THURSDAY, MARCH 17, 1881

SIR WILLIAM HERSCHEL[1]

II.

HERSCHEL'S removal from Bath to Datchet appears to have been brought about by the unwillingness he felt, at the time of his visit to London, to continue the toils of teaching, which, with the tastes he had now formed, his sister tells us, "appeared to him an intolerable waste of time," and he chose rather the alternative of a salary of 200*l.* from the king. "Never bought monarch honour so cheap!" exclaimed his friend Sir Thomas Watson, to whom alone the sum was mentioned, all other inquirers being simply assured that "the king had provided for him." From letters received by the family at Bath during Herschel's stay in London, they had been led to infer that the king would not suffer him to return to his profession again. Herschel took part in the musical service at St. Margaret's Chapel at Bath for the last time on Whit-Sunday, 1782, when the anthem for the day was of his own composition.

On August 1 he arrived at Datchet. "The new home was a large neglected place, the house in a deplorably ruinous condition, the garden and grounds overgrown with weeds." But these circumstances had no effect upon him: there was a laundry which would serve as a library, and roomy stables which were just suitable for the grinding of mirrors, and a grass-plot where "the small twenty-foot" could be erected. Under such conditions the end of the introductory epoch of his life, as Prof. Holden expresses it, was reached: henceforth he lived in his observatory, rarely leaving it, from his forty-fourth year onwards, except for short periods to submit his classic memoirs to the Royal Society, and even selecting for such visits periods when moonlight interfered with the work of the telescope. We are told that much of his time was occupied, soon after he was settled at Datchet, in going to the Queen's Lodge, to show objects through the 7-feet reflector to the king and Court, but "when the days began to shorten, this was found impossible, for the telescope was often (at no small expense and risk of damage) obliged to be transported in the dark back to Datchet, for the purpose of spending the rest of the night with observations on double stars for a second catalogue."

In his paper entitled "An Account of Three Volcanoes in the Moon," communicated to the Royal Society in 1787, Herschel refers to previous observations of a similar kind, and Prof. Holden gives a translation of a letter written by Baron de Zach, from London, to Bode, the editor of the *Berliner Jahrbuch*, in which these observations are mentioned. An occultation of a star at the moon's dark limb was to take place on the evening of May 4, 1783, and was observed by Herschel and Dr. Lind, a physician in Windsor. Mrs. Lind also placed herself at a telescope to watch the phenomenon. "Scarcely had the star disappeared before Mrs. Lind thought she saw it again, and exclaimed that the star had gone in front of, and not behind, the moon. This provoked a short astronomical lecture on the question, but still she would not credit it, because she *saw* differently. Finally Herschel stepped to the telescope, and in fact he saw a bright point on the dark disk of the moon, which he followed attentively. It gradually became fainter, and finally vanished." . . . Zach professes to report what actually fell from Herschel's lips: Mrs. Lind's observation might be supposed to refer to the apparent projection of a star upon the moon's dark limb, of which we have other instances, but that after an astronomical lecture, however brief, Herschel should have looked into the telescope and still found the same bright point is hardly reconcilable with this explanation: and further if there was no misapprehension of Herschel's words on Zach's part, he seems to have ascribed the appearance to a lunar volcano.

In 1783 Herschel married a daughter of Mr. James Baldwin, a merchant of the City of London, and the widow of Mr. John Pitt: she was entirely interested in his scientific pursuits, and brought him a considerable jointure. Their only child was John Frederick William, born March 7, 1792.

Writing in 1783, Herschel says he had finished his third review of the heavens, which was made with the same instrument as the second, but with the power increased from 227 to 460. It extended to all the stars of Flamsteed's Catalogue, "together with every small star about them to the amount of a great many thousands of stars." He tells us of this third review, that he had "many a night, in the course of eleven or twelve hours of observation, carefully and singly examined not less than 400 celestial objects, besides taking measures, and sometimes viewing a particular star for half an hour together." The summer months of 1783 were occupied in energetic efforts to get the large 20-feet reflector ready for observations during the ensuing winter, and with success; the sweeps for the fourth review of the heavens were commenced before the end of the year. Caroline Herschel relates that at the end of 1783 her search for comets and nebulæ was interrupted to write down her brother's observations with the large 20-foot, and states that in the early use of so cumbrous an instrument and its appurtenances in the open air, she could give "a pretty long list of accidents" which were near proving fatal to her brother or to herself.

In the long days of the ensuing summer months many 10- and 7-feet mirrors were finished. Prof. Holden mentions that in 1785 the cost of a 7-feet telescope, six and four tenths inches aperture, stand, eyepieces, &c., complete, was 200 guineas, and a 10-feet was 600 guineas. A 20-feet telescope would cost from 2500 to 3000 guineas. Herschel made four 10-feet telescopes for the king, one of which was delivered in July, 1786, as a present from the king to the Observatory of Göttingen. Later a 7-feet telescope complete was sold for 100 guineas. For a 10- and a 7-feet telescope the Prince of Canino paid 2310*l.*

Prof. Holden reproduces a letter addressed to Bode about this time by De Magellan, which appeared in the *Jahrbuch* for 1788, from which we make one or two extracts. He writes:—"I spent the night of the 6th of January at Herschel's at Datchet, near Windsor, and had the good luck to hit on a fine evening. He had his 20-foot Newtonian telescope in the open air and mounted in his garden very simply and conveniently. It is moved by an assistant who stands below it. . . . In the room near it

[1] Continued from p. 431.

sits Herschel's sister, and she has Flamsteed's Atlas open before her. As he gives her the word she writes down the declination and right ascension, and other circumstances of the observation. In this way Herschel examines the whole sky without omitting the least part. . . . He has already found about 900 double stars and almost as many nebulæ. I went to bed about one o'clock, and up to that time he had found that night four or five new nebulæ. The thermometer in the garden stood at 13° Fahrenheit, but in spite of this Herschel observes the whole night through, except that he stops every three or four hours and goes in the room for a few moments. For some years Herschel had observed the heavens every hour when the weather is clear, and this always in the open air, because he says that the telescope only performs well when it is at the same temperature as the air. . . . He has an excellent constitution, and thinks about nothing else in the world but the celestial bodies."

An account of the discoveries made with the 20-feet instrument and the improvements effected in its mechanical parts during the winter of 1785 is given with the catalogue of the first 1000 new nebulæ in the *Phil. Trans.* 1786. The house at Datchet being found to be more and more unfit for the requirements of the family, Herschel removed in June 1785 to Clay Hall in Old Windsor, but here "a litigious woman" for a landlady brought unlooked-for troubles, and on April 3, 1786, the house and garden at Slough were taken, and all apparatus and machinery immediately removed there. "The last night at Clay Hall was spent," as Caroline Herschel records, "in sweeping till daylight, and by the next evening the telescope stood ready for observation at Slough." Here Herschel resided for thirty-six years, or from 1786 until his death. As Arago has said of this spot, "On peut dire hardiment du jardin et de la petite maison de Slough, que, c'est le lieu du monde où il a été fait le plus de découvertes. Le nom de ce village ne périra pas; les sciences le transmettront réligieusement à nos derniers neveux."

On January 11, 1787, Herschel discovered two satellites to the planet Uranus, and Prof. Holden relates, before making known his discovery to the world, he satisfied himself by this crucial test: he prepared a sketch of Uranus attended by his two satellites, as it would appear on the night of February 10, 1787, and when the night came "the heavens displayed the original of my drawings, by showing, in the situation I had delineated them, the Georgian planet attended by two satellites. I confess that this scene appeared to me with additional beauty, as the little secondary planets seemed to give a dignity to the primary one, which raises it into a more conspicuous situation among the great bodies of the solar system." In the subsequent announcement of the discovery of four additional satellites of Uranus it is now generally conceded that Herschel was misled by minute stars: his American biographer indeed conjectures that he may have seen *Ariel* on March 27, 1794, and *Umbriel* on April 17, 1801, but however this may be, the discovery of these satellites in the strict sense of the term is considered due to the late Mr. Lassell, who, from repeated observations, was enabled to assign their periods of revolution and mean distances from the primary.

Herschel dates the completion of the celebrated 40-feet reflector from August 28, 1789, when he writes: "Having brought the instrument to the parallel of Saturn I discovered a *sixth* satellite to that planet, and also saw Saturn better than I had ever seen them before." On September 17 following a *seventh* satellite was discovered with the same instrument, of which we shall have occasion to say more, when we come to treat of the subjects included in Prof. Holden's last chapter.

Although Herschel's relations with his contemporaries were usually of the most pleasant kind, there were several occasions upon which he appears to have been somewhat irritated by their comments respecting his work and writings, as in the case of the discovery, or rather supposed discovery, of mountains of great elevation upon the planet Venus, claimed by Schröter of Lilienthal, and described in a paper which appeared in the *Phil. Trans.* for 1792. Herschel's memoir, "Observations on the Planet Venus," in the *Phil. Trans.* of the following year, is viewed by Holden as intended far more as a rejoinder for detractors at home than for the astronomer abroad. At this time he considers there certainly existed a feeling that Herschel undervalued the labours of his contemporaries, an impression no doubt fostered by his general habit of not quoting previous authorities in the fields in which he was working: but he is nevertheless of opinion that "his definite indebtedness to his contemporaries was vanishingly small." The work of Michell and Wilson he always mentioned with appreciation. Some annoyance may have been evinced that the papers of Christian Mayer, "De novis in cœlo sidereo phenomenis" (1779), and "Beobachtungen von Fixterntrabanten" (1778), should have been quoted to prove that the method which he had proposed in 1782 for determining the parallax of the fixed stars should not have entirely originated with himself, but his biographer affirms that in the Memoir of Caroline Herschel there is direct proof that it did so, and further it is shown in his Catalogue of Double Stars. His proposal to call the minor planets detected by Piazzi and Olbers (*Ceres* and *Pallas*) *asteroids* also led to much criticism, and Prof. Holden transfers from the first volume of the *Edinburgh Review* part of an article on the subject, as it is remarked, "simply to show the kind of envy to which even he, the glory of England, was subject."

In the Diary and Letters of Madame D'Arblay we find various personal reminiscences of visits paid to Herschel both by herself and Dr. Burney between 1786 and 1799. In 1793 Herschel was a witness for his friend James Watt in the case of Watt *v.* Bull, tried in the Court of Common Pleas, and it appears that he visited Watt at Heathfield in 1810. In the "Life and Letters of Thomas Campbell," edited by William Beattie, is published a letter from the poet, describing his meeting with Herschel in September, 1813. "His simplicity, his kindness, his anecdotes," writes Campbell, "his readiness to explain—and make perfectly conspicuous too—his own sublime conceptions of the universe are indescribably charming. He is seventy-six, but fresh and stout; and there he sat, nearest the door, at his friend's house, alternately smiling at a joke, or contentedly sitting without share or notice in the conversation. Any train of conversation he follows implicitly; anything you ask he labours with a sort of boyish earnestness to explain." Campbell relates that he was anxious to get from him as many particulars as he could, respecting his interview with Buonaparte, when First Consul, who, it had been reported, had astonished him by his astronomical knowledge. This interview must have taken place in 1802, his sister's Memoir recording that he left Slough on July 13 in that year to go to Paris, returning on August 25 with his son (who had accompanied him) dangerously ill. The result of Campbell's inquiries was hardly confirmatory of the reports which were prevalent. "The First Consul," he said, "did surprise me by his quickness and versatility on all subjects; but in science he seemed to know little more than any well-educated gentleman, and of astronomy much less for instance than our own king. His general air was something like affecting to know more than he did know." There would seem to be no other record of this interview; Lalande, gossip that he was, has no reference in his notes for 1802 to Herschel's visit to Paris, though he, in common with other French astronomers, as Cassini, Mechain, Legendre, had visited at Slough, and might be supposed to be interested in Herschel's return-visit to the French capital. In a letter to Alison, written in December, 1813, Campbell reverts to the pleasure which the day spent with Herschel had afforded him; in this letter he repeats it was "not true, as reported, that Buonaparte understood astronomical subjects deeply, but affected more than he knew."

The occurrences of the later years of Herschel's life are very briefly noticed by Prof. Holden. All through the years 1814-1822 his health was very feeble. The severe winter of 1813-14 told materially upon him. In 1814 he attempted to re-polish the mirror of the 40-feet telescope, but was obliged to give up the work. He found it necessary to make frequent excursions for change of air and scene. In December, 1818, he went to London to have his portrait painted by Artaud, and while there his will was made. Particulars of the will appeared in the *Gentleman's Magazine* for 1822, p. 650; the instruments, telescopes, observations, &c., were given, on account of his advanced age, to his son for the purpose of continuing his studies. "It is not necessary to say how nobly Sir John Herschel redeemed the trust confided to him. All the world knows of his Survey of the Southern Heavens, in which he completed the review of the sky which had been begun and completed for the northern hemisphere by the same instruments in his father's hands." During the next three years the time he was able to spend in work was devoted to putting his papers in order, but he was daily becoming more and more feeble.

Herschel died on August 22, 1822, at the age of eighty-four years. He was buried in the church of St. Lawrence at Upton, near Slough, and a memorial tablet was placed over his grave with an epitaph which some have ascribed to the late Dr. Whewell, others to a Provost of Eton, with three lines from which we may close the present notice, reserving for a concluding article the consideration of the scientific labours of William Herschel, which forms the subject of Prof. Holden's last chapter.

"*Novis artis adjumentis innixus*
Quæ ipse excogitavit et perfecit
Cœlorum perrupit claustra."

J. R. HIND

A POLAR RECONNAISSANCE

A Polar Reconnaissance: being the Voyage of the "Isbjörn" to Novaya Zemlya in 1879. By Albert H. Markham, F.R.G.S., Captain R.N. Maps and Illustrations. (London: Kegan Paul and Co., 1881.)

A "RECONNAISSANCE" in military parlance is, we understand, a preliminary to a serious attack in full force; and in this sense Capt. Markham evidently uses it in the work before us. Had we any doubt of this, on a perusal of Capt. Markham's story of his summer cruise, the preface by Mr. C. R. Markham would set that doubt at rest. But indeed the whole tone of the volume bears on the resumption by Government of the search for the Pole, and Mr. Markham's preface is essentially a catalogue of the qualifications of the Captain for the command of an Arctic expedition. Apart from the questionable taste of this preface and the unpleasant feeling that the book as a whole has been written with a purpose, most of those who are competent to form an opinion will agree with us that in this direction Capt. Markham's work is premature. There is, we are glad to think, little chance of any Government Polar Expedition being sent out for a long time to come. No good could accrue to either science or navigation from an expedition similar to our last expensive failure, and even the additions to mere geography could be of the most trivial importance. While we should be glad enough to see the whole of the Polar area explored, and to know whether the "apex of the world" is land or water, we are content to wait until polar problems of much greater scientific importance are solved. The result of Sir George Nares's expedition has been to compel the enthusiasts on behalf of the Smith Sound Route to abandon it as hopeless, and seek for some other gateway to the Pole. In this it may be found they have been too hasty, for indeed our knowledge of the conditions of the Polar area is of the scantiest. The expedition sent out in the *Jeannette* by Mr. Gordon-Bennett has been given up by many for lost; though we are glad to learn that the U.S. Government have resolved to send out a search expedition. Within recent years the route by Franz-Josef Land has become a favourite with many, though why this should be so it is difficult to fathom, seeing that we know scarcely anything about it. It was discovered six years ago by the Payer-Weyprecht expedition, and since then it has been twice visited—by the *Willem Barents* in 1879, and by Mr. Leigh Smith in his yacht last year. Mr. Smith, as we showed at the time of his return, did some excellent work, having traced the land to a considerable distance to the north-west. He returns again next summer, and we trust he will be able to add still farther to our knowledge not only of the land itself, but of its physical and biological conditions, past and present. One or two enthusiasts who hail the discovery of a barren Arctic islet as if it were a new world, have rushed to the conclusion that Franz-Josef Land would form an excellent basis from which to storm the Pole. But we consider it useless to discuss the question. In a recent article we showed that in every country but our own scientific geographers have come to the conclusion that a mere search for the Pole is a wanton waste of resources, and that the only effective method of adding to our knowledge of the Polar area is by a series of observations continued over several years carried on at permanent observing stations all round the Arctic region. Preparations are now being actively made to begin this work next year, and before that time we trust our own Government will have seen it to be its duty to join the international scheme. If the Geographical Society really wishes to advance scientific geography, let it use its influence to promote this end; surely it has a higher conception of geography than that it consists of mere topography.

Leaving the purpose of Capt. Markham's book out of account, it is very pleasant reading. He did not break up any new ground, but he is a good observer, and has been able to make some fresh additions to what is already known of Novaya Zemlya and the neighbouring seas. He accompanied Sir H. Gore Booth in the Norwegian cutter, the *Isbjörn*, from May to September, 1879. They sailed along most of the west coast of Novaya Zemlya, passed through Matotschkin Schar into the Kara Sea, and sailed down the east coast some distance; afterwards pushing northwards they reached to within 2° of Franz-Josef Land, which was all but touched by the *Willem Barents*, with which the *Isbjörn* had forgathered in the Schar. Sir H. Gore Booth's object was sport, and very good sport he had, both on the sea, the ice, and Novaya Zemlya. Capt. Markham made some useful observations on the movements of the ice, and brought home valuable collections in zoology, geology, and botany, which have been examined and arranged by a number of specialists, and printed as an appendix to Capt. Markham's narrative. He is really skilful in the use of his pen, and the story of his cruise is quite delightful reading. Sir Joseph Hooker's account of the plants of the little expedition in the appendix is specially interesting. "Comparing, then," he says, "the Floras of the three high Arctic meridians of Novaya Zemlya, lat. 70°–77°, long. E. 60°; Spitzbergen, lat. 76½°–80½°, long. E. 20°; West Greenland and Smith's Sound, &c., lat. 71°–82°, long. W. 60°–70°, we find that they present great differences, Greenland being the most remarkable—1. From the number of species of European types it contains which there reach so very high a parallel; 2. From differing more in its flora from Spitzbergen and Novaya Zemlya than these do from one another; and, 3. From the absence of Arctic *Leguminosæ*, *Caltha*, and various other plants that extend elsewhere around the Arctic circle. These facts favour the conclusion which I have expressed in the Appendix to Sir G. Nares's narrative (ii. 307), that the distribution of plants in the Arctic regions has been meridional, and that their subsequent spread eastward and westward has not been sufficient to obliterate the evidence of this prior direction of migration. To this conclusion I would now add, that whereas there is no difficulty in assuming that Novaya Zemlya and the American Polar islands have been peopled with plants by migration from the south, no such assumption will explain the European character of the Greenland, and especially the high northern Greenland vegetation, the main features of which favour the supposition that it retains many plants which arrived from Europe by a route that crossed the Polar area itself, when that area was under geographical and climatal conditions which no longer obtain."

There are several very good and apparently new illustrations of scenery in Novaya Zemlya, evidently from photographs, and two useful maps.

OUR BOOK SHELF

Contributions to the Agricultural Chemistry of Japan. By Prof. E. Kinch. (*Trans.* Asiatic Soc. of Japan, 1880.)

THIS interesting and valuable paper opens with an historical survey of the question: "Is the soil of Japan generally fertile?" The observations of former travellers and the evidence of recent investigators are used in order to show how far the productiveness of Japanese soils is due to natural *fertility*, and how far to artificial *condition*, using these terms in the agricultural senses usually attached to them in England. Prof. Kinch has collected some analyses of Japanese rocks made by various authorities, and has supplemented them by analyses of nine soils. The results, so far as nitrogen and immediately available phosphoric acid and potash are concerned, do not point to any high degree of natural fertility. Passing from the soil-question to that of manures, he gives analyses of fossil shells and of various vegetable ashes employed for enriching the land. An examination of crude nitre yielded 56·5 per cent. of pure potassium nitrate. The Japanese use certain leguminous plants for green manuring; they also employ as manure the cakes of oil-seeds, malt dust from rice, millet, and barley, the residues from the manufacture of rice-beer and soy, and the "cleanings" of rice-grain. Analyses of these materials have been made by Mr. Kinch. A waste product obtained in the manufacture of indigo was found to contain about 3 per cent. of potash, 5·75 per cent. of phosphorus pentoxide, and nitrogen equal to 1·70 per cent. of ammonia.

After a few remarks on fish manures and the composition of the sweepings from barbers' shops, Mr. Kinch turns to the subject of Japanese foods. The "glutinous" rice was found to differ from common rice mainly by containing *less* gluten—only 5·1 per cent. instead of 6·1—both figures being extremely low for a main article of diet. In this particular three kinds of Japanese millet gave more favourable figures, about 12 being the average percentage of gluten or flesh-formers.

Mr. Kinch has examined the soy bean and its chief products with care. A white round variety of this leguminous seed gave no less than 21 per cent. of fat and nearly 38 per cent. of albuminoids or flesh-formers. The seeds of *Phaseolus radiatus* contained about ½ per cent. of fat and 18 per cent. of albuminoids. The gigantic radish of Japan much resembles the common turnip in composition, and contains 95 per cent. of moisture. The analyses of seaweeds eaten in Japan are numerous, and furnish some interesting facts concerning an important source of food greatly neglected in Europe. A few details concerning the waters of Japan and certain matters relating to the silk industry conclude a paper which, though it is of necessity unsystematic and imperfect, yet contains a large amount of condensed and useful information about the chemico-agricultural subjects which the author discusses.

A. H. C.

Experimental Chemistry for Junior Students. By J. Emerson Reynolds, M.D., F.R.S. Part I. Introductory. Pp. 142. (London: Longmans, Green, and Co., 1881.)

THE aim and the plan of this little book clearly mark it out among the numerous small treatises on practical chemistry which flow in such a steady stream from the press. The aim is to teach a beginner in chemistry the leading principles of the science by a graduated course of experiments which he is himself to perform; the plan is to begin with the fundamental differences between chemical and mechanical action, and to lead the experimentalist on to the laws of definite proportion, and of general chemical action. Quantitative experiments are introduced at an early part of the course; those chosen seem to be well suited for the fulfilment of the author's aim, being fairly easily conducted, and at the same time definite and trustworthy in their results.

The principal chemical differences between metals and non-metals are illustrated by experiments on hydrogen and oxygen; the meaning of the terms "acid," "base," "salt," &c., are clearly demonstrated by experimental evidence. The clearness of the enunciation of the fundamental assumptions of the modern atomic theory; the method, experimentally illustrated, of determining molecular and atomic weights; the experimental proof of the splitting of elementary molecules in chemical changes; the method of determining the atomic heat of a metal; the proof of the gaseous laws; the determination of the volume of unit weight of hydrogen, and the application of this determination to the calculation of the weights of gaseous volumes generally; these and other experiments and deductions are all admirably described.

The author is certainly to be congratulated on the production of this book; the care and trouble bestowed on it are doubtless not to be measured by the small number of pages which it contains; the result is most satisfactory. No better guide to the study of chemical science could be placed in the hands of the beginner than this modest little volume of Prof. Reynolds'. M. M. P. M.

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.]

Barometric and Solar Cycles

I SEE that Prof. Hill regards the barometric evidence as favourable to the hypothesis that the sun is most powerful when there are fewest spots on his surface. Perhaps I may therefore be allowed to state the reasons which have induced me to entertain a contrary opinion, which are, I imagine, the same as have also occurred to others. I quite agree with Prof. Hill that the true relation between the variations of sun-spot area and barometric pressure will ultimately be discovered by means of the admirable weather-maps of the United States. Nevertheless, we must wait until these have been produced in sufficient number before we attempt to generalise.

I do not think therefore that Prof. Hill is warranted in drawing any conclusion from a single map, however important, such as that for July, 1878—a time of minimum sun-spots.

Referring to your article (NATURE, vol. xxi. p. 567), I find the evidence from this map to be summarised as follows:—

"It may be worth remarking that this increased pressure over the oceans and diminished pressure over the land of the northern hemisphere is in accordance with what might be expected to result from an increased solar radiation; whilst on the other hand the increased pressure over Southern and Central Asia, and diminished pressure in the southern hemisphere, is not in direct accordance with this supposition."

It thus appears that this evidence is after all of a very mixed nature.

Regarding the unequal distribution of barometric pressure as without doubt caused by the sun, we may with much justice imagine that whenever the sun is most powerful these peculiarities of distribution will be greatest and most apparent. If we now look at a map of isobaric lines (Buchan, "Handy Book of Meteorology") we shall find that the Indo-Malayan region is one that for the mean of the year has a barometric pressure probably below the average. Now during years of powerful solar action we should imagine that this peculiarity would be increased. But this is precisely what all the Indian observers have found for years with most sun-spots. On the other hand, Western Siberia in the winter season has a pressure decidedly above the average, and we should therefore imagine that during years of powerful solar action the winter pressure in Western Siberia would be particularly high. This again is the state of things that Mr. Blanford has found in his discussion of the Russian stations (NATURE, vol. xxi. p. 479) to correspond with years of most sun spots.

It therefore appears that the barometric evidence, as far as it goes, is favourable to the belief that years of maximum sun-spots are years of greatest solar power. BALFOUR STEWART

Bi-Centenary of Calderon

I AM requested by H. E. Don A. Aguilar, Secretary-General of the Royal Academy of Science of Madrid, to beg you will have the goodness to insert in your journal the inclosed notice from that body, offering a prize for an essay on the works of Calderon de la Barca. I am aware that the other Academies (History and Spanish) have already offered prizes for similar works, but this being intimately associated with science, the Academy in that branch has thought it desirable to offer a separate and special one.

I trust I may count on your kind hospitality for a foreign colleague if not trespassing too far on your valuable space.

F. J. RICARDE-SEAVER

Conservative Club, St. James Street, S.W., March 11

ROYAL ACADEMY OF SCIENCE, MADRID.

Programme (adopted by the Council) for the adjudication of a Prize in Commemoration of the Bi-centenary of Calderon de la Barca, 1681, *May* 25, 1881.

The Royal Academy of Science of Madrid being desirous amongst others of commemorating the bi-centenary of the great Spanish dramatic poet Don Pedro Calderon de la Barca, offers a prize for public competition on the following theme:—

"The conception of Nature and her laws deducible from the works of Calderon, as the expression of the standard of scientific knowledge amongst individuals at that period who, without specially professing science, excelled in the cultivation of letters. An analysis of the works of contemporary poets in support of their theme being optional with competitors."

Conditions.

Article 1.—The author of the successful essay will receive a prize consisting of a bronze medal with the legend of the Royal Academy of Science and the sum of 500 pesetas (20*l.*), as also 200 copies of the prize essay printed and bound at the cost of the Academy.

Article 2.—The competition shall remain open from this date up to the 10th May next.

Article 3.—The essays must be written in Spanish or Latin.

Article 4.—These must be delivered or forwarded to the Secretary of the Academy (H. E. Don A. Aguilar, 2, Plaza de la Villa, Madrid) before the above date, with a distinctive endorsement on the outer cover, so as to be easily recognised, but without further notes or indication whatever.

Accompanying the essay the author must transmit a *sealed* letter bearing the same endorsement as the essay itself, and containing *inside* the name and address of the author.

Further conditions may be learned from

A. AGUILAR, Secretary-General

2, Plaza de la Villa, Madrid, February 12

The Photophone

THREE years ago, whilst experimenting on the action of radiant heat and light on the electrical resistance of substances, I was induced to believe that coating selenium with varnish or lampblack would largely increase its sensibility to light. I therefore annealed a stick of selenium about 2 cm. in length and 5 cm. in diameter, having previously melted into each end a platinum wire, and thus obtained a specimen which, though of very high resistance, was exceedingly sensitive to the action of light. The effect of diffused daylight was tested in the following manner:—The specimen was placed in a glass box and connected directly with two Leclanché cells and a very delicate Thomson's galvanometer having a resistance of 6000 ohms; a deflection of, as far as I now remember, about 300 divisions of the scale was produced, and the light was then brought to zero by means of the adjusting magnet; a dark blind which had previously been drawn down was now pulled up, and the result was a deflection of about 100 divisions in the same direction as before. The glass box was placed three yards in front and a little to one side of the window, which was closed, and the sun at the time (about 4 p.m. July, 1877) was on the other side of the house. The selenium was then coated with shell-lac varnish, and about two hours afterwards again tested in the same manner as before, when the light was found to produce a deflection of 220 divisions, or more than twice the previous amount. The action of radiant heat was similar to that of light in the case of this particular specimen, but I have little doubt that *any* specimen may be rendered more sensitive to light by coating it with varnish or lampblack. I hope that this suggestion will prove of service to those philosophers who may aspire to "hear a beam of light" or to "see by electricity," and shall be glad to hear that such has been the case. HERBERT TOMLINSON

King's College, Strand, March 7

Cave Animals and Multiple Centres of Species

THE readers of Semper's "Existenzbedingungen der Thiere," now translated into English, will find (vol. ii. p. 268 of the German edition) an interesting discussion on the question of monophyletic or polyphyletic evolution of species, the author decidedly inclining to the latter hypothesis. Considering that at the root of the manifold and difficult problems here involved, there is the relatively simple one of single or multiple centres of each species in a biographical sense, I take leave to ask the following question, hoping for an answer from among your readers versed in these matters.

To me it seems impossible to maintain the single centres of species in a strict and definite sense without also maintaining the single progenitor of each species, which latter view, formerly considered as a necessary assumption, has been given up by Mr. Darwin in Chapter IV. of the later editions of the "Origin of Species" (5th ed. p. 103, 104). Of course the acceptance of single centres, in the sense of more or less restricted areas of origination, may remain valid for the vast majority of species—but this is very different from considering it, once for all, as "a necessary consequence of the adoption of Darwinian views," as has been formerly said by Mr. Bentham (NATURE, vol. ii. p. 112).

Now, I have sometimes thought that there might be a test for the *possibility* of multiple centres, which, eventually, would amount almost to an experimental demonstration—namely: *whether there are cases of the same species of blind animals occurring in different caves distant from and without subterranean communication with each other?* Should such cases occur it would be most improbable that the animals in question had been transported from one cave to the other in the modified state, and most probable that they had been independently evolved in each cave from identical species which entered it from without. I formerly noted one instance perhaps in point, viz. a statement of Prof. Cope's (NATURE, vol. vii. p. 11) that "the blind fish of the Wyandotte Cave is the same as that of the Mammoth, the *Amblyopsis spelaeus*, Dekay," but I am not aware whether subterranean communication is, or has been, impossible in this instance. Perhaps more decisive cases have become known of late?

Freiburg im Breisgau, March 4 D. WETTERHAN

Prehistoric Europe

WILL you kindly allow me to correct a clerical error in my letter which appeared in NATURE, vol. xxiii. p. 433. For "'hash-up' of *the* species," read "'hash-up' of species." A number of the species from the Upper or Interglacial Bone-bed of Mont Perrier (and some of which are mentioned in my letter) are of course too characteristically Pleistocene to be claimed by Prof. Dawkins as Pliocene forms, and do not therefore appear in his list of Upper Pliocene species to which I referred.

Perth, March 14 JAMES GEIKIE

Measuring the Height of Clouds

IN NATURE, vol. xxiii. p. 244, Mr. Edwin Clark gives a method whereby the height or distance of clouds may be measured. This end has already been attained by me, several years ago, and I believe with adequate success. I have also worked out the method in detail, so that its practical realisation no longer offers any difficulty. It is very simple and easy, and the apparatus ("nephoscope") is not difficult to make. A full description of the nephoscope will be found in the *Zeitschrift der Oesterreich. Ges. für Meteorologie*, edited by Jelinek and Hann, vol. ii. p. 337, in so far as the instrument serves for measuring the *direction and velocity* of the passage of clouds. In order also to ascertain the *absolute height* of clouds (N.B. all without calculation) I have introduced an improvement. This and a guide to practical use I have published in the same *Zeitschrift* (vol. ix. September, 1874, pp. 257-61). I believe Mr. Edwin Clark will find in the article referred to his idea fully worked out.

C. BRAUN,

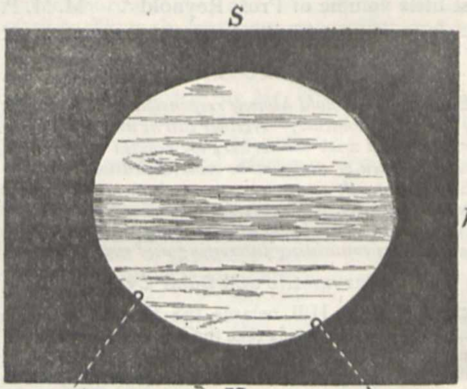
Kalocsa, Hungary, March 3 Director of the Observatory

Occultation of 73 Piscium

I OBSERVED here this evening the occultation of 73 Piscium by Jupiter, which was predicted in your "Astronomical Column" under the date December 23, 1880 (NATURE, vol. xxiii. p. 183). At 1h. 52m. 30s. G.M.T. the star was hanging on the limb of the planet, and by 1h. 54m. it had entirely disappeared.

The phenomenon strongly resembled the occultation of a satellite, except that the disappearance was more rapid. But it was not instantaneous as I had expected. The planet and star appeared to cohere for about one and a half minute. The contrast in their colours was very marked, Jupiter appearing of a yellowish tinge, while the star shone out white like a diamond. During the occultation the red spot was on the planet's disk, and its following end was in about the same meridian as the point of the star's occultation.

I had no micrometer, but I inclose a diagram showing the estimated points of occultation and reappearance.



The G.M.T. of reappearance was 2h. 44m., when the star was again observed to hang on to the planet's limb.

The telescope used was a 4¼ inch refractor by Cooke equatorially mounted, with a power of 96.

The planet was well placed for observation, being nearly in the zenith.

Before and after the occultation Jupiter appeared as if with five moons, the star being almost indistinguishable from the satellites.

As the occultation could not be observed in Europe these few notes may possibly prove of some interest.

A diagonal (prism) eyepiece was used in making the sketch.

Meean Meer, Lahore, February 3 H. COLLETT

Colours of British Butterflies

MOST of the protectively coloured British butterflies pair either on the ground as the "Blues," or on low herbage as the majority, or on the leaves of trees, as some of the "Hair-streaks," and with closed wings. The wings of both sexes are usually opened as widely as possible immediately before copulation.

I have been struck by the fact, which I may mention in reference to the remark of Mr. J. Innes Rogers (NATURE, vol. xxiii. p. 435), that I have never seen the "peacock" attacked by any British bird, and I have often watched him flaunting his colours in the presence of shrikes, flycatchers, and other—one would imagine dangerous—company. W. CLEMENT LEY

Ashby Parva, Lutterworth, March 11

Lecture Representation of the Aurora Borealis

I HAVE recently employed a simple device for giving to an audience a vivid idea of an aurora, and that has been to paint a representation of it with Balmain's luminous paint. When dry the drawing may be hung up in the lecture-hall and covered with black tissue-paper until required. At the appointed time the lights are lowered, the tissue-paper withdrawn, and magnesium wire burnt in front of the painting. I had last week the pleasure of showing this to an audience of 500 persons, and from the expressions of curiosity and approval found it to be a very taking experiment. WM. ACKROYD

Sowerby Bridge, March 10

Squirrels Crossing Water

HAVING read in NATURE the two interesting communications on Squirrels Crossing Water, I was so free as to cite them in my paper *Lumír*, requesting the readers to let me know whether any of them had seen instances of squirrels taking to water here in Bohemia. Upon this I received from my friend Prof. A Tiráseh of Litomysl the following :—

"You seem to doubt of squirrels taking to water, and I hasten to give you notice of what I myself witnessed when a boy. With the help of other young fellows like myself I succeeded in driving a squirrel down from an old ash-tree that stood in our garden, not far from the River Medhuje (Metan). The squirrel must have come from the other side of the water, where there was a wood, and must have crossed the river. Of this however I cannot be sure, but when driven down from the tree, and seeing its way to landward cut off, the squirrel turned to the river, and sprang in, I following it. Now it swam very cleverly, but was overtaken by me in the middle of the water, and brought back in triumph, of course with my hands all bleeding from its sharp teeth, which the animal used cleverly too."

Prague, March 13 T. V. SLÁDEK

Tacitus on the Aurora

THERE is a passage in the "Germania" of Tacitus (chapter xlv.) which I do not think can have ever been examined by the historians of natural science, or it would have created a considerable stir amongst them. Side by side with a plain account —probably the earliest written one—of an arctic twilight, there lurks in it a description of the aurora borealis, which moreover lends countenance to the still prevailing notion that the northern lights are accompanied by sound.

Speaking of the Suiones, a tribe on the northern borders of Germany, the great writer says :—"Beyond them is another sea, calm even to stagnation, by which the circle of the earth is believed to be surrounded and confined ; because the last gleam of the setting sun lingers till he rises again, and so brightly that it dims the stars. It is believed too that a sound is heard, that the forms of gods and rays from a head are seen (persuasio adjicit sonum audiri insuper formas deorum et radios capitis adspici). Up to that point [however]—and the report [I have given] is true—everything is natural."

As to the question of sounds being heard, the din of carts and factories in our city, and the roar of trains in our suburbs make an observation here for determining it impossible ; while the rarity of the phenomenon in England generally keeps spectators from being on the watch. But I have heard an intelligent old man who has often gazed on the bright streamers during the clear still nights of Aberdeenshire declare that he has plainly observed sharp switching sounds to proceed from them. It seems to me probable, since electricity can change into sound and takes part in producing the aurora, that the spectacle is attended by audible vibrations. M. L. ROUSE

Chislehurst, Kent

ON THE PRACTICABILITY OF LIVING AT GREAT ELEVATIONS ABOVE THE LEVEL OF THE SEA [1]

"UP to this time most of the loftiest portions of the earth are totally unexplored, and this arises principally from the fact that the mountaineer, in addition to experiencing all of the troubles which occur to other travellers, has to deal with some which are peculiar to his work. I do not now refer to the 'distressing hæmorrhages,' 'alarming vomitings,' and 'painful excoriations' which are said to afflict him. Hæmorrhage and excoriation are rather large words, and they are apt to be alarming if they are not translated. But they do not seem so very formidable if they are rendered 'bleeding at the nose' and 'loss of skin through sunburn' ; and it may perhaps tend still further to allay alarm if I say that I have never known bleeding at the nose to occur upon a mountain except to those who were subject to the complaint ; while with regard to vomitings, although such unpleasant occurrences *do* happen, they have only been known when persons have taken that which has disagreed with them.

