THURSDAY, MARCH 10, 1881

SIR WILLIAM HERSCHEL

I.

ON March 13, 1781, the planet *Uranus* was discovered by William Herschel, and very opportunely at this centenary of that memorable addition to the planetary system, Prof. Holden has presented us with a popular biography of the great astronomer and an outline of his works, which he has been careful to make intelligible to the general reader.[1]

Of the great modern philosophers, writes Prof. Holden, that one of whom least is known, is William Herschel, and we may appropriate the words which escaped him as one of the starless spaces in the constellation Scorpio passed through the field of his telescope, when his sister Caroline Herschel, his constant attendant during his night-watches, tells us he exclaimed, "*Hier ist wahrhaftig ein Loch im Himmel.*" A life of Herschel which shall be satisfactory in every particular, Prof. Holden remarks, can only be written after a full examination of the materials which may have been preserved by the family; but as two generations have passed since his death, he thinks no apology will be needed for a conscientious attempt to make the best use of material already in hand, scanty as it may be.

Herschel did prepare, about the year 1818, a biographical note or memorandum, which was then placed amongst his papers, and which has not been made public, and his sister, writing in June, 1842, mentions having commenced a work which she almost despaired of finishing, "The History of the Herschels," in which presumably her brother's life and work would have formed the main feature, but we do not hear that in her then infirm state of health any considerable progress was made with it.

The only authentic sources of biographical information before the world are in the "Memoir and Correspondence of Caroline Herschel," published in 1876, and in a much less known sketch of his life furnished by Herschel himself in a communication to Lichtenberg, dated November 15, 1783, and printed in the *Göttingen Magazine of Science and Literature*, iii. 4; this sketch was forwarded at the request of Lichtenberg, when acknowledging the receipt of memoirs on double stars, &c., which Herschel had sent him.

William Herschel was born in Hanover on November 15, 1738, and was the second son of Isaac and Anