptions of new and rare species.—A communication was read from Prince Ladislas Lubomirski, containing the description of a collection of shells made in High Peru, by Messrs. Jelski and Stolzman.—Mr. G. French Angas, C.M.Z.S., read a paper in which he gave the descriptions of two new species of helix (*Eurycratera*) from south-east Betsileo, Madagascar.—Mr. Arthur G. Butler, F.Z.S., read a paper on some Arachnida of Madagascar and the Mascarene Islands, in which an account was given of a collection of spiders recently received by the British Museum from Réunion and Mauritius, through Mr. H. H. Slater.—Lieut.-Col. H. H. Godwin-Austen, F.Z.S., and Mr. G. Nevill, C.M.Z.S., gave descriptions of two collections of land shells obtained at Perak and in the Nicobar Islands by Surgeon-Major E. Townsend and Dr. F. Stolizka.—A communication was read from Dr. A. Günther, F.R.S., containing a notice of a collection of mammals and reptiles recently received from Cyprus by Lord Lilford.—Dr. F. Day, F.Z.S., read a paper upon the fishes of Weston-super-Mare, a locality he had lately visited in order to inquire into some species described by Yarrell and Couch as found on this coast. Mr. Day also gave some account of the results of Lord Ducie's trawling investigations in Ballinskelley Bay, on the Coast of Ireland, and described a specimen of the long flounder received from Mr. M. Dunn of Mevagissy, in Cornwall.

Institution of Civil Engineers, November 18.—Mr. W. H. Barlow, F.R.S., vice-president, in the chair.—The paper read was on tunnel outlets from storage reservoirs, by Mr. C. J. Wood, M.Inst.C.E.

December 2.—Mr. Bateman, F.R.S., president, in the chair.—The paper read was on "The Passenger Steamers of the Thames, the Mersey, and the Clyde," by Mr. W. Carson, M.Inst.C.E.

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Academy of Sciences, December 8.—M. Daubrée in the chair.—The following papers were read:—On the satellites of Mars, by M. Tisserand. By a different analysis from that of Prof. Adams, he concludes that, if Mars be homogeneous, or if the law of densities in it be the same as in the earth (a certain flattening being supposed), the orbits of the two satellites, Phobos and Deimos, will always coincide with the planet's equator, or at least will diverge from it very little.—Remarks on saccharoses, by M. Berthelot. He calls attention to the resemblance of the new substance, saccharine, in general reactions and crystalline form, to trehalose.[1]—Relation between the heat of solution and the heat of dilution in complex solvents, by M. Berthelot. The difference between the two heats of solution is equal to that between the two heats of dilution, observable when there is added to the concentrated liquor before and after having dissolved in it the third substance, the water necessary to bring it to the state of dilute liquor.—On the protochloride of copper, by M. Berthelot. This relates to heat of solution and heat of formation.—Reply to the two questions about chlorophyll in M. Chevreul's last note, by M. Trécul. Crystals of chlorophyll dissolve without residue in alcohol and ether. Each grain, in plants, composed of protoplasm and the chlorophyll it has secreted, should be considered a particular living organ.—Agronomic map of Seine-et-Marne, by M. Delesse. This shows the comparative fertility of the land, and its features, physical, chemical, geological, &c.—Experiments with divergent ajutages, divided into several parts by plates, by M. De Caligny.—On a function of direction in the flight of insects, by M. Jousset de Bellesme. Birds can, but insects in general cannot, alter at will the angle at which the wing is vibrated (the muscles of insects are not inserted in the wing, but in the piece of thorax which supports them). Direction of flight is determined in insects by altering the relative position of the centre of gravity and the axis of sustention, the former being most commonly displaced, and in some cases by movements of the abdomen, in others, of the elytra, in others, of the balancers.—Experiment relative to transport of phylloxera by the wind, by M. Faucon.—On the direct visibility of the photospheric network of the sun, by Dom Lamey. On November 16, observing the sun with a 6-inch equatorial at Grignon (Cote d'Or), he saw quite well that two spots on the left side were surrounded by a reticulated region. With a weak magnifying power the crateriform aspect was manifest.—On series relative to the theory of numbers, by M. Lipschitz.—Coloured rings produced at the surface of mercury, by M. Guébhard. Having carefully cleared off the grey pellicle which forms on the surface of mercury, breathe on the clear metal. Beautiful ring systems are formed in light by the layer of condensed vapour. They contract as evaporation diminishes the thickness. Better results are had by dropping a volatile oil on the surface, and the best with collodion. Diluted with ether, the latter gives pellicles which can be detached, after having regulated their thickness and colours, at will, and transferred to paper.—Reply to M. Trécul and M. Chevreul regarding crystallised chlorophyll, by M. Gautier.—Influence of phosphorus on the urinary secretion, by M. Cazeneuve. Experiments on the dog and the cat show that phosphorus, given in toxic doses, causes increase of urea, phosphoric acid, sulphuric acid, the total nitrogen, and iron. The author disagrees with the view of certain physiologists who regard the liver as the principal organ formative of urea.—On alcoholic fermentation (reply to M. Berthelot), by M. Cochin.—On the inferior Pyrenomycetes of New Caledonia, by M. Crié.—Note on the general circulation of the atmosphere on the surface of the globe, by M. Brault. The fourth and last of the author's series of maps of winds is now published; it relates to the Pacific. M. Brault points out that the problem of atmospheric circulation falls into two parts; finding what the circulation would be if all the earth were covered with water (it would be in a system of zones oscillating from south to north, and *vice versâ*), and finding in the actual circulation what is due to the presence of continents and unequal distribution of land and sea. The former question is best studied in the southern hemisphere.—On a glazed frost observed at Angers on December 4, 1879, by M. Decharme. It commenced about 8 A.M., after a night of strong east wind, and lasted till 4 P.M.

[1] In last week's "Paris," on this subject, the phrase "or saccharine, not yet sugar" should read "or saccharose, yet not sugar."

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