"There is, however, behind these, another trouble, which cannot be dismissed so lightly. All travellers, without exception, who have ever attained to great altitudes, have spoken of having been affected by a mysterious complaint, and this complaint is known to affect native races living in high mountain regions, as well as casual travellers. With us it is usually called mountain sickness. There are many native names for it, and numerous conjectures have been put forward as to its cause. Very commonly it is supposed to be the work of evil spirits, or mysterious 'local influences' ; but there is no doubt that it is simply an effect which is the result of the diminution in the atmospheric pressure which is experienced as one goes upward. The reduction which takes place at great heights is quite sufficient to account for disturbance of the human system. At 20,000 feet pressure is less than half the amount that it is at the level of the sea ; that is to say, whereas at the level of the sea atmospheric pressure is generally capable of sustaining a column of mercury of thirty inches, at 20,000 feet it will not sustain a column of fifteen inches. * * * * *

"From air-pump experiments, and from purely philosophical considerations, it is obvious that the human system must be liable to derangement if subjected to sudden diminution of the atmospheric pressure to which it has been accustomed. These disturbances have often been so severe as to render mountain travellers incapable, and their lives well-nigh unendurable ; and it is scarcely to be wondered at that they have endeavoured to escape from the infliction by descending into lower regions. I do not know a single instance of a traveller who, having been attacked in this way, has deliberately, so to speak, sat it out, and had a pitched battle with the enemy. Nor am I aware that any one has even suggested the bare possibility of coming out victorious from such an encounter. Yet, upon doing so, depended the chance of pushing explorations into the highest regions of the earth ; and I long felt a keen desire to know whether my own organisation, at least, could not accommodate itself to the altered conditions. From considerations which would occupy too long to enter into now, I gradually acquired the conviction that patience and perseverance were the principal requisites for success ; and the journey of which I am now going to speak was undertaken with the view of bringing this matter, amongst other things, to a definite issue. In the course of it we camped out at very great heights. Twenty-one nights were spent above 14,000 feet above the level of the sea ; eight more above 15,000 feet; thirteen more above 16,000 feet ; six more above 17,000 feet ; and one more at 19,450 feet. I shall not now anticipate what you will presently hear, and I have made these preliminary observations to render less frequent the interruption of the narrative, and for the purpose of explaining allusions in it which might otherwise perhaps have been only half-understood."

After describing the route taken to Chimborazo, Mr. Whymper proceeded to mention the first journey he made to that mountain ; and said that whilst returning from it to the town of Guaranda (8870 feet), whilst still about 13,000 feet above the sea, he was overcome by dizziness, feverishness, and intense headache, and had to be supported by two of his people for the greater part of the

[1] Extracts made, by permission of the author, from a lecture delivered by Edward Whymper to the Society of Arts in the Theatre at South Kensington, March 9, 1881—"On Chimborazo and Cotopaxi."

way. "Imagining that I was attacked by fever, I took thirty grains of sulphate of quinine in the course of the night, and was covered up with a mountain of blankets; but next morning there was nothing the matter, and as the symptoms were precisely those which occurred at a later period, when we were *evidently* affected by low atmospheric pressure, I ultimately concluded that it was through this that the indisposition was caused.

"At this point allow me to say a few words further with regard to the troubles which occur to persons who get to great altitudes. Although the heights of the Andes which we were about to visit had not been well determined, there was reason to believe that several of them approached, if they did not exceed, 20,000 feet. At the time of our departure there were only three tolerably well-authenticated instances of persons having reached that height on land, and I could learn nothing whatever which was of the least service respecting the experiences of those who were engaged in those expeditions. But from others, who had reached altitudes of from 17,000 to 18,000 feet, I heard a confirmation of my supposition that, at such great elevations, I ought not to expect a continuance of the immunity from mountain sickness which I had hitherto enjoyed.

"I made up my mind, therefore, before we left, that, sooner or later, we should suffer like the rest of the world; but, being of opinion, as I have already said, that patience would overcome mountain sickness, it was my intention, on all our expeditions, first to establish camps as high as we could force the natives and mules. As it would be impossible to retain the natives at those positions, it became necessary to provide ourselves with food sufficient for weeks, or even for months, so that, in the event of our failing in our enterprises, either from badness of weather, mountain sickness, or other causes, we should not have the mortification of being obliged to abandon our positions simply from want of sustenance."

Mr. Whymper then described the establishment of his second camp on Chimborazo at the height of 16,500 feet above the level of the sea, and said, "Although we had succeeded in establishing our camp on the selected spot, it had only been done by the greatest exertions on the part of my people and their beasts. The mules were forced up to the very last yard that they could go, and staggering under their burdens (which were scarcely more than half the weight they were accustomed to carry), stopped repeatedly, and by their trembling, falling on their knees, and general behaviour, showed that they had been driven to the verge of exhaustion. When we arrived at the second camp, we ourselves were in good condition; which was to be expected, as we had ridden up the entire distance from Guaranda; but within an hour I found myself lying on my back, along with both of the Carrels, placed *hors-de-combat*, and incapable of making the least exertion. We knew that our enemy was upon us at last, and that we were experiencing our first attack of mountain sickness.

"We were feverish, had intense headaches, and were unable to satisfy our desire for air, except by breathing with open mouths. This naturally parched the throat, and produced a craving for drink, which we were unable to satisfy, partly from the difficulty of obtaining it, and partly from the difficulty of swallowing it. For, when we got enough, we were unable to drink, we could only *sip*; and not to save our lives could we have taken a quarter of a pint at a draught. Before one-tenth part of it was down, we were obliged to stop for breath, and gasp again, until our throats were as dry as ever. Besides having our normal rate of breathing largely accelerated, we found it impossible to get along, without every now and then giving a spasmodic gulp, just like fishes when they are taken out of water. Of course there was no desire to eat; but we wished to smoke; and found that our pipes almost refused to burn, for they, like ourselves, wanted more oxygen.

This condition of affairs lasted all night and all the next day, and I then managed to pluck up spirit enough to get out the chlorate of potash, which, by the advice of Dr. Marcet, I had brought in case of need. Chlorate of potash was, I believe, first used in mountain travel by Dr. Henderson, in the Karakorum range, and it was subsequently employed on Sir Douglas Forsyth's Mission to Yarkand in 1873-4. The surgeon to the expedition states that he distributed little bottles of it amongst the members of the embassy, and says that, from his own experience, he can testify to its value in mitigating the distressing symptoms produced by a continued deprivation of the natural quantity of oxygen in the atmosphere. Before my departure, Dr. Marcet urged me to experiment, with the view of confirming these experiences. Ten grains to a wine-glass of water was the dose recommended, to be repeated every two or three hours if necessary. I say distinctly that I *thought* it was of use, though it must be admitted it was not easy to determine, as one *might* have recovered just as well without taking any at all. Anyhow, after taking it the intensity of the symptoms diminished; there were fewer gaspings, and in a degree a feeling of relief. I am so far in favour of its use, that I shall always carry it on future expeditions. Louis Carrel also submitted himself to experiment, and seemed to derive benefit, but Jean Antoine, the elder of the two, sturdily refused to take any doctor's stuff, which he regards as an insult to intelligence. * * * * * *

"It seems curious to relate that Mr. Perring (interpreter) did not appear to suffer at all. Except for him we should have fared somewhat badly. He kept the fire going—no easy task, for the fire appeared to suffer from want of oxygen just like ourselves, and it required such incessant blowing that I shall consider for the future a pair of bellows an indispensable part of a mountaineer's equipment. Mr. Perring behaved on Chimborazo in an exemplary manner. He melted snow, and brought us drink, and attended to our wants in general. It goes, therefore, somewhat against the grain to say that he had been for a number of years in Ecuador much addicted to pursuits which play havoc with the human frame. He was so far debilitated that he could not walk a quarter of a mile on a flat road without desiring to sit down, or 100 yards on a mountain side without being *obliged* to rest. Had I been aware of his previous history, he certainly would not have accompained us.

"You will naturally inquire—How can you account for this man, of shattered constitution (who also was no mountaineer) being unaffected, when the three others, who where all more or less accustomed to high ascents, were for a time, completely incapable? The explanation appears to be this. Perring had been for a long time residing in the interior, at heights of from 9000 to 10,000 feet, and had several times passed backwards and forwards over the Arenal, a height of over 14,000 feet. The mean elevation at which he had resided during the previous ten years was, in all probability, much higher than the mean elevation at which we others had lived; and it would probably have been found, had he been subjected to examination, that his manner of respiration, and even his organs of respiration, had become better adapted to a pressure of $16\frac{1}{2}$ inches, which was the height of the mercurial column at our second camp." * * *

Mr. Whymper and his Italian mountaineers remained in the same condition for several days. At length the Carrels, becoming better, were eager to be off exploring, and they were sent upwards to find a higher camping place. "They returned soon after dusk, both extremely exhausted. They could scarcely keep on their legs, and threw themselves down and went to sleep, without eating or drinking. Their condition, and the report which I heard next day, rendered it certain that our second camp, as a starting-point, was not placed high enough. It appeared that the Carrels, neglecting their instructions, had made a push towards the summit, but had reached a height of only about 19,000 feet. As they were quite unencumbered, carrying no instruments, and only enough food for their own use, and had no traveller to look after, and yet came back quite exhausted, it was obvious that we should have to get still higher up before we could make a serious effort to reach the summit. So, as soon as he was well enough, I sent Louis with Perring down to the first camp to fetch up a tent, which had been left there, and when this arrived we were in a position to go forward again.

"On the following morning I went myself up the ridge to look for a higher camping place, and found one on the eastern side on some broken rocks, at a height of 17,400 feet. By this time I was in rather better condition than the Carrels. Feverishness had disappeared, and my blood had resumed its normal temperature. The gaspings had entirely ceased, and headache had gone. You will perhaps inquire how I knew that I was feverish; for in regard to this matter one is often mistaken, and fever is supposed when it does not exist. By the advice of the distinguished physician whose name has been already mentioned, Dr. Marcet, I had provided myself with a registering clinical thermometer for the purpose of taking blood temperature at great elevations. This was duly done, and in respect to this matter nothing more need be said than that at our greatest heights the temperature of the blood was (just as it is at the level of the sea) higher during periods of warmth, and lower when it was unusually cold; but stood at its normal height, when the thermometer was at 60° or thereabouts, and did not appear to be affected by low atmospheric pressure at all. In recommending me to take this little instrument (which I have in my hand), Dr. Marcet rendered me a great service; and amongst all the devices and instruments which have been pressed upon the attention of travellers in general, of late years, I know nothing equal to it in importance. By constant observation, I was able to detect the earliest advances of fever; and by taking proper steps in time, was able to get through the entire journey without having an attack of fever worth mentioning. Its expense is trifling, and it can easily be carried in the waistcoat pocket. When we were first laid on our backs by mountain sickness, it showed that my blood temperature mounted to 100°·4, but by the end of the year it had fallen to its usual height, viz., 98°. Still, although the more disagreeable symptoms had gone, we found ourselves remaining comparatively lifeless and feeble, with a strong disposition to sit down when we ought to have been moving." * *

Mr. Whymper then described his first ascent of Chimborazo, and concluded his account of this mountain by saying, "My residence on Chimborazo thus extended over seventeen days. One night was passed at a height of 14,400 feet, ten at a height of 16,500 feet, and six at 17,300 feet. During this time, besides ascending to the summit, I also went three times as high as 18,500 feet. When we quitted the mountain, *all trace of mountain sickness had disappeared*, nor did it touch us again until we arrived at the summit of Cotopaxi. * * *

"The height of Cotopaxi is 19,600 feet. Our camp was placed about 130 feet below the loftiest point, and it was the most elevated position at which any of us had ever slept. We remained there twenty-six consecutive hours, feeling slightly at first the effects of low pressure, having the same symptoms as we had noticed on Chimborazo; and we used chlorate of potash again with good effect. All signs of mountain sickness had passed away before we commenced the descent, and *they did not recur again during the journey*. * * * * *

"This, ladies and gentlemen, nearly brings my remarks to a close, and, in conclusion, permit me to say a word more in respect to mountain exploration in general. Amongst certain persons it is still fashionable to affect a description of scorn, bordering on contempt, for anything in connection with mountains and mountain work. None of us feel, perhaps, very deeply the criticism of those who are evidently ignorant of the subjects on which they talk; and, in this matter, speaking for myself, I rather look forward to the time, which will surely come, when the study of mountains, the ascent of mountains, and even prolonged residence on mountains, will be found essential for the prosecution of a score of sciences. Before this could be carried out, it was necessary to learn whether life could be made endurable at great heights. We were always haunted by the fear of an invisible enemy who might strike us down at any moment. What we wanted to know was, not whether life could exist at a height of 20,000 feet (that was settled seventy-five years ago, by Lussac), but whether man could become so far habituated to the low pressure which is experienced at that height, as to be able to live without inconvenience, and to do useful work. I went to the Andes in search of an answer to these questions, you have heard the story, and can form an opinion whether it affords encouragement for the prosecution of exploration in other quarters."

ON SOME POINTS RELATING TO THE DYNAMICS OF "RADIANT MATTER"

AS the important researches of Mr. Crookes may be said to have made the evidence of the molecular state of matter (grounded on indirect reasoning) almost ocularly visible—the mechanics of gaseous matter therefore acquires a fresh interest. As some years back the present writer devoted much thought to the clear realisation of the nature of the motions of the molecules of gases in connection with a proposed explanation of the mode of propagation of sound on the basis of the kinetic theory (published in the *Philosophical Magazine* for June, 1877), it then appeared to him that the systematic *regularity* of the motions of the molecules of gases was not in practice so generally appreciated as it might be; although of course the mathematical basis of the subject was well established. It has been not unusual to speak of the extreme "irregularity" of the normal motions of gaseous molecules—which is undoubtedly true of any molecule taken individually. The comparison of the molecules of a gas to a "swarm of bees" (sometimes adopted), though no doubt highly convenient and useful to aid the conceptions in some respects, has probably gone to support (rather than not) the idea of a kind of confusion in the motions of the constituent molecules of gases; whereby the systematic *regularity* (or symmetry of the motion) tends to be left out of view. This will perhaps appear more evident if I state the following proposition in regard to a gas, which is only a direct corollary from the established mathematical principles—true in every state of the gas, but emphasised by rarefaction.

The normal motion of the molecules of a gas takes place in such a way, that every point in the gas is a "radiant point," such that matter passes to and from that point (to a certain distance) in the direction of rays; i.e. *as if a luminous point were situated at the point in question.* Or more generally put: If finely subdivided matter be in motion in space according to its own dynamics, every point of space becomes a radiant point; the extent of the radiation of matter depending on its fineness (other things being equal).

It is, I believe, the losing sight of the systematic regularity (or symmetry) of the motion of the molecules of a gas in its normal state, which (as it would seem, at least) has caused the connection of gaseous motion with the conditions for gravity to be overlooked—or the fact to escape realisation that on rarefying the gas, this symmetry of motion (existing in the normal state of the gas) gradually merges, without break of continuity, into the radiant streams of matter moving in the right directions to produce gravity under Le Sage's sheltering principle, without the necessity for adopting any of his postulates as to *direction* of motion, or assuming a *supply*[1] of matter from ultramundane space in continuous currents ("ultramundane corpuscles"). As this subject was carefully thought out and dealt with by me in the *Philosophical Magazine* for September and November, 1877, &c., I may perhaps claim some right to say a few words about "radiant matter."[2]

The immense importance—in its possible practical applications—of this remarkable self-correcting principle (directly based on the mathematical results of the kinetic theory) whereby particles of matter, left to their own dynamics, rigidly adjust their motions so as to move in a "radiant" manner [and to return energetically to this beautifully symmetrical kind of motion when after disturbance they are left to themselves], has, I venture to think, not been duly appreciated. For, looking at the case broadly, it would seem that this dynamical principle is capable of affording a means for substantially satisfying at least three fundamental objects in nature. For, firstly, it will appear evident that we can have thereby a means perpetually present in every point of space for *carrying* energy in a "radiant" manner (*i.e.* in the direction of the rays of light from a point) in all possible directions. Secondly, by this automatic system we can have a mechanism capable of causing (under the sheltering principle of Le Sage) the *approach* of the molecules of gross matter at any point of space—such as exhibited in the phenomena of "gravity" and (under modifying conditions probably) the other phenomena of approach, "cohesion" and "chemical action." Thirdly, since the "radiant" character of the motion is inevitably attended by an exact balance of the momenta at every point of space, we can have in this system an exhaustless store of energy in perfect equilibrium (and therefore concealed in its normal state), competent to throw some rational light on such unexplained phenomena as explosions, combustion, or the violent developments of motion taking place in the molecules of gross matter generally.[3]

As the phenomena of rarefied gases are attracting attention at present, perhaps some calculations I have made (based on the mathematical results of others) in regard to conditions attending extreme rarefaction, may not be without interest. The fact that the mean length of path of the molecules (of a gas) increases in the *triple* ratio of the mean distance on rarefying, leads to some remarkable results, which would scarcely be expected perhaps unless they had been worked out—and have their application in regard to the long mean path required for gravity. For it is a consequence of this that while the mean distance of the molecules of a gas increases with extreme slowness on rarefying, the mean path augments at a great rate.

This may be perhaps best elucidated by a mode of illustration, which I have chosen with the endeavour, if possible, to convey clear conceptions to the mind, which is far more important than the mere writing down of numbers (millions, &c.) which afford no defined idea at all. Some conception of what actually occurs when a gas is rarefied to a millionth of its normal density (a common amount in experiments) may perhaps be presented to the mind by supposing a cubical box, say one foot in the side, containing gas at normal density—hydrogen for instance—to be opened in a room one hundred feet in the side, containing a vacuum. This will then accurately represent the actual degree of rarefaction in the case under notice. The mean distance of the molecules will then be increased (from known principles) in the ratio of the linear side of the cubical box to that of the cubical room, *i.e.* as 1 to 100. Since the mean distance of the molecules at normal density is known to have been about one seven-millionth of an inch[1] (according to the mathematical results obtained by the late Prof. Clerk Maxwell and others); the mean distance or rarefying to a millionth will become one seventy-thousandth of an inch (a hundred times greater, but still a very small distance). The mean length of path will have increased as the *cubic* contents of the room (*i.e.* in the triple ratio of the mean distance). The mean length of path (which is known to have been about $\frac{1}{250000}$ of an inch at normal density) will now have rapidly risen to the very perceptible dimensions of four inches (nearly). Here we have the state of "radiant" matter (previously existing however in the normal state of the gas, but concealed) coming to be quite appreciable to the senses. For the gaseous molecules now "radiate" regularly to a mean distance of some inches from every point in the room; and if a portion of the gas were inclosed in a bulb, about four inches in diameter, the molecules would (on the average) strike across from one side to the other without colliding among themselves: the beautiful "radiant" character of the motion then becoming lost, and the motion (and consequent pressure) irregular, owing to the confined space and absence of those mutual encounters among the molecules by which the motion is forcibly corrected and made symmetrical.[2] It appears therefore that the truly "radiant" character of the motion (if we use the word in relation to the rays of light radiating from a luminous point) would then cease—though no doubt the term "radiant" may be also conveniently employed in another sense, viz. to express the fact [when a portion of gaseous matter is in a confined space where a proper adjustment of pressure is not possible] that the molecules may, by suitable means, be diverted from their paths, like the rays of light, so as to move in a parallel (or common) direction, and cast virtual shadows of objects placed in the bulb.

It will be apparent therefore that the establishment of

[1] These postulates of Le Sage's theory relating to *supply* of matter from boundless space, &c., were unfavourably criticised by the late Prof. Clerk Maxwell (*Encyc. Brit.*, 1875, under article "Atom"). Prof. Maxwell remarks (p. 47) as follows:—"We may observe that according to this theory the habitable universe which we are accustomed to regard as the scene of a magnificent illustration of the conservation of energy as the fundamental principle of all nature, is in reality maintained in working order only by an enormous expenditure of external power, which would be nothing less than ruinous if the supply were drawn from anywhere else than from the infinitude of space."

It will be seen that this objection vanishes by regarding the gravific æther as simply a stationary gas, within the limits of mean path of whose particles the gravitating parts of the universe are immersed; as then no *supply* of matter or expenditure of external power is required. Also, it may be added, that a difficulty (mentioned p. 47 of same article "Atom") in regard to the supposed excessive heating of gross matter that would occur under the impacts of the gravific particles, was considered by the present writer (*Phil. Mag.*, November, 1877), and a means suggested for removing it without the necessity for admitting any conditions which could be regarded as in themselves improbable.

[2] It is said that Faraday was the first to use the expression "radiant matter."

[3] To my mind, I must confess, it seems difficult to understand why "potential" energy (in the sense of an energy which is *not* kinetic) appears to be (comparatively speaking) so much brought to the fore-ground, to the exclusion of the intelligible view of *motion transferred from matter in space.* Is it not in general considered a right principle to give preference to the intelligible or conceivable, in place of that which cannot appeal to our reason? Evidently the term "*kinetic*" (applied to energy) would be a redundant and superfluous prefix, unless it were thereby implied that some *other* energy than "kinetic" energy, viz., an energy *without motion*, existed.

[1] I quote this dimension from a former paper, "On the Nature of what is commonly called a 'Vacuum'" (*Phil. Mag.*, August, 1877), a few of the data of which it is convenient to use here as a commencement. It should be remarked that Mr. Johnstone Stoney appears to have been the first to carry out calculations regarding molecular dimensions and distances, and to deduce therefrom conclusions regarding the number of molecules in unit of volume of a so-called "vacuum"—which tended to upset preconceived ideas.

[2] It is evident that the "radiant" form of motion (or motion of the molecules *equally in all directions*) is the sole condition for equilibrium of pressure in all directions in a gas, or for an exact balance of momenta in every direction. It is an obvious corollary from this—expressing a known fact—that if any imaginary straight line be taken anywhere in a gas, as many molecules at any instant are moving towards one extremity of the line as are moving towards the opposite extremity—the resolved components of the motions along the line being taken when the motions are oblique. It appears therefore that in order to bring gas rarefied to one millionth under the normal conditions for correcting the motions of its molecules (so as to move in the normal "radiant" manner); it would be necessary to employ a containing vessel of such size that the molecules can adjust their motions freely by mutual encounters. Hence a containing vessel whose diameter was a considerable multiple of the mean path (four inches in this case) would be required—say some feet in diameter at least.

the peculiar state of matter observed by Mr. Crookes does not depend on the rarefaction of the gas, but on the dimensions of the bulb (or confining envelope) relatively to the mean path—inasmuch as if it were possible to construct a bulb approximating to the mean path of the molecules of gas at (or near) normal density, analogous phenomena would inevitably occur, though of course they could not be observed by very small dimensions. [Besides the electric discharge cannot so readily take place in dense gas.] What is done therefore is to raise the mean path approximately up to the diameter of the bulb (by a high degree of rarefaction), instead of—conversely—diminishing the bulb down to the length of mean path (at a lower degree of rarefaction); when the effect would be difficult to perceive from the smallness of scale. It will be observed that it is only a question of scale (rarefaction being a mere relative thing)—only it becomes possible to use a bulb or containing vessel of larger size (to produce the conditions) in direct proportion as the rarefaction is greater; so that the whole effect becomes more magnified and distinct. The truth of this view may be more apparent by considering the case of the atmosphere when, at different heights, different degrees of rarefaction prevail. Let us take the heights where the mean path of the molecules is (say) one-tenth of an inch, one inch, and ten inches respectively. Then at all these heights (as at ordinary density) the molecules of the gas move in the same normal "radiant" manner, or there is nothing peculiar about the state of the gas at any degree of rarefaction. If now a portion of gas be inclosed at each of these heights in bulbs of one-tenth of an inch, one inch, and ten inches in diameter respectively: then the gas in all these bulbs will be in an abnormal condition, or in that peculiar state where it has ceased to have the power of adjusting its pressure, and consequently the phenomena of diverting the molecules (by suitable means, electric, &c.) into any paths at desire will be possible in all the bulbs. These considerations will perhaps contribute something towards clearing up any difficulties or divergence of views as to the theoretic aspects of this question—which happens to trench on a line of inquiry pursued by the present writer for some years. Returning to our former example, it may be instructive to consider what takes place on further rarefying. Suppose the rarefaction to be carried to another millionth, by opening out our cubical room into another whose linear side is 100 times greater, viz., 10,000 feet. Here the mean distance of the molecules becomes one seven-hundredth of an inch (multiplying by a hundred)—still a very small quantity, it will be observed. It may be remarked that by this degree of rarefaction (about a million times further than a good mercurial pump could attain) there are still no less than 340 million molecules in each cubic inch of the space. The mean path however has now sprung to sixty miles—greater than the dimensions of the room (by about twenty to thirty times).[1] Our room has therefore approached the state of a confined bulb where the molecules of gas have lost control over themselves, or cannot adjust their motions so as to move in a "radiant" manner, but the molecules rebound irregularly backwards and forwards from one wall to the other, without (as a rule) colliding together, and may produce considerable irregularities of pressure. In order to restore the uniformity of pressure, and reproduce the normal "radiant" form of motion, it would be necessary to open out our room into another a considerable multiple of sixty miles in the side (the mean path)—adding fresh gas so as to leave the density unchanged. Here we should have molecules moving in streams and passing within (on an average) one seven-hundredth of an inch of each other, and "radiating" from each point of the room with perfect symmetry to a distance of many miles, like the rays of light from a luminous point. In this case we should have molecules capable of becoming virtual carriers of energy to radial distances such as might really in principle serve to some extent the practical object required in the case of light.

If we imagine (for further illustration) the rarefaction carried a million times beyond this—viz., to a millionth × a millionth × a millionth of an atmosphere—then the mean distance of the molecules would still only have risen to the small amount of one-seventh of an inch; but the mean length of path sixty million miles (about). We are thus approaching astronomical distances. It seems a curious fact to consider that a portion of matter can be projected among other portions only one-seventh of an inch apart, so as to move (on the average) sixty million miles without touching one of them. This may form an illustration of the smallness of molecules. A hydrogen molecule moving at about four times the velocity of a cannon ball (its normal rate) would take, calculably, about a year and three quarters to traverse its mean path under these conditions.

These considerations may serve to show, or facilitate the conceptions as to how particles of matter may have an extremely small mean distance and yet have an extremely long mean path. For it is readily conceivable that since (as has been mathematically proved by Clausius and others) the mean length of path of a particle increases, *cæteris paribus*, as the *square* of its diameter diminishes (a rapid rate)—particles, such as those of the æther, for instance, may have such an adequately small diameter as to admit of being in very close proximity, and yet their mean path extremely great (many millions of miles long perhaps). These conclusions, rendered more interesting by the additional light thrown on streams of molecules in the gaseous state by the experimental researches of Mr. Crookes—would therefore point, in their possible application to the æther, to a possible means for carrying energy in a "radiant" manner, producing gravity (or the general phenomena of *approach*), and capable of serving as a great source of motion, the transferences of which are illustrated and exemplified in the motions developed in gross matter on every hand, and which to the appreciative mind who will not admit the *creation* of motion, inevitably demand the presence of an agent inclosing a hidden store of motion. The above view would also have the advantage of correlating the æther with ordinary matter (as merely a body consisting of very much finer molecules—or a difference of scale). Why should we suppose the æther to be something abnormal or different from ordinary matter, without positive evidence? Would not this be a deviation from the rule of admitting *one* principle as sufficient until two are found to be necessary? This also holds in regard to energy. Why countenance at all *two* kinds of energy until we have evidence, or why deviate from *one* grand fundamental principle until we are forced to do so—hardly a probable event, especially when this deviation involves something like a rush into the inconceivable represented by an energy *without motion?*[1]

In conclusion it should be observed that there is nothing hypothetical in the above deductive results re-

[1] It evidently follows from these considerations that if it were possible by some practical means to expand a glass bulb after rarefying; the mean path of the molecules of the inclosed gas would increase three times as fast as the diameter of the bulb.

[1] The apparently logical plan of admitting *one* principle until *two* are shown to be necessary would appear to be reversed in the case of energy. It would seem that *two* kinds of energy are first believed in, because the existence of one kind is not (as it is said) *physically* proved yet—*i.e.* proved in such a way as to be obvious to our gross senses, and not merely a deduction derived from pure reasoning based on the observed and otherwise inexplicable developments of motion taking place in gross matter everywhere around us. Some might think that the contrary procedure to the above would be the more logical—viz., to believe in one kind of energy, *because the existence of two kinds had not been proved yet.* But in the history of science there has notoriously always been a tendency to lean towards the inconceivable, rather than be contented with what our understanding can teach us. At a future day possibly the recognition that all energy is of *one* character will be thought by some a grand discovery. Some may however think it to be only the correction of an error which ought never to have been committed, for which there was no real justification—all analogy, rationality of conception, and that *oneness* of principle so characteristic of nature pointing the other way.

garding the mean distances, mean paths, &c., of molecules on rarefying gases. For the relations computed depend on known mathematical principles. The only possible ground for question would be the particular data of mean distance, &c., taken as a basis for the calculations. But it should be noticed that these rest on an experimental basis: having been deduced from observed facts by investigators of admitted competence, and by means of several *diverse* lines of argument which are found to accord in a remarkable manner as to the results,—which is therefore strong confirming evidence of their substantial accuracy. Also the above inferences regarding a mechanism for the fundamental purposes of carrying energy, storing energy in equilibrium, and producing effects of approach (such as gravity, &c.), cannot as mechanical facts admit of any question. For mechanical principles (like mathematical truths) hold independently of any inquiry as to whether they actually find practical *application* in nature or not. The best argument for their practical application in nature is the incomprehensibility of observed facts without them. We can at least say with certainty that under such conditions, effects (phenomena of approach,[1] transferences of motion, &c.) of the character observed would be produced,—and which effects have not hitherto found any explanation that appeals to our reason. The certainty of simple and automatic mechanical conditions being conceivable which are capable of producing such important effects, should lend a legitimate interest to these inquiries, and the mechanical beauty of the "radiant" adjustment of moving particles of matter which adapts them to so many noteworthy purposes at once, should surely itself be an argument in favour of the practical application of the scheme in nature,—as a simple means to great and important ends.

S. TOLVER PRESTON

DEEP-SEA OPHIURANS

IN the anniversary *Memoirs* of the Boston Society of Natural History, Prof. Theodore Lyman gives an account of a structural feature hitherto unknown among Echinodermata which he has discovered in deep-sea Ophiurans. The remarkable structures described appear under the microscope as little tufts resembling bunches of simple Hydroids on the sides of the arms of certain Ophiurans. On careful examination these tufts are found to be bunches of minute spines, each inclosed in a thick skin-bag, and in form resembling agarics, or parasols with small shades. They are arranged in two or even three parallel vertical rows, and in this respect the animals on which they occur differ from all other Ophiuridæ known, for all others possess a single row only of articulated spines. The peculiar tufts, which are apparently homologous with pedicellariæ, are attached to the outer joints of the arms, near the margins of the side arm-plates. Two new genera, Ophiotholia and Ophiohelus, closely allied to Ophiomyces, are described in which these curious appendages occur. The species of the genera are soft with imperfect calcification. Examples of Ophiotholia were dredged off Juan Fernandez, in 1825 fathoms, and of Ophiohelus off Barbadoes in 82 fathoms, and off Fiji in 1350 fathoms.

Prof. Lyman states that among the Ophiuridæ and Astrophytidæ of the *Challenger* Expedition the entire number of new genera brought home is 20; that of species 167.

[1] It would not be difficult substantially to imitate what occurs in gravitation (according to the dynamical theory), by cooling down the opposed faces of two metal disks freely suspended in a moderately large vessel of rarefied gas, at a less distance apart than the mean length of path of the gaseous particles,—when from known principles (already experimented on by Mr. Crookes) the two disks would approach. Here the diminished velocity of rebound of the gaseous particles from the cooled inner surfaces of the disks (which entails the approach), is imitated in gravitation by a similar diminished velocity of rebound of the gravific particles from gross matter, owing to their translatory motion being partly shivered into vibration (and rotation) at the shock of impact against gross matter (in a manner elucidated by Sir W. Thomson, *Phil. Mag.*, May, 1873). On a large scale, a similar diminution of translatory motion at impact is universally illustrated by the known retarded rebound of elastic masses at collision,—when part of the translatory motion is (in a somewhat analogous way) converted into a vibratory or rotatory motion of the colliding body at the encounter. It becomes interesting in a dynamical phenomenon of the nature of gravitation to contemplate the possibility of doing something towards illustrating it experimentally, and to acquire the certainty of the existence of the streams of particles which produce the effect,—by almost visualising them, through the means employed in the recent researches by Mr. Crookes.

AN ELECTRICAL THERMOMETER FOR DETERMINING TEMPERATURES AT A DISTANCE

THE success of many industrial operations depends upon the steady maintenance or proper variation of certain temperatures, and it is often of the highest importance that the person in charge of these operations should be able readily to ascertain by means of the thermometer if the workmen are performing their duties correctly. It sometimes happens that thermometers have to be placed in positions which are difficult of access, or removed some distance from the centre of the manufactory, and that considerable time has to be expended in visiting the different stations. It was in order to meet the requirements of such a case as this that the electro-thermometric apparatus here described was constructed.

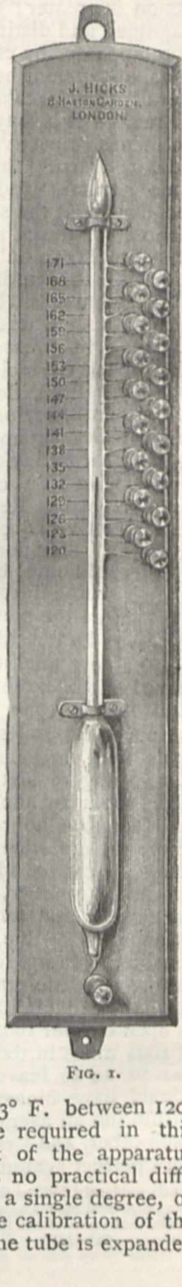


FIG. 1.

I had for some time been much in need of an instrument which would admit of the temperature of a series of malt-drying kilns being determined at a considerable distance from the kilns themselves, and, not being able to meet with a description of a suitable instrument, I was led, after several trials, to contrive this apparatus, which, although it does not embody any new principle, and is not perhaps adapted to accurate meteorological work, is nevertheless very suitable for the technical purpose for which it was originally designed, and is doubtless capable of extended application in many industries.

The apparatus consists essentially of two parts, a mercurial electro-thermometer, and a combination of apparatus which constitutes an automatic receiver and transmitter of signals from the thermometer.

The thermometer, which is shown in Fig. 1, was constructed for me by Mr. J. Hicks of Hatton Garden. It is an ordinary thermometer about nine inches in height, with a large bulb and a stem of wide bore. Through the side of the stem, and fused into the glass, are inserted a series of short platinum wires, the free end of each being connected with a binding screw. These wires, which project slightly into the bore of the thermometer, are, in my instrument, inserted at intervals of 3° F. between 120° and 171°, the range of temperature required in this case. The constructor of this part of the apparatus informs me that, if necessary, there is no practical difficulty in inserting wires at intervals of a single degree, or even less, without interfering with the calibration of the tube. The upper part of the bore of the tube is expanded into a small bulb which is partly filled with glycerine, this

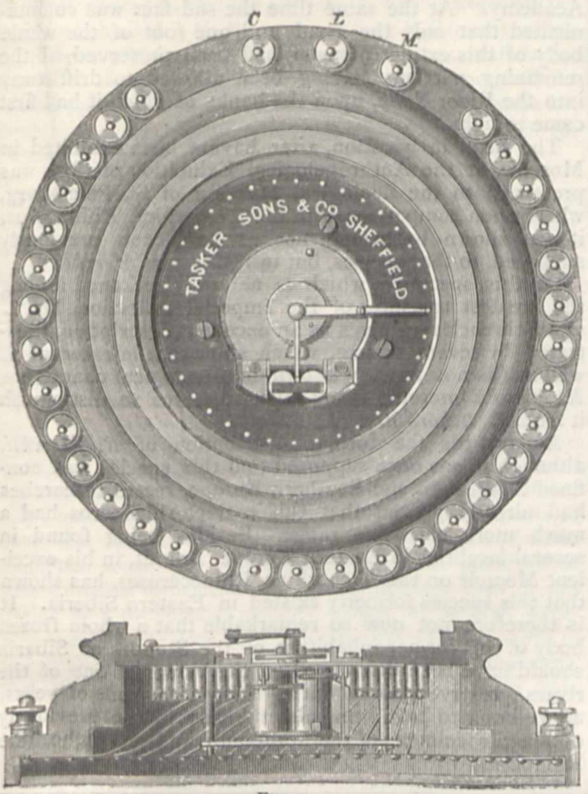


Fig. 2.

liquid of course also filling the bore of the tube above the mercury column. A wire fused into the main bulb of the thermometer is connected with a binding-screw from which a wire leads to one pole of a battery of two Leclanché cells, the opposite pole of the battery being placed permanently to earth.

If the free end of a wire, put to earth through a galvanometer or bell, is brought successively in contact with the binding-screws at the side of the thermometer, commencing at the lowest, a signal will be given from each wire in contact with the mercurial column, but not from the wires above it. By carrying a conducting wire from each of the binding-screws to a series of ordinary electrical bell-pushes arranged on a key-board, the main bar of which is put to earth through a signalling apparatus, it is evidently possible to ascertain at any distance from the thermometer the height of the mercury column, and consequently the temperature, the mean error of observation depending upon the intervals between the wires inserted in the bore of the thermometer. Such a form of apparatus is however inconvenient, as it necessitates carrying a large number of insulated wires to the observing station.

To avoid this difficulty I have devised the *transmitting* portion of the instrument, an apparatus which, placed as near as is convenient to the source of heat, is capable of collecting the various signals from as many different thermometers as may be desired, and of transmitting all these signals down a *single* wire to an observing station at any required distance. This part of the apparatus, shown in Fig. 2, was constructed for me by Messrs. Tasker and Sons of Sheffield. It consists essentially of an ebonite ring, through the thickness of which are inserted, at even distances, a series of small platinum studs, terminating level with the surface of the ebonite ring, and connected at the lower side with a series of binding-screws arranged round the circumference of the circular wooden frame enclosing the instrument. Within the case of the instrument is an ordinary clockwork

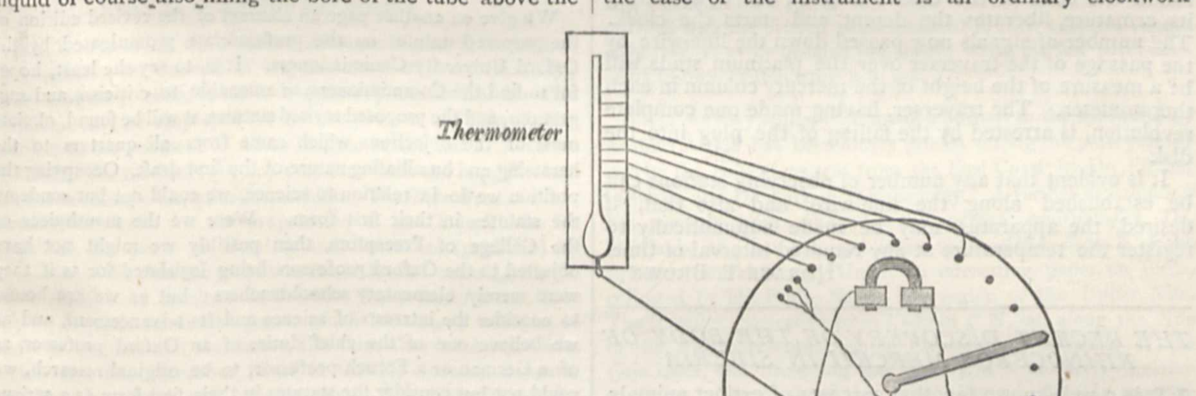


Fig. 3.

motion driving a small metallic traverser, which is capable of a somewhat rapid movement similar to that of the hand of a watch. This traverser, furnished at its extremity with a small piece of platinum, is caused, by means of an adjusting screw, to press lightly against the face of the ebonite ring, and to produce metallic contact with the studs when passing over them. The binding screws around the case of the instrument are connected in serial order with the wires inserted in the bore of the thermometer, and the traverser is in permanent electrical contact with the binding screw L, to which is attached the line-wire.

If the transmitter is intended to convey the signals from more than one thermometer, there are inserted in the ebonite ring, at suitable intervals, three small platinum studs very close together. These studs are not in connection with the thermometers, but with the binding-screw C, which is in permanent connection, through the battery, with earth. By this arrangement the current is short-circuited whenever the traverser passes over these extra studs, and the three signals sent down the wire in quick succession serve to show that the transmitter has commenced to send signals from another thermometer.

The axis which drives the traverser carries round with it a metallic disk, which is drilled with a hole into which fits, when the clockwork is at rest, a small plug. This plug, which acts as a detent, is attached to the heavier side of a light lever, the opposite end of which is furnished with an iron armature in close proximity to the poles of a very small electro-magnet. One end of the magnet coil is connected with the binding-screw C, and so through the battery with earth, whilst the other end of the coil is connected through the binding-screw M (Figs. 2 and 3) with another line-wire which is carried to the observing station, and is capable of being put to earth through an ordinary electric bell-push.

The general arrangement of the whole apparatus is shown in the diagram, Fig. 3. The action of the instrument is as follows:—The line-wire connected with M is momentarily put to earth at the observing station by depressing the bell-push; this causes a current to circulate round the coils of the electro-magnet, which, attracting its armature, liberates the detent, and starts the clock. The number of signals now passed down the line-wire by the passage of the traverser over the platinum studs will be a measure of the height of the mercury column in each thermometer. The traverser, having made one complete revolution, is arrested by the falling of the plug into the disk.

It is evident that any number of observing stations can be established along the line-wire, and also that, if desired, the apparatus may be made automatically to register the temperature at any required interval of time.

HORACE T. BROWN

THE RECENT DISCOVERY OF THE BODY OF RHINOCEROS MERCKII IN SIBERIA

IT is a well-known fact that carcases of extinct animals, such as the Mammoth (*Elephas primigenius*) and Tichorhine Rhinoceros (*Rhinoceros tichorhinus*) are obtained in a more or less perfect state of preservation in the frozen tundras of Siberia. A memoir recently presented by Dr. Leopold von Schrenck to the Imperial Academy of Sciences of St. Petersburg,[1] informs us that the most recent discovery of this nature (which took place in 1877) is of a specially interesting character. The remains found upon this occasion turn out, not to belong to either of the above-named animals, but to a distinct species of Rhinoceros, *Rhinoceros Merckii* (better known in England as *Rhinoceros leptorhinus* of Owen), which had never been known previously to occur in such a condition. Unfortunately full advantage has not been taken of this extraordinary discovery. Although the carcase, as already mentioned, was found in 1877, it was not until March, 1879, that it came to the knowledge of the Imperial Academy. At the same time the sad fact was communicated that only the head and one foot of the whole body of this extinct monster had been preserved, all the remaining portions having been allowed to drift away into the River Yana, upon the banks of which it had first come to light.

[1] "Das erste Fund einer Leiche, *Rhinoceros Merckii*, Jaeg." Von Dr. Leop. v. Schrenck (Mém. Ac. Imp. Sc. St. Pet., vii^e série, vol. xxvii. No. 7, 1880).

The head in question, after having been exhibited in Moscow, at the Anthropological Exhibition of 1879, was presented to the Zoological Museum of St. Petersburg, where upon comparison with the Tichorhine Rhinoceros, it was shown to belong, not as had been previously supposed, to that species, but to *Rhinoceros Merckii*.

Of this specimen, which is naturally reckoned among the greatest treasures of the Imperial collection, Dr. L. von Schrenck now gives us an excellent description, illustrated by several figures, which show that in external as well as (as now already known) in osteological characters, *R. Merckii* presents many salient features to distinguish it from *R. tichorhinus*.

As regards the former distribution of *R. Merckii*, although it was once supposed that this species was confined to Western and Southern Europe, recent researches had already proved that this extinct rhinoceros had a much more extensive range. Besides being found in several localities in Eastern Europe, Brandt, in his excellent Memoir on the Tichorhine Rhinoceroses, has shown that this species formerly existed in Eastern Siberia. It is therefore not now so remarkable that a whole frozen body of this former inhabitant of the Steppes of Siberia should have been discovered on the banks of one of the rivers, preserved frozen during many thousands of years, as we know to have been also the case in the previously obtained specimens of the Mammoth and the Tichorhine Rhinoceros.

NOTES

WE give on another page an abstract of the revised edition of the proposed statutes on the professoriate promulgated by the Oxford University Commissioners. It is, to say the least, hopeful to find the Commissioners so amenable to criticism and suggestions, and the proposed revised statutes, it will be found, obviate most of the objections which came from all quarters to the harassing and humiliating nature of the first draft. Occupying the position we do in relation to science, we could not but condemn the statutes in their first form. Were we the mouthpiece of the College of Preceptors, then possibly we might not have objected to the Oxford professors being legislated for as if they were merely elementary school-teachers; but as we are bound to consider the interests of science and its advancement, and as we believe one of the chief duties of an Oxford professor, as of a German or a French professor, to be original research, we could not but consider the statutes in their first form as a serious blunder.

ON Monday, March 15, the Paris Academy of Sciences held its annual sitting, when the prizes for 1880 were delivered. M. Ed. Becquerel was in the chair. He opened the sitting by an *éloge* of M. Michel Chasles, who died quite recently, and who was one of the most popular members of the Academy. At the end of his address he reminded his fellow members of the completion of the great work of M. Milne-Edwards, which has lasted for a quarter of a century. The great prize for mathematics was awarded to M. Halphen, with honourable mention to M. Poincaré; the Poncelet Prize to M. Leonte, engineer of the machinery constructed by the Government. A sum of 3000 francs was awarded to M. Ader for having advanced in an essential manner phonetic telegraphy (also telephony). The Trémont Prize was awarded to M. Vinot, the editor of the only astronomical paper published in France, and the founder of the only astronomical society. M. Dumas, with his usual eloquence, read the *éloge* of M. Victor Regnault, the celebrated physicist. M. Regnault was born in Germany during the occupation of the Rhenish provinces by France. His father was killed during the invasion of Prussia by France, and his beloved son was killed during the siege of Paris. After the last event took place Regnault's life was a long agony, which M. Dumas described with touching eloquence.

THE Transit of Venus Commission established by the French Academy of Sciences has resumed its labours under the presidency of M. Dumas. A credit has been given by the Government for constructing new refractors. Not less than twelve are now building, to be used on the several stations which have been already selected, and will be ready by the end of the year. The heads of the scientific missions will soon be appointed, as well as their staff. The greater number of instruments built for the 1874 transit have been disposed of to several public institutions.

SIR JOHN LUBBOCK showed a good deal of courage in introducing his motion on Ancient Monuments into the House of Commons in the present temper and obstructed condition of that body; nevertheless he carried his point. All he did was to move that in the opinion of the House the Government should take some steps to provide for the better protection of ancient national monuments; the House declared itself of this opinion by a considerable majority, though, we imagine, something more must be done before Government has the power to step in and prevent the destruction of any ancient monument. That there is no time to be lost if we do not wish most of these relics of the past to disappear entirely, is evident from the long list given by Sir John Lubbock of important monuments that have already been mutilated or destroyed. Sir John suggested that any owner of such a monument who contemplated its destruction should be compelled first to offer it for sale to the country. This course would be both simple and effective.

MR. ROBERTS of the Nautical Almanac Office is authorised by resolution of Council of the Secretary of State for India, dated August 7, 1880, to make it generally known that his Tide Predicter may be employed for the preparation of Tide Tables (subject to the payment of a nominal fee to the India Office for the use of the machine) for any port for which the requisite data are forthcoming on application to him. The Tide Predicter has already been used for the preparation of the Tide Tables for 1880 for the ports of Bombay and Kurrachee (published by authority of the Secretary of State for India in Council) with the most satisfactory results. It has also been used for the Tide Tables for 1881 for Indian ports, which include, in addition to those of Bombay and Kurrachee, the tides also for Aden, Okha Point, and Beyt Harbour (Gulf of Cutch), Karwar, Beypore, the Paumben Pass, and Vizagapatam. The Tide Tables for 1882, the preparation of which is already far advanced, will include, in addition to the above eight ports, the following seven, viz.:—Madras, Rangoon, Moulmein, Port Blair, and on the Hooghly River, Fort Gloster, Diamond Harbour, and Kidderpore (Calcutta). It is anticipated that in addition to a still further number of Indian ports to be predicted for 1883, that Mr. Roberts will have the preparation of Tide Tables for Table Bay, Port Elizabeth, East London, and Durban, tidal observations at these places being now in progress, or shortly to be commenced for this purpose. The observations, when a sufficient series has been taken, will be placed in the hands of Mr. Roberts for the determination of the requisite data for the predictions.

THE Senatus Academicus of Aberdeen University have resolved to confer the degree of LL.D. on David Ferrier, M.A., M.D., Professor of Forensic Medicine in King's College, London

WE have received from Mr. Marsden of Regent Street, Gloucester, a "List of British Birds," with, as an appendix, "The Graduated List for Labeling Eggs." With similar lists the present one compares favourably, and it is a pity that Mr. Marsden, who is evidently an intelligent man, did not make his catalogue still more perfect. The insertion of species like the Russet Wheatear (*Saxicola stapazina*), and the Barred Warbler (*Sylvia nisoria*), which are not entered in so recent a work as Newton's edition of "Yarrell," show that the author is abreast of the latest information on the subject of rare visitants to this country. But the Black-winged Kite (*Elanus cæruleus*) has equal rights to a place in a British list, and we are sorry to see the Great Black Woodpecker (*Picus martius*) and the Rufous Swallow (*Hirundo cahirica*) still allowed as visitors to Great Britain. The careful researches of Mr. J. H. Gurney, jun., published in Sharpe and Dresser's "Birds of Europe," have entirely disproved ever single supposed occurrence of the Great Black Woodpecker, while the so-called Rufous Swallow turned out to be nothing but a common *Hirundo rustica* in fine spring plumage. The abbreviations of authors' names are, to say the least, ingenious, but as they differ in nearly every case from those adopted by all ornithologists, we cannot perceive any real advantages to be gained by their use, as they involve continual reference to the introductory explanation to find out the author's meaning. If brevity in quoting authors' names is desired, "Bp." for Bonaparte is better than "Bo," and is moreover frequently so employed. "Bon" in Mr. Marsden's list means Bonnaterre, but in many ornithological works Bonaparte is thus signified, so that we cannot commend this portion of the author's labours. We were at first puzzled as to the meaning of the "Graduated List for Labeling," but we find on referring to it that the names of the British birds are there printed in various-sized types according to the size of the different bird's egg, and we are sorry to think that there is still a demand for a list of this kind whereby collectors become satisfied with the printed name attached to their captures instead of having, as every genuine egg should have, the full particulars of its history written upon it in ink.

THAT we may still expect many additions to the avi-fauna of Eastern Africa has been amply proved during the past year or two by the collections sent from the East Coast by Dr. Fischer to Berlin and Dr. Kirk to this country. A further contribution has recently been made by the veteran ornithologist, Dr. Hartlaub, who has just published in the *Abhandlungen* of the Bremen Natural History Union an interesting paper on Birds, collected by Dr. Emin Bey in the region of the Upper Nile. The traveller proceeded from Lado in 5° N. lat. along the Nile to the Albert Nyanza, visiting the northern extremity of the Coja Lake, and traversing the country in a northerly direction to Fatico. The result of this expedition considerably modifies the generally received opinion respecting the relation of the avi-fauna of the Upper Nile region; for although a large number of the species obtained are, as might be expected, Abyssinian, there is a certain infusion of South and West African forms, with a sprinkling of peculiar genera and species. The new species described are as follows:—*Cisticola hypoxantha*, *C. marginalis*, *Eminia* (g.n.) *lepida*, *Drymocichla* (g.n.) *incana*, *Dryoscopus cinerascens*, *Tricholais flavotorquata*, *Muscicapa infulata*, *Hyphantornis crocata*, *Hyphantica cardinalis*, and *Sorrella emini*. The Whale-headed Stork (*Balæniceps rex*) was looked for in vain on the Victoria and the Albert Nyanzas, and is said to exist only north of Schambé.

MESSRS. W. EAGLE CLARKE and William Denison Roebuck, secretaries of the Yorkshire Naturalists' Union, are preparing for publication "A Handbook of Yorkshire Vertebrata: being a Complete Catalogue of British Mammals, Birds, Reptiles, Amphibians, and Fishes, showing what Species are or have, within

Historical Periods, been found in the County of York." The authors state that when engaged on the compilation of various papers on the natural history of the county for the *Transactions* of the Yorkshire Naturalists' Union, find that there is a deficiency of information of a reliable nature as to the detailed distribution in Yorkshire of the various species of vertebrated animals, and this in spite of the fact that all available published information has been by them systematically and diligently collected. This deficiency they believe to some extent arises from the circumstance that never yet has there been published a list of the vertebrated animals (or of any subdivision thereof) of the county as a whole. Such a list they propose to supply. The Birds will be undertaken by Mr. Clarke, the Mammals, Reptiles, and Amphibians by Mr. Roebuck, and the Fishes jointly. The writers would be glad to have co-operation, in the way of supplying lists and notes for as many districts in the county as possible. Scattered observations on any species are as much desired as lists. Notes on the historical evidence of the former existence of species in the county, and on the local names used for the various species, are also desirable. Communications are requested to be addressed to either author at his residence, or at No. 9, Commercial Buildings, Park Row, Leeds.

THE *Times* correspondent sends some additional facts to account for the recent earthquake at Casamicciola. "The lamentable accident," Prof. Palmieri states, "which has happened at Casamicciola was not only not felt by the University seismograph, nor by that of Vesuvius, but did not extend even to the whole of the island. It must be regarded, therefore, as a perfectly local phenomenon, produced probably by the sinking of the soil occasioned by the slow and continual subterraneous action of the mineral waters." That there were severe shocks of earthquake, the *Times* correspondent goes on to say, is unquestionable, but unless the ground had, so to speak, been prepared for it, the disaster would probably have not been so great. The fact is that the island is burrowed in many parts. Wherever there is any chance of finding a spring the ground is hollowed out, and the fortunate proprietor makes a good thing of it during the season. In addition to this fact, a considerable part of the soil is formed of clay, which is held in high estimation; and not merely Naples, but the country around to a great extent, is provided with bricks and pottery from Ischia. This branch of industry has been carried on successfully for many years, and it may readily be understood, therefore, that the subsoil is so perforated that any violent shock suffices to wreck the houses on the surface. Ischia is well known to be of volcanic formation, and has, in times long past, been subject to shocks and eruptions from Epomeo, the now dormant cone in the centre of the island. What is called the Lake of Ischia is supposed to have been the crater of an extinct volcano. The last great eruption occurred in 1301, and lasted two months, inflicting complete ruin on the island. A scientific Commission, composed of Professors Palmieri, Scacchi, Linno, and Guiscardi, have gone to Casamicciola to endeavour to ascertain whether the earthquake there was due to local causes or not.

EARTHQUAKE shocks continue in Switzerland to an extent that, in view of the terrible disaster at Ischia, is causing considerable apprehension. A very strong oscillation was observed at Heniveil, in Zürich, early on Monday morning, and about two o'clock on the following morning two separate shocks were felt at Lausanne. Two deaths resulted in a rather singular way on Friday last from the earthquake of the preceding day. The shock loosened a mass of rock overhanging a quarry at Oberburg, in Berne, and twenty-four hours afterwards it fell, literally grinding to powder two unfortunate men who were working hard by.

IT has been decided by a large number of friends and admirers of the late Mr. Frank Buckland to perpetuate, by a substantial memorial, the services which he has rendered to the study of natural history and fish-culture by his numerous writings, and also by the formation of his celebrated fish museum at South Kensington, which he has bequeathed to the nation. A committee which has been formed with this object in view includes among others Sir William Vernon Harcourt, M.P., Sir Philip Cunliffe-Owen, Prof. Owen, Mr. Spencer Walpole (Inspector of Salmon Fisheries), and several other gentlemen representing the different fishery boards throughout the country and the various fishery interests. The exact form which the memorial shall take has not yet been determined. This will be decided at the next meeting of the committee, which will shortly be held.

WE hear that Mr. Walter Hill is about to retire from the Curatorship of the Botanic Gardens at Brisbane, in connection with which his name has become widely known. It is rumoured that the Gardens will be placed under the management of a board.

WE are glad to see that the Liverpool College of Chemistry has been reopened after being renovated and refitted with modern apparatus for research. Under the guidance of Dr. Tate and Mr. G. H. Sharpe, we have no doubt it will prove a useful centre for instruction and science.

THE stenographic machine which we mentioned in our last issue was presented on March 11 to the Société d'Encouragement, meeting under the presidency of M. Dumas. It is a small instrument, about 1½ foot long and 1 foot wide, placed on a stand 2½ feet high, on which it is easy to play with both hands. The number of elementary signs is only six, which by mutual combination give seventy-four phonetic letters. It has been worked with an astounding velocity, reproducing the words pronounced by a man reading a passage from a book. The limit of velocity is stated to be 200 words in a minute, which is more than sufficient, no speaker having ever uttered more than 180. The signs are very neatly printed on a paper band passing automatically under the types. They can be read by any person conversant with the peculiarities of the system, which requires the teaching of a very few months. The work of the stenographer is more difficult, but in little more than a year he can be educated. Women and persons who have an acute and correct hearing can practise it with success. Blind people, generally having very delicate hearing, will be most useful, the reading and translation being done by other people. The same machinery is available for every language in existence. The system is so perfect that it can be used for reproducing a language that is neither spoken nor understood by the operator. But under such circumstances the orator must speak slowly and in a very distinct manner. This machine was worked by a young lady belonging to the stenographic staff of the Italian Senate, where the machine is in constant use.

THE work of laying subterranean cables is proceeding favourably from Nancy to Paris. This telegraph line is composed of twelve insulated wires placed in a large tube of cast iron. For each length of 500 metres doors have been arranged so that any section can be removed and replaced without having to open the ground, which is necessary in the German system of laying the cables in a solid bed of asphalte.

WE are asked to make known that at the request of the Commissaire-Général, the Society of Telegraph Engineers and of Electricians have undertaken to supply to and collect from intending British exhibitors, applications for space at the forthcoming Exhibition. Forms of application and copies of the general rules can be obtained at the offices of the Society, 4, Broad Sanctuary, Westminster, London, by letter addressed to the Secretary of the Society, or by personal application between the hours of 11 and 5.

THE *Photographic News* of March 11 publishes an excellent photo-engraving of Fox Talbot.

MR. W. HEIGHWAY has issued a useful "Handbook of Photographic Terms," an alphabetical arrangement of the processes, formulæ, applications, &c., of photography for ready reference. Piper and Carter are the publishers.

A NEW Natural History Society has been formed at Banbury under the title of "The Banburyshire Natural History Society and Field Club." Mr. T. Beesley, F.C.S., is president, and Mr. E. A. Walford, hon. secretary.

THE *Times* Dublin correspondent telegraphed on Sunday night:—"A very interesting scientific work, the most important of its kind yet attempted in the kingdom, has just been completed. It is the great refracting telescope, constructed by Mr. Grubb of Rathmines, Dublin, for the Austro-Hungarian Government, and it is to be placed in the Observatory at Vienna. A commission appointed by the Government to examine the work transmitted yesterday to the Austro-Hungarian Embassy in London a report expressing their full approval of the manner in which the task has been completed. It is a matter of no little pride to Ireland that she has produced the largest refracting as well as the largest reflecting telescope in the world." Several interesting details concerning the telescope are give in the *Irish Times* of March 10.

M. LOUIS FIGUIER'S *L'Année Scientifique et Industriel*, published by Hachette and Co., is a really useful summary of the science of the year. The twenty-fourth issue is quite up to previous volumes, and in the absence of anything of the kind published in this country may prove serviceable to English readers.

THE *Annuaire* of the Montsouris Observatory for 1881 contains much useful information in meteorology and allied subjects. Under the head of Agricultural Meteorology are a variety of experimental data on the action of heat, light, and water on vegetation, with their application to special cultures. There is also a meteorological *résumé* for the agricultural years 1873-80, and an article on Bacteria in the Atmosphere.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. R. W. Okes-Voysey; an Azara's Fox (*Canis azaræ*) from Buenos Ayres, presented by Mr. William Petty; a Gold Pheasant (*Thaumalea picta* ♂) from China, presented by Mr. W. H. St. Quintin; an Ornamental Ceratophys (*Ceratophys ornata*) from Buenos Ayres, presented by Mr. E. W. White, F.Z.S.; a Water Vole (*Arvicola amphibius*), British, purchased; two Dingo Dogs (*Canis dingo*), born in the Gardens.

CHEMICAL NOTES

OBSERVATIONS have been published from time to time concerning the existence of alkaloid-like substances in exhumed corpses. These substances appear to be produced in organised matter which, after brief exposure, has been kept out of contact with air. A summary of these observations and a discussion on their bearing on toxicological examinations is given by Husemann in a recent number of *Archiv für Pharmacie*. Substances having different physiological actions appear to be produced at various stages of decay of flesh or vegetable matter. A substance resembling atropine in its action has been separated from an anatomical maceration fluid by Sonnenschein, and this same substance has been found in the bodies of persons who have died from typhus fever.

AN important paper on "The Influence of Isomerism of Alcohols on the Formation of Ethereal Salts," by Menschutkin, appears in *Annales Chim. et Phys.* The process of etherification reaches a limit in every instance, but this limit varies with the molecular weight, and generally with the "structure" of the alcohol employed. In the ethylic series the limit increases with increase of molecular weight, but is not influenced by isomerism; in the secondary alcohols the limit does not show an increase for increased molecular weight. The influence of isomerism is most marked in this series.

IT is well known that by adding dilute acid to a solution of sodium thiosulphate and warming, a copious precipitate of yellow sulphur is obtained. Colson states in *Bull. Soc. Chim.* that when a very dilute solution of sodium thiosulphate is added to dilute hydrochloric acid, hydrogen sulphide and sulphuric acid are alone produced. He supposes that the water present acts on the sulphur as quickly as it is liberated from the thiosulphate, in the manner indicated; if flowers of sulphur be acted on by boiling water, a similar reaction occurs, but proceeds only very slowly.

FROM a study of the thermal phenomena which accompany the action of water on alcohols, and of alcohols on water, Alexejeff (*Bull. Soc. Chim.*) concludes that hydrates of the saturated alcohols exist, which hydrates are less stable the greater the number of carbon atoms in the molecule.

THE heats of formation, and of solution, of a large series of metallic sulphides, and sulphydrates, principally those of the alkalis and alkaline earths, have been determined and published in *Annales Chim. et Phys.* (January), by M. Sabatier.

IN an investigation of alcoholic fermentation (*Annales Chim. et Phys.*) Boussingault states that by the addition of a large quantity of yeast to wines rich in sugar, fermentation proceeds rapidly at a boiling temperature, provided the pressure be considerably diminished.

IN the *Berliner Berichte* Herr T. Donath describes experiments on *chinolin*, in which he shows that this alkaloïd possesses marked antiseptic properties: in 0·2 per cent. solution it stops the putrefaction of urine and lactic fermentation; in 0·4 per cent. solution it completely stops the putrefaction of blood and largely decreases the coagulation of milk. Blood containing 1 per cent. of chinolin cannot be coagulated. At low temperatures the alkaloïd forms compounds with albumin, which coagulate.

IN a paper "presented to both Houses of Parliament" the subject of "*oleomargarine*" as manufactured in the United States is discussed. This substance is made from beef suet by disintegrating in warm water, passing through a fine sieve, melting at 120° F., settling, draining off the oil, and allowing to solidify. If "*butterine*" is to be made, the oil is mixed with 10 per cent. of milk, churned, coloured with annatto, rolled with ice, and salted. During the year ending June 30, 1880, 18,833,330 lbs. of oleomargarine were exported from New York, the greater part going to Holland. The manufacture and sale of this substance is strongly condemned by many butter merchants, and as strongly recommended by various well-known American chemists. Analyses given in the report show very small differences between oleomargarine and natural butter, except in the particular of soluble fats, of which oleomargarine contains considerably less than natural butter.

THE Newcastle-upon-Tyne Chemical Society publishes in its *Proceedings* a paper by R. Hasenclever, on the alkali manufacture in Germany in 1880, in which it is shown that the consumption of alkali in Germany at present exceeds the supply, and that manufacturers are now extending their works and building new ones. The ammonia process is coming largely into use; the cost of plant and expenses are less than when Leblanc's process is employed; but the latter process is also extending year by year.

A NEW journal, devoted to analytical chemistry, has just made its appearance with the title *Repertorium der analytischen Chemie*; it is published by Voss of Leipzig, and promises to be useful to those who are interested in this branch of applied science.

OBSERVATIONS on the production of crystalline albuminoid compounds have from time to time been published. In a recent number of *Zeitschrift für Krystallographie* a general account of these observations is given by Herr Schimper, and the following, among other, general statements are made: albumenoid substances are capable of crystallising, but the crystals (or crystalloids, as they are called) differ from ordinary crystals in their mode of growth; the angles of crystalloids are also probably somewhat variable. The crystalloids being chiefly regular and rhombohedral forms, some are compounds containing metals—chiefly magnesium, calcium, barium—others are free from metals. The growth is connected in a definite manner with the crystalline form; the forms of the regular crystalloids remain unchanged, while the rhombohedral crystalloids undergo changes in their angles, the maximum growth being in the direction of the principal axis. The growth and solubility of the crystalloids are not equal throughout; they increase from without inwards, so that in dilute reagents the growth or the solution begins in the middle. The crystalloids are also frequently distinguished, like starch granules, by layers of unequal growth.

HERR BALLO states in *Berliner Berichte* that if camphor be heated with a quantity of spirit of wine, containing from 36 to 65 per cent. ethylic alcohol, such that some of the camphor remains undissolved, fusion of the camphor occurs on the surface of the alcohol, and the melted camphor either floats on the surface of the alcoholic solution, or sinks to the bottom according to the specific gravity of the liquid.

IN reference to the observations of Hautefeuille and Chappuis regarding "pernitric acid," recently mentioned in these Notes, the following details may be of interest. If a perfectly dry mixture of oxygen and nitrogen is ozonised, and the absorption spectrum of a layer about two metres long of this mixture is observed, certain fine dark lines are noticed in the red, orange, and green, in addition to the characteristic absorption bands of ozone. These lines are not exhibited by nitrogen, nitrous anhydride, nitrogen tetroxide, or nitric anhydride, when submitted to the action of the electric discharge. If the gas which exhibits the new lines be conducted through water, the water acquires an acid reaction, and the ozone bands alone remain in the spectrum. If the gas be heated to redness the spectrum of nitrogen tetroxide appears. If the gas be allowed to remain at ordinary temperatures the new lines gradually fade away; after twenty-four to forty-eight hours they have entirely disappeared; the spectrum of nitrogen tetroxide becomes gradually more prominent, and reaches a maximum after a few days. The same lines are noticeable in the absorption-spectrum of the gas produced by the action of the electric discharge on a mixture of nitrogen tetroxide and oxygen. The authors conclude that the newly-observed lines are due to the presence of an oxide of nitrogen containing relatively more oxygen than N_2O_5, *i.e.* to the anhydride of "pernitric acid."

METEOROLOGICAL NOTES

IN a paper on the "Marche des Isotherms au Printemps dans le Nord de l'Europe," Prof. Hildebrandsson of Upsala Meteorological Observatory has struck out a fresh line of inquiry and produced results at once of great scientific and practical value. In a series of five maps he shows the advances with season northwards over North-Western Europe of the isotherms of 32°·0, 37°·4, 42°·8, 48°·2, and 53°·6 respectively, the isotherms being thus 5°·4 (or 3°·0 C.) apart. On January 15 the isotherm of 32°·0 proceeds along the south coasts of the Black Sea and thence westwards to near Lyons, from which point it strikes northwards, passing into the North Sea at Gröningen, and skirts the west of Norway as far as Christiansund. The progress northwards and eastwards of this isotherm at the subsequent fortnightly epochs is extremely instructive, the advance northwards over the plains of Russia being manifoldly more rapid than its advance over the south-west of Norway. By May 1 the mean temperature of the whole of North-Western Europe has risen above 32°·0 except a small portion from the North Cape to the White Sea. In the height of summer the isotherm of 53°·6 (12° C.) reaches its northern limit, and then includes the whole of Europe except a thin slice of Norway from Vardö to the Lofoden Isles. Since on April 15 this isotherm skirts the southern shores of the Black Sea, its advance northwards is much more rapid than that of 32°·0. Specially instructive is it to note the influence of the various seas and mountain systems on the seasonal advance of the different isotherms. An interesting table is given showing the time taken by various natural phenomena to advance a degree of latitude northwards along the shores of the Baltic. The flowering of plants takes 4·3 days in advancing over a degree of latitude in April, 2·3 days in May, 1·5 days in June, and 0·5 days in July; the ripening of fruits generally 1·5 days; and the fall of forest leaves 2·3 days. Hence the phenomena are propagated with the greatest rapidity when the temperature approaches and reaches the annual maximum.

SOME months ago Miss Ormerod made a present to meteorologists of some value in her book entitled "The Cobham Journals," which gives an appreciative, well-written, and in some respects novel and ingenious account of the meteorological and phenological observations made by the late Miss Caroline Molesworth at Cobham, from 1825 to 1850. For each of the years complete tables are given of temperature, rainfall, and wind, which include also a comparative table for temperature and rain for Chiswick, taken from Glaisher's discussion of the Chiswick meteorological observations from 1826-69. Along with these tables are printed full notes setting forth the main features of the weather of each month, the month being divided into more or fewer sections, according to the number of types of weather which prevailed; and a detailed account of the accompanying phenomena of vegetation and animal life. In the general summary appended to the work the bearings of weather on plant and animal life are more specially dealt with, and a valuable table is given showing the dates of the flowering of plants, the leafing of trees, the ripening of fruits, and the arrival of birds. What is much to be admired in the work is the modesty, conscientiousness, and earnestness everywhere manifest, and these qualities of the scientific worker, it may be added, equally characterise the admirably-planned and worked scheme of Observations of Injurious Insects the author is now conducting so successfully.

AT the General Meeting of the Scottish Meteorological Society held on Friday last, Mr. Buchan read a paper on the atmospheric pressure of the British Islands, based on the observations of the last twenty-four years at about 300 stations. The mean pressure of these Islands taken as a whole is very nearly 29·900 inches, this isobar crossing the country from Galway to Newcastle. From this it rises southwards to 29·983 inches in the Channel Isles, and falls northward to 29·780 inches at North Unst in the extreme north of Shetland, there being thus a difference of about two-tenths of an inch of mean pressure between the extreme south and north. As regards individual stations the annual monthly maximum is attained in May, to the north of a line drawn from the mouth of the Shannon to the Wash, and thence round to Colchester, and the excess of this month's pressure is the greater as we advance north-westwards to the Hebrides; it is greatest in July over the extreme south of Ireland and the extreme south-west of England; but elsewhere the highest monthly mean is in June. The maximum in May over the whole of the northern portion of these Islands is connected with the maximum during the same month over arctic and sub-arctic North Atlantic, and regions adjoining, and the maximum in July over the south-west is connected with the high pressure which obtains in this month over the Atlantic between Africa and the United States. The July pressure of the south-east of England is lowered from its proximity to the Continent, where pressure falls to the minimum in July. The mean monthly minimum occurs in January everywhere to the north of a line from Galway to Berwick; in March to the east of a line from Hull to Osborne; and in October over the rest of England and Ireland, which thus includes the larger portion of the British Islands. Of these depressions in the annual march of the pressure, by far the largest is the January one, which in the Outer Hebrides falls to 0·080 inch below the mean of any other month. It is there accordingly where the great diminution of pressure in the north of the Atlantic during the winter month is most felt. The greatest difference between the extreme north and south, amounting to nearly 0·400 inch, takes place in January, and it is in this month when the isobars lie most uniformly from west-south-west to east-north-east, thus giving the gradient for the south-westerly winds which prevail in this season. The least variation occurs in May, the extremes being 30·002 inches in Scilly in the south, and 29·906 inches at North Unst in the north, being thus only a fourth part of the difference which obtains in January. The greatest divergence from parallelism among the isobars occurs in July, where the arrangement somewhat resembles a fan with the hand part in the west of Ireland, and the lines opening out to their greatest extent in the east of Great Britain—a disposition of the lines due to the position of Great Britain between the high pressure which at this season overspreads the Atlantic to the south-west, and the low pressure which is so characteristic a feature of the meteorology of the old Continent in summer.

THE temperature of January last was of a character sufficiently striking and unusual as to call for a permanent record in ou pages. Lower mean temperatures of particular months have occurred previously in Shetland, Orkney, and the extreme north of Caithness and Sutherland, January, 1867, having been colder in these northern regions. Other months, notably February, 1855, were as cold as, or colder than, January last over England generally except its north-western counties. But in this latter district and over the whole of the rest of Scotland January was colder than any month on record, going back for the different districts on observations which extend over periods varying from 24 to 118 years. The mean temperature fell below that of any previously recorded month in varied amounts up to 4°·0, this excessive degree of cold being experienced chiefly in the upper narrow valleys of the interior of the country, such as Lairg in Sutherland, Upper Deeside, and Tweeddale, and the uplying valleys of the Cheviots. The greatest absolute cold occurred on the nights immediately preceding the great London storm of the 18th, the lowest, so far as the facts have reached us, being −16°·0 near Kelso; −15°·0 at Stobo Castle in Peeblesshire; −13°·0 at Paxton House near Berwick; −11°·0 at Lairg, and Thirlestane Castle near Lauder; and −8°·0 at Milne Graden near Coldstream. This depression of temperature thus equalled that of the memorable night of December 4, 1879, when it fell, at Springwood Park near Kelso, to −16°·0, which is absolutely the lowest authentic temperature that has been recorded in Great Britain since thermometers came into use, leaving out of view as incomparable and misleading all observations made with exposed thermometers. In Scotland, the mean temperature of each of the five months ending with February was under the average, the depression being greatest just where as stated above the cold of January was greatest. The mean temperature of these five months was 5°·6 under the average in West Perthshire, 5°·0 at Lanark, 4°·5 at Thirlestane Castle, Braemar, and Culloden, and about 3°·0 in the west from North Unst to the Solway Firth. In South Britain, the mean temperature of this period did not fall so low owing to the milder weather there during November and December. The snowstorms of this winter are, at least, equally memorable, particularly the great storm of the third week of January in the south of England, and the great storm in Scotland in the first week of March, when railway traffic was paralysed, many trains being buried under snow-wreaths, twenty, thirty, and even in some cases forty feet in thickness.

THE OXFORD UNIVERSITY COMMISSIONERS AND THE PROFESSORIATE

THE University Commissioners have issued a revised edition of the proposed statutes on the professoriate. The scheme laid before the Hebdomadal Council last November met with considerable opposition, which resulted in representations being made by the Council to the Commissioners in favour of certain modifications in the duties assigned to the professors. On comparing the revised with the old proposals, it is evident that the Commissioners have become convinced that it is desirable to allow each professor a larger individual liberty in the mode of giving instruction in his department than was granted in the former scheme. In the General Regulations of last November Clauses 4 and 5 ran as follows:—

4. During the period of each term over which his course of lectures shall extend, and on so many days in the week as the particular regulations applicable to his chair require, he shall be ready to give private instruction to such students, being members of the university and attending his lectures, as may desire to receive it, in such matters relevant to the subjects of his lectures as may more conveniently be explained in that manner, and also to test by questions or otherwise, as may be convenient, the knowledge of such students in those subjects. Such private instruction shall be open without fee to students who are members of a college out of the revenues of which his chair is wholly or partly endowed, and to other students on payment of such fees (if any) as the professor may require, not exceeding in number or amount the limit set by any statutes of the university in that behalf which may be in force for the time being.

5. At the end of each term in which he has delivered lectures he shall examine the students who have attended them, and shall, on the request of the head of any college, inform the college of the results of the examination as regards the students who are members of such college, and shall also, if requested, give like information to the Delegates of students not attached to any college or hall.

In the new statutes the obligation to examine the whole class is removed; but each professor at the head of a laboratory or observatory must inform the college authorities of the regularity and proficiency of students attending his department. The new general regulations run as follow:—

Duties of Professors

1. It shall be the duty of every professor in his department to give instruction to students, assist the pursuit of knowledge, and contribute to the advancement of it, and aid generally the work of the university.

2. Every professor shall in respect of the lectures to be given by him conform to the particular regulations applicable to his chair. He may lecture in such manner and form as he judges to be best for the instruction of students and the advancement of knowledge.

3. It shall be his duty to give to students attending his ordinary lectures assistance in their studies by advice, by informal instruction, by occasional or periodical examination, and otherwise, as he may judge to be expedient. For receiving students who desire such assistance he shall appoint stated times in every week in which he lectures.

4. At the request of any student who has regularly attended any course of lectures he shall certify in writing the fact of such attendance.

5. The ordinary lectures of every professor shall be open to all students who are members of the university without payment of any fee, unless the university shall otherwise determine. But the university may, if it should deem it expedient so to do, by statute or decree authorise any professor to require payment of fees not exceeding a specified amount in respect of all or any of his lectures or of the instruction to be given by him.

6. Every professor shall in addition to his ordinary lectures deliver from time to time, after previous public notice, a public lecture or lectures to be open to all members of the university without payment of any fee.

With regard to the manner of election to professorships and to the dispensations and leave of absence granted by the visitatorial boards, little or no alterations have been made. The professoriate is divided into three schedules. With the exception of the professors of geology, mineralogy, and botany who come under Schedule B, the professors in the different departments of natural science come under Schedule C, to which division the following particular regulations are applicable:—

(*a*) The professor shall reside within the university during six months at least in each academical year, between the first day of September and the ensuing first day of July.

(*b*) He shall lecture in two at least of the three university terms. His lectures shall extend over a period not less in any term than six weeks, and not less in the whole than fourteen weeks, and he shall lecture twice at least in each week.

(*c*) The laboratory under the charge of each professor, and in the case of the Savilian Professor of Astronomy, the University Observatory, shall be open for eight weeks in each term, and at such other times and for such hours as the university may by statute determine.

Students shall be admitted to the university observatory, and to the laboratory under the charge of each professor, upon such conditions as the university shall from time to time by statute determine, and upon the terms of paying such fees, not exceeding such amount as may be fixed by any statute of the university in force for the time being, as the professor may from time to time require.

(*d*) Except for some grave reason to be approved by the Vice-Chancellor, the professor shall, for seven weeks in each term, and during some part of three days in each week, be ready to give instruction in the subject of his chair to such students as shall have been admitted to the laboratory under his charge (or in the case of the Savilian Professor of Astronomy, to the University Observatory); and such instruction shall be given in the laboratory or observatory (as the case may be) or in some class-room connected therewith.

(*e*) The professor shall also, at the close of each term, inform any college which may request him to do so as to the regularity of attendance and the proficiency of the students belonging to such college who have been admitted into the laboratory or observatory under his charge, and shall give like information, if requested, to the Delegates of students not attached to any college or hall.

4. The particular regulations next following shall be applicable to the several professors named in them respectively (that is to say)—

(*a*) The Savilian Professor of Astronomy shall have the charge of the University Observatory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(*b*) The Professor of Experimental Philosophy shall have the charge of the Clarendon Laboratory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(*c*) The Waynflete Professor of Chemistry shall have the charge of the chemical laboratories in the University Museum, or such part thereof as the university may by statute assign to him, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(*d*) The Linacre Professor of Human and Comparative Anatomy shall have the charge of the anatomical and ethnological collections and the anatomical laboratories in the University Museum, or such part thereof as the university may by statute assign to him; and shall undertake the personal and regular supervision of the same and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(*e*) The Professor of Botany and Rural Economy shall have the charge and supervision of the Botanical Gardens and botanical collections belonging to the university; and it shall be part of his duty to make such gardens and collections accessible to, and available for the instruction of, students attending his lectures.

(*f*) The Professors of Geology and Mineralogy respectively shall have the charge and supervision of the geological and palæontological collections and of the mineralogical collection belonging to the university; and it shall be part of their duties to make such collections respectively accessible to, and available for the instruction of, students attending their lectures.

To the class of teachers to be called University Readers some of the duties assigned to the professoriate under the old scheme are now transferred. The "informal instruction" twice a week to all students who may demand it becomes now part of the regular duty of the Reader, and not of the Professor. The following are the most important clauses on University Readers:—

(*a*) Every appointment of a University Reader shall be made by the Delegates of the Common University Fund, or by persons, not fewer than three in number, nominated for that purpose by the Delegates.

(*b*) Every University Reader shall hold his office for five years, but shall be re-eligible.

(*c*) He shall receive from the Common University Fund 300*l.* per annum.

(*d*) He shall in every year lecture in each of the three University Terms (Easter and Trinity Terms being counted as one). His lectures shall extend over a period not less than seven weeks in each term, nor than twenty-one weeks in the whole, and he shall lecture twice at least in each week. In addition to these lectures he shall, twice at least in every week in which he lectures, receive students desirous of informal instruction and other assistance in the studies with which his readership is connected.

(*e*) He may require from students receiving the informal instruction and assistance mentioned in the foregoing regulation payment of a fee not exceeding 2*l.* for any university term. With this exception his lectures shall be open to all members of the university without payment of any fee.

5. It shall be the duty of every reader to lecture and give instruction in the subject or branch of study for which he is appointed, and in arranging the subjects and times of his lectures it shall also be his duty to have regard to the arrangements made or proposed to be made by the professors, if any, lecturing in the same department of study.

The most important change in the new scheme is the liberation of the professor and reader from the immediate control of the council or board of his faculty. Under the old scheme each professor and reader was obliged during Easter term to send in to the faculty a schedule of all his lectures and other instruction for the ensuing year, giving the days, hours, and subjects of the lectures. The faculty was to have the power of criticising the schedules and of recommending alterations, and the two following clauses were intended to reduce a refractory professor to submission:—

14. The Council shall not alter any schedule without the consent of the person named in it. But if a recommendation made by the Council as to any schedule be not acceded to, the Council may, if they think fit, exclude the schedule or the part of it affected by such recommendation from the list, unless such schedule was sent in by a Professor or University Reader. In the last-mentioned case the Council shall not exclude the schedule, but may, if they think fit, report the fact to the Vice-Chancellor, who shall lay the report before the Visitatorial Board.

15. If a Professor or University Reader wilfully neglect to send in schedules of his lectures, the Visitatorial Board may, on a report of the Council of the Faculty, and without any charge laid before the board, proceed against him by admonition or otherwise as for a neglect of the duties of his office. Refusal on the part of a Professor or University Reader to accede to any recommendation of the Council of his faculty respecting his lectures may likewise be treated by the board as a neglect of duty, if, on a consideration of the circumstances, the board be satisfied that such refusal was without reasonable justification. Provided that if the recommendation relate to the subjects of the proposed lectures it shall be sufficient for the Professor or University Reader to show that such lectures are in respect of their subject-matter a *bonâ fide* fulfilment of the statutory duties of his office.

The following are the new clauses which regulate the relation between the professoriate and the board in the different faculties of arts, theology, law, and natural science:—

The board of each faculty shall have the following duties and powers:—

It shall be the duty of the board to prepare and send to the Vice-Chancellor for publication—

(*a*) Before the end of each term a list of the lectures which are to be given in the ensuing term in the subjects of the faculty under the authority of the university or of any college, or of the Delegates of students not attached to any college or hall, and are to be open to persons other than the members of any one college, or (as the case may be) other than the students not attached to any college or hall.

(*b*) In Easter or Trinity Term annually a general scheme or statement showing, as far as may be, the lectures to be given as aforesaid during the course of the ensuing academical year.

(*c*) In Michaelmas Term, or at such other time in each year as the university may by statute appoint, a summary statement of the lectures given during the preceding year in the subjects of the faculty by Professors and University Readers, and of all other lectures which have been advertised in the published lists of the faculty and given in conformity therewith. The board shall add to this statement such further information (if any) respecting the studies and instruction of the faculty as the university may by statute require, and may point out any deficiencies in the provision made for instruction, and make recommendations for supplying them.

10. It shall be the duty of every Professor and University Reader to send to the Secretary of the Boards of Faculties timely notice of the lectures he proposes to give in any of the subjects of any faculty to which he belongs, pursuant to the statutes and regulations in force for the time being, and in arranging his lectures to have due and reasonable regard to the recommendations of the board of the faculty; but this duty shall not be deemed to preclude him from the free use of his discretion in selecting for his lectures any subject or part of a subject which he deems most advisable within the province assigned to him by statute.

GOLD IN NEWFOUNDLAND

REPORTS having been circulated for some time past that gold had been discovered in quartz veins in the regions near Brigus of Conception Bay, Newfoundland, Mr. Murray has recently made a personal examination of the ground.

In his report to the Governor of the Colony, dated October 8, he states that by the first blast from two to three cubic feet of rock were removed, all of which was carefully broken up, washed, and examined; which operation finally resulted in the display of ten or twelve distinct "sights" of gold. In one fragment about five pounds weight, largely charged with dark green chlorite, the gold shows itself in three places distinctly, while many small specks are perceptible by means of a good lens. The fracture of a fragment of milky white and translucent quartz, which was broken off the large piece, revealed two patches of gold, both of which together, if removed from the matrix, would probably produce about a dwt. (pennyweight) of the metal; whilst several small masses or nuggets were found adhering to the small broken fragments of quartz at the bottom of the pail in which the rock was washed, the largest of which contained about ten or twelve grains of gold. From some specimens in which no gold was perceptible to the naked eye, and had been selected for analysis, a small nugget weighing three grains was obtained in the dust of the bag in which the specimens were carried. In the specimen from Fox Hill the metal occurs thickly in the minutest specks, scarcely, if at all, perceptible to the naked eye, but readily recognised under the lens, where it chiefly surrounds a small patch of chlorite.

The rock formation intersected by these auriferous quartz veins is of Huronian or Intermediate age, or the group of strata next below the *aspidella* slates of St. John's. The group consists chiefly of greenish fine-grained felsite slates, which, judging by the weathering of the exposed surfaces, are also magnesian and ferruginous. The cleavage is exactly coincident with the bedding, and the slates occasionally split into very fine laminæ, but frequently into strong stout slabs, which are used to a considerable extent at Brigus for paving, for hearthstones, and for building foundations and walls.

A rough and hummocky belt of country from three-quarters to one mile wide, which forms the nucleus of the peninsula between Bay-de-Grave and Brigus Harbour, is thickly intersected by reticulating quartz veins varying in thickness from less than an inch to upwards of a foot, which often appear to ramify from a central boss or great mass of quartz, often extending over many square yards, and usually forming low isolated hummocks or hills. The general run of the belt is as nearly as possible north-east and south-west from the true meridian. Although many of the veins, both small and large, may be seen for considerable distances to run exactly parallel with the bedding, the net-work of the whole mass runs obliquely to the strike of the beds, which are also minutely intersected by the smaller veins crossing and reticulating in all directions.

The resemblance in general character of the strata with their included auriferous quartz veins in Newfoundland to those of Nova Scotia is striking, although according to Dr. Dawson the auriferous country of Nova Scotia is probably of Lower Silurian age, while that of Newfoundland is undoubtedly unconformably below the Primordial group, which, with abundant characteristic fossils, skirts the shores of Conception Bay.

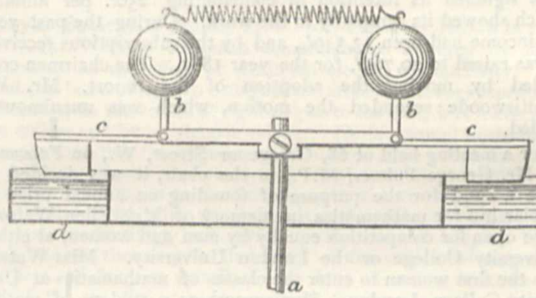
That a large area of country in the regions referred to is auriferous there can scarcely be a doubt, although nothing short of actual mining and practical experience can possibly prove what the value of the produce may be, or whether the prospects of obtaining a remunerative return for the necessary outlay are favourable or otherwise. The specimens which have been obtained, although an unquestionable evidence of the presence of the precious metal, cannot by any means be taken as indicative of a certain average yield. An analysis of quartz collected, in which gold is imperceptible to the naked eye, may aid in revealing some evidence of its constancy, and may throw some light upon the possible average of superficial contents over certain areas under similar circumstances; but it may safely be predicted that the irregularities of distribution, so conspicuously displayed by the veins on the surface, will extend beneath it, and that it will be mainly on the stronger and more persistent bands, where intercalated with the strata, that mining will extend to any considerable depth.

The indications of gold in Newfoundland are certainly sufficiently favourable to merit a fair trial; and there are good reasons to hope and expect that ample capital applied to skilled and judicious labour may be found remunerative to future adventurers, while a new industry will be added to give employment to the labouring population of the island, and possibly bring this despised and but little-known colony into more prominence and consideration abroad than it hitherto has enjoyed.

A SPEED GOVERNOR FOR CONTINUOUS MOTION

IN NATURE, vol. xxiii. p. 61, a speed governor for a chronograph is described, the invention of the Astronomer-Royal, in which a conical pendulum acts on a paddle moving in a viscous fluid, so as to make it dip more deeply into the fluid when the speed is increased. A similar apparatus, with a spring instead of a pendulum, has recently been applied by me to a clock driving a recording seismograph whose motion is required to be continuous and fairly uniform. As the apparatus is very simple and easily made, requiring no nice fitting, and has proved itself to be a very effective governor, a description of it may perhaps be useful.

a is a vertical spindle driven by the clock, and making about one turn per second. Near the top of it a cross-bar is fixed, whose ends are forked, and in them are jointed two bell-crank levers *b c*, *b c*. At the top of *b b* are two masses, which in my instrument are two smooth-bore musket balls. These are tied together by a spiral spring between two hooks at the top. At the ends of *c c* are two flat paddles, and when the balls fly out from the axis of rotation the paddles dip into glycerine contained in the annular trough *d d*, which is shown in section. The trough rests on the top of the clock frame. By using only one spring, instead of tying each ball to the spindle by a separate spring, I secure that the pull inwards is necessarily the same for both.



As the balls go out a component of their weight comes into action, helping this motion and opposed to the pull of the spring. For small displacements this force increases very nearly in proportion to the displacement, and hence, by choosing a spring of suitable stiffness, a small change of speed can be made to produce a relatively very large displacement, the proper condition for approximate isochronism.

A governor whose actual size is about twice that of the sketch, roughly made in my laboratory, gives only a slight rise in speed when the driving weight is doubled, and works very smoothly. The apparatus can easily be applied to a clock, perhaps most easily by rolling contact between a horizontal disk on *a* and a vertical disk on one of the axles of the clock, and it gives sufficient control for many purposes. If great accuracy were required the resultant effect of change of temperature on the elasticity of the spring and on the viscosity of the fluid might be corrected by making *c* of two metals, so as to bend and raise or lower the paddles. It is well to put stops to prevent the balls from falling inwards beyond the vertical position. J. A. EWING

The University, Tokio, Japan, January 21

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The electors to the Radcliffe Travelling Fellowship have, after examination, awarded the Fellowship to Mr. A. J. Anderson, B.A., late Natural Science Demy of Magdalen College.

The examiners for the Burdett-Coutts (Geological) Scholarship have recommended Mr. J. B. Nias, B.A., scholar of Exeter College, for the scholarship.

The Junior Studentships in Natural Science at Christchurch have been awarded to Mr. G. C. Chambres, Commoner of Balliol College, and late of Dulwich School, and to Mr. R. E. Moyle (private tuition). *Proxime accessit*, Mr. C. D. Spencer, of Clifton College. Mr. W. C. Hudson was elected to an Exhibition in Natural Science.

The various lecturers and demonstrators in physics met last week at the instance of Prof. Clifton, and arranged a scheme of lectures for next term, similar to that carried out during the present term. The object of the scheme is to divide the subjects among the independent college and university lecturers, so that students may attend, by going from one lecturer to another, all the lectures required for any particular course of study.

THE annual meeting of the Governors of the City and Guilds of London Institute for the Advancement of Technical Education was held on Monday at the Mercers' Hall, Sir S. Waterlow, M.P., one of the vice-presidents, in the chair. The most important points referred to in the report were the course taken in reference to the plans and estimates for the central institution, the settlement of the plans for the Technical College, and the technological examinations. With regard to the central institution the Board thought it ought not to authorise the entering into any contract beyond that for which they had the money in hand. The Chairman earnestly hoped that some of the companies that had not yet contributed would subscribe and enable the 20,000*l*. which was yet required to be made up. With reference to the Technical College at Finsbury there was no reason why the foundation-stone of the building should not be laid at an early date. He was glad to be able to state that the Drapers' Company had announced its intention of increasing its subscriptions from 2000*l*. to 4000*l*. per annum, the additional sum to be applied for the first two years towards the cost of building and fitting the Finsbury Technical College. The Vintners' Company had likewise signified its intention of contributing 250*l*. per annum, which showed its sympathy in the work. During the past year the income had been 13,549*l*., and by the subscriptions received it was raised to 20,765*l*. for the year 1881. The chairman concluded by moving the adoption of the report. Mr. W. Spottiswoode seconded the motion, which was unanimously carried.

AT a meeting held at 68, Grosvenor Street, W., on February 18, Mr. George Palmer, M.P., in the chair, it was decided to raise a fund for the purpose of founding an annual prize or scholarship for mathematics in memory of Miss Ellen Watson, to be open for competition equally by men and women, at either University College or the London University. Miss Watson was the first woman to enter the classes of mathematics at University College, London. Her success as a student of mathematics was brilliant, and at the end of the session, in June, 1877, she gained the Mayer de Rothschild Exhibition, which is awarded annually to the most distinguished mathematical student of the year. After passing the 1st B.Sc. examination at the London University, in July, 1879, Miss Watson was obliged by failing health to leave England for Grahamstown, South Africa, where she died last December, aged twenty-four years. It may be added that the Ellen Watson scholarship, or prize, would be the first that has been founded in memory of a woman's mathematical genius and promise of scientific work. A second meeting to determine to which of the above institutions the scholarship should be offered, and to arrange other matters in connection with it, was held yesterday. Subscriptions will be gladly received and may be paid to Miss Alice M. Palmer, hon. sec., 68, Grosvenor Street, W., or to the account of the "Ellen Watson Fund," Messrs. Dimsdale and Co., Bankers, Cornhill, E.C.

PRINCE LEOPOLD will formally open the new University buildings at Nottingham on Thursday, June 30.

AT a meeting of the Council of the Wilts and Hants Agricultural College, at Downton, Salisbury, on Wednesday, it was unanimously resolved that the College should henceforth be called the College of Agriculture.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 2.—On absorption of carbonic acid by wood charcoal, and its relation to pressure and temperature, by P. Chappuis.—On absorption of dark heat-rays in gases and vapours, by E. Lecher and J. Pernter.—New researches on Newton's rings (continued), by L. Sohncke and A. Wangerin.—On the discharge of electricity in rarefied gases (continued), by E. Goldstein.—On the question as to the nature of galvanic polarisation, by F. Exner.—On the same, by W. Beetz.—On excitation of electricity on contact of metals and gases, by F. Schulze-Berge.—Note on F. Exner's paper on the theory of Volta's fundamental experiment, by the same.

Bulletin de l'Academie Royale des Sciences (*de Belgique*), No. 1. —Geodetic junction of Spain and Algeria in 1879, by M. Perrier. —Fire-damp and atmospheric perturbations, by M. Cornet.—On the excretory apparatus of rhabdocœlan and dendrocœlan Turbellaria, by M. Fancotte.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xiv., fasc. i. and ii.—Synoptic tables of results obtained in the Botanical Garden of Pavia University from cultivation of fifteen qualities of vine (Asiatic and American species and varieties), by S. Giacomo.—Contribution to the pathology of voluntary muscles, by C. Golgi.—Contribution to the physiology of strychnic tetanus, by G. Ciniselli.—On Cremonian correspondences in the plane and in space, by C. F. Archieri.—The invasion by the *Peronospora viticola* in Italy, by S. Garovaglio.—On the damage which Peronospora may do in Italy in future, by V. Trevisan.—Statistical note on inflammation, on cancer, on cirrhôsis, on tuberculosis, and on pyæmia, by G. Sangalli.—Proposed classification of the stature of the human body, by S. Zoja.

Atti della R. Accademia dei Lincei, vol. v. fasc. 2 (December 18, 1880).—Reports on prize competitions.

Fasc. 3 (January 2).—Contributions to the study of medullated nerve fibre and observations on amylaceous corpurcles in the brain and spinal cord, by A. Ceci.—On the bacillus of contagious mollusca, by M. Domenico.—On an equation between the partial derivatives of the inverse distances of three planets which attract one another, by Dr. G. Annibale.—Two small fossil hymenoptera of Sicilian amber, by G. Mulfatti.—On some rare species of Italian birds, by P. Luigi.—On Stilbite from Miage (Monte Bianco), by C. Alfonso.—On ollenite, an amphibolic rock of Mount Ollen, by the same.

Rivista Scientifico-Industriale, No. 2, January 31.—Coglievina's centigrade photometer, by R. Ferrini.

Memoirs of the St. Petersburg Society of Naturalists.—The last volume of the *Memoirs* of the St. Petersburg Society of Naturalists contains, besides the minutes of meetings of the Society, a most interesting paper by Prof. Kessler, on the "Law of Mutual Help," or sociability, which he proves to be the necessary complement of Darwin's law of the struggle for existence.—Ornithological observations in Transcaucasia, by M. Mikhailovsky.—Observations on the motions of diatomaceæ and their causes, by M. K. Merejkovsky.—Materials for the knowledge of the infusorial fauna of the Black Sea, by the same author.—A sketch of the flora of the province of Toula, by MM. D. Kojevnikoff and W. Tzinger, with a map.—Figures showing the quantities of gases in the blood and the quantities of urea and urine secreted by man under various conditions of life, by M. Shitz; and a paper on Medusæ, by M. K. Merejkovsky.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 3.—Dr. Klein communicated a paper by John Haycraft, Senior Physiological Demonstrator in the University of Edinburgh, on the cause of the striation of voluntary muscular fibre. The author showed that all the cross striæ observed are due not to any differences of structure along the fibre, but simply to the shape of the fibre itself. The fibre is not a smooth cylinder, but is ampullated, alternate ridges and depressions occurring with beautiful regularity across its length. The striæ correspond with these in position, and are caused by their action on the transmitted light. He showed theoretically how this must be so, and illustrated it with a model of the same shape but of uniform structure, which exhibited down to the minutest detail the cross striæ seen in the muscle itself. He then showed the true explanation of the action of staining agents and of polarised light.

Mathematical Society, March 10.—S. Roberts, F.R.S., president, in the chair.—Prof. Cayley read a paper on the equilibrium and flexure of a skew surface.—Mr. Tucker communicated portions of papers, viz.:—An application of elliptic functions to the nodal cubic, by Mr. R. A. Roberts; and note on Prof. C. S. Peirce's probability notation of 1867, by Mr. H. McColl.—Mr. J. W. L. Glaisher, F.R.S. (vice-president), having taken the chair, the president communicated the following direct analogue in space of the well-known plane theorem, "If we take an arbitrary point on each side of a triangle and describe a circle through each vertex and the two points on adjacent sides, the three circles meet in a point," viz. if we take an arbitrary point on each edge of a tetrahedron and describe a sphere through each vertex and the three points on adjacent edges, the four spheres meet in a point. The analogue was used as a point of departure for the study of four spheres meeting in a point.

Chemical Society, March 3.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the action of Bacteria on various gases, by F. Hatton. An aqueous extract of flesh was used as the source of the Bacteria-containing liquid. A small flask half full of this liquid and half full of mercury was inverted in mercury. The gas was then passed up. In the case of atmospheric air a large absorption of oxygen was observed. The other gases experimented with were hydrogen, oxygen, carbon monoxide, cyanogen, sulphur dioxide, nitrogen, nitrous oxide, nitric oxide, carbon dioxide, and coal-gas; in all cases the Bacteria remained alive and (except with cyanogen) flourished well. Acetylene, salicylic acid, strychnia (10 per cent), morphine, narcotin, and brucin were equally without effect on the Bacteria. Spongy iron, phenol, and alcohol were very destructive to these organisms.—On the influence of intermittent filtration through sand and spongy iron on animal and vegetable matters dissolved in water, and on the reduction of nitrates by sewage, by Mr. F. Hatton. In the case of peaty water some diminution was observed in the organic carbon, but none in the organic nitrogen. Sewage promotes the reduction of nitrates. Spongy iron converts nitrates into ammonia and free nitrogen.—Prof. Tidy then read a lengthy paper on river-water. This is a reply to the criticisms of Dr. Frankland and Miss Lucy Halcrow on a former paper by the author. In the present paper the author restates his firm conviction that a fairly rapid river, having received sewage in quantity not exceeding one-twentieth of its volume, regains its purity after the run of a few miles, and becomes wholesome and good for drinking.—On β diquinoline, by F. Japp, Ph.D., and C. Colborne Graham. This substance was obtained by heating quinoline and benzoyl chloride in sealed tubes to 240°–250° C.; it gave on analysis the formula $C_{18}H_{12}N_2$; it crystallises in colourless satiny laminæ, and fuses at 191° C.

Anthropological Institute, February 22.—F. W. Rudler, F.G.S., vice-president, in the chair.—The election of F. E. Robinson was announced.—A paper on arrow-poisons prepared by some North American Indians, by W. J. Hoffman, M.D., was read. The information was obtained from prominent Indian chiefs who visited Washington in 1880, and the tribes alluded to in the paper were the Shoshoni and Banak, Pai-ute, Comanche, Lipan Apache, and Sisseton Dakota; this last tribe have a method of poisoning bullets by drilling four small holes at equal distances around the horizontal circumference and filling the cavities with the cuticle scraped from a branch of cactus (*Opuntia missouriense*), the projecting rim of metal caused by the drilling is then pressed over the scrapings to prevent their being rubbed off or lost. As the opuntia is a harmless plant, the idea of poison is evidently suggested by the pain experienced when carelessly handling the plant, which is covered with barbed spines.—A paper by David Christison, M.D., on the Gauchos of San Jorge, Central Uruguay, was read. Having given a description of the country and a history of the people, the author remarked that it had often been a matter for surprise that Englishmen should be able to live safely among a turbulent race of people such as the Gauchos, but our countrymen, when placed in a higher sphere and independent of their political or private feuds, ran little risk in ordinary times; moreover here, as elsewhere, the innate capacity of the British for managing semi-barbarous races by a combination of fair-dealing and kindness was conspicuously manifested. The Englishman had acquired a certain liking for the Gauchos which grew rather than diminished with time. The Gaucho could not be a permanent type, and in the Banda Oriental was rapidly being modified. The more strict definition and sub-division of property, the increase of sheep-farming and change in the management of cattle to the tame system, the rapid extension of wire fencing, and the introduction of agriculture, conspired to cramp his movements and to do away with the necessity for his peculiar accomplishments. It was even to be feared that he himself would pass away, and that the race which ultimately possesses the Campos will show but slight traces of his blood or of the aboriginal Indian race which he represents. The great mortality from murder and homicide which the place was noted for was increased by the numbers who perished under quack doctors. The Gauchos had been badly governed, and much of the evil in them was due to this cause.

Entomological Society, March 2.—H. T. Stainton, F.R.S., president, in the chair.—Mr. E. A. Fitch exhibited a specimen of *Strangalia 4-fasciata*, taken at West Wickham by Mr. A. S. Olliff last August.—Mr. W. C. Boyd exhibited a specimen of *Nonagria lutosa*, taken outside the Great Eastern terminus at Liverpool Street, and a curious variety of *Ennomos tiliaria* from Cheshunt.—Mr. W. F. Kirby called attention to a general illustrated work on insects on which Herr Buckecher of Munich is engaged, and laid specimens before the meeting.—The following papers were then read:—Mr. F. P. Pascoe, On the genus *Hilipus* and its neotropical allies.—Mr. W. L. Distant, Descriptions of new genera and species of *Rhynchota* from Madagascar.—Prof. J. O. Westwood, Observations on the hymenopterous genus *Scleroderma* and some other allied groups.—Mr. McLachlan then called the attention of members to an important paper by Dr. Adler on the dimorphism of oak-gall flies (*Cynipidæ*), which has just been published in Siebold and Kölliker's *Zeitschrift für wissenschaftliche Zoologie*, vol. xxxv.—Mr. E. A. Fitch read a report from the *Western Daily Mercury* of the trial which has lately taken place at Yeahampton (South Devon) in reference to the possession of living specimens of the Colorado potato-beetle by a farmer who had brought them from Canada.

Institution of Civil Engineers, March 1.—Mr. Abernethy, F.R.S.E., president, in the chair.—The paper read was on the tide-gauge, tidal harmonic analyser, and tide-predicter, by Sir William Thomson, LL.D., F.R.SS. L. and E.

EDINBURGH

Royal Society, February 21.—Prof. Fleeming Jenkin in the chair.—Sir William Thomson communicated a paper by Mr. Witkowski on the effect of strain on electric conductivity. A cylindrical brass tube, with a magnet and attached mirror suspended horizontally in the centre at right angles to the axis, was traversed from end to end by an electric current. In its original unstrained isotropic condition the cylinder so conducted the current that the inclosed magnet was unaffected. A couple was then applied in a plane at right angles to the axis, so as to distort the metal tube by a definite twist, thus rendering it æolotropic as regards its electrical conductivity, and giving to the current a spiral set, which was evidenced by the deflection of the suspended magnet. The lines of flow set spirally round in a direction contrary to that of the applied couple—a result in complete accordance with the theory of twists, which requires a lengthening (and therefore an increase of resistance) along spiral lines that set round with the couple and a simultaneous compression (and corresponding decrease of resistance) along lines at right angles to these. Quantitative results were obtained by balancing the electro-magnetic action of the current in the strained tube by means of an external circular movable conductor traversed by a steady current.—Sir William Thomson described certain experiments which he had lately made on the effect of moistening the opposing surfaces in a Volta-condenser, and of substituting a water-arc for a metallic arc in the determining contact. The main features of the paper were, the non-existence of any measurable difference of potential when contact was made by means of a drop of clean water between opposed polished surfaces of zinc and copper, the effect of oxidising the surfaces in the pure metallic contact experiment, and the exact similarity in the action of dry polished zinc and wet oxidised zinc when opposed to dry copper and brought into contact by a metallic arc. Sir William also described the "vortex sponge." A vortex column spinning at the heart of a mass of fluid revolving irrotationally inside an imperfectly elastic cylindrical case forms a system in a position of maximum energy; and any slight disturbance from the truly circular rotation of the vortex core results in a gradual drawing off of energy, in virtue of the imperfectly elastic character of the bounding material, until the system assumes its position of minimum energy with the rotationally-revolving fluid on the immediate inner surface of the inclosing case and altogether surrounding the irrotational fluid, which is now in a state of quiescence. The intermediate stages between these first and last conditions are what Sir William Thomson characterises by the name of vortex sponge.—Mr. T. Muir presented a paper on continuants, to which special form of determinant he could, by suitable transformations, reduce any given determinant of ordinary type, and so was able to express a determinant as a continued fraction.—Prof. Chrystal added a note on this paper showing how in the most general case *n* equations between *n* unknown quantities can be made to yield by suitable elimination *n* other equations, in no one of which more than three terms appear, so that a continuant form of determinant is got which bears a simple relation to the determinant formed by the coefficients of the original equations.

MANCHESTER

Literary and Philosophial Society, November 9, 1880.—E. W. Binney, F.R.S., F.G.S., president, in the chair.—On gravitation, by the Rev. Thomas Mackereth, F.R.A.S.

December 28, 1880.—E. W. Binney, F.R.S., president, in the chair.—The literary history of Parnell's "Hermit," by William E. A. Axon, M.R.S.L.

February 22, 1881.—E. W. Binney, F.R.S., president, in the chair.—The president reminded the members present that yesterday was the hundredth anniversary of the first meeting of the Society.—Dr. Balfour Stewart, F.R.S., communicated a letter from Mr. Herman Hager containing notes from Schultz' "Das höfische Leben" with regard to severe winters and famines from 1100 to 1315.—Ozone and the rate of mortality at Southport during the nine years, 1872-1880, by Joseph Baxendell, F.R.A.S.

PARIS

Academy of Sciences, March 7.—M. Wurtz in the chair.—The following papers were read:—On observations of contact during the transit of Venus of December 8, 1874, by M. Puiseux. He is led to divide the nine French observers into two groups (of six and three respectively), there being a marked difference between them in the way of estimating the hour of a contact. Hence the necessity of a sort of common education, ensuring that observers work in the same way.—On the reciprocal displacements of hydracids, by M. Berthelot.—Spiral cells of very great length, by M. Trécul. By macerating, in water, the leaves of certain *Crinum* he found cells from 5 mm. to 13·40 mm. long.—Note on photography of the ashy light of the moon, by M. Janssen. He presented a photograph showing that part of the moon illuminated by light from the earth. The exposure was for 60 seconds. The moon was three days old. The general figure of the lunar continents can be made out. With photography the interesting phenomena in the double reflection of solar light, under varying circumstances, may be more exactly studied.—On the presence of trichinæ in pork of American importation, by M. Bouley. Infection of this pork with trichinæ has probably long been a fact, though observed more lately. Trichinosis is little known in France, thanks to the culinary habits of the people. M. Bouley was sent to Havre to see if a sanitary service of inspection, sufficient for the public hygiene, could be organised. He recommends the initiating of a number of children and young girls in microscopical preparations, for assistance of the meat-inspector to make his examination with the necessary despatch. Should this plan succeed the prohibition of American pork will probably cease.—On the presence of alcohol in the ground, in water, and in the atmosphere, by M. Müntz. He has developed the method depending on the change of alcohol into iodoform, so that one-millionth of alcohol in water can be detected. Alcohol is found in all natural waters except very pure spring water; also (and more of it) in snow. Rain water and Seine water contain about 1 gr. per cubic metre. Alcohol no doubt also exists as vapour in the air. In soils, especially those rich in organic matters, there is a considerable quantity. The destruction of organic matter by various agents of fermentation accounts for the wide diffusion of alcohol in nature.—Observation of solar spots, faculæ, and protuberances at the observatory of the Roman College during the last quarter of 1880, by P. Tacchini. There was a progressive diminution of frequency of spots. The maximum of faculæ of September extended into October. The minimum of extension and height of protuberances fell in October, as well as the minimum of size of spots. For spots and faculæ the maximum frequence was in the same zones as the previous quarter, viz., $\pm$ 10° $\pm$ 30°. For protuberances the two maxima are not symmetrical. We are still far from the maximum of solar activity.—Observations of the moon and of Jupiter's satellites at Algiers Observatory during the last quarter of 1880, by M. Trepied. M. Mouchez, in presenting these, the first, astronomical observations from Algiers (where only a little meteorology has been done hitherto), said M. Tripied had lately gone from Montsouris to take charge, and felicitated the Academy on having observations of the moon, &c., in the Algerian climate.—On the algebraic integration of an equation similar to the equation of Euler, by M. Picard.—The formula of interpolation of M. Hermite expressed algebraically, by M. Schering.—On a general reason, justifying synthetically the use of the various developments of arbitrary functions employed in mathematical physics, by M. Boussinesq.—On an integrator, by M. Abdank-Abakanowicz.—On circular double refraction and the normal production of the three systems of fringes of circular rays, by M. Croullebois.—On the enlargement of hydrogen lines, by M. Fievez. He finds from experiment (with Geissler tubes) that the enlargement is correlative to rise of temperature. Thus the temperature of one heavenly body is higher than another when its hydrogen lines are wider and more nebulous. This agrees with the ideas of Huggins and Vogel.—On some phenomena of optics and vision, by M. Trève. Both in vision and in photography it appears that light is propagated with more intensity through a horizontal than through a vertical slit.—On the solubility of chloride of silver in hydrochloric acid in presence of water, or of little soluble metallic chlorides, by MM. Ruyssen and Varenne.—On the heat liberated in combustion of some substances of the saturated fatty series, by M. Louguinine.—On the transformation of glucose into dextrine, by MM. Musculus and Meyer.—On an active amylamine, by M. Plimpton.—On active propylglycol, by M. le Bel.—On the winter of 1879-80 in the Sahara, and on the Saharan climate, by M. Rolland. The winter was exceptional. North-east and north winds prevailed. The mean temperature from January 17 to April 16, between 35° and 30° lat., was only 14°·1; the extremes $-4°·7$ in the night of January 17-18, and 31°·1 on April 13 in the day. Rain fell several times in the Algerian Sahara, and abundantly in the end of January. It comes generally at intervals of over ten years. The Saharan climate seems to have degraded. The region had probably at one time a larger population.—M. Melsens showed in a letter the economy realised by his lightning-conductors.—M. Zenger presented a photograph of the sun taken at Prague during total eclipse, in a very clear sky.

VIENNA

Imperial Academy of Sciences, March 10.—L. T. Fitzinger in the chair.—Dr. P. Weselsky and Dr. R. Benedikt, on the influence of nitrous acid on pyrogallic acid.—T. B. Tanovsky, on a new azosulfobenzoic acid.—Dominico Coglievina, on the Centigrade-photometer, a new optical instrument for determining the intensity of any source of light.—Dr. M. Buchner, analysis of the water from the "Lindenbrunnen," at Zlatten, near Pernegg (Styria).—Dr. Max Margulies, on the determination of the coefficients of friction and sliding by the plane motions of a fluid.—Dr. T. Kreuz, on the development of the lenticells in the shadowed branches of *Ampelopsis hederacea*, Mels.—Dr. Hann, on the daily course of the meteorological elements on the plateau of the Rocky Mountains.—T. B. Heindl, on crystalline combinations of chloride of calcium with alcohols.—Dr. T. Herzig, on the influence of sulphuric acid on mono- di- and tribromo-benzol.—Alex. Lustig, on the determinations of nerves in the smooth muscles.—F. Toula, report on his geological researches in the western regions of the Balkans.

Imperial Institute of Geology, March 1.—R. M. Paul, on the occurrence of petroleum in Wallachia.—Dr. E. Tietze, on some detritus-formations on the southern slope of the Persian Albur Mountain.—Dr. V. Hilber, exhibition of geological maps of Eastern Gallicia.

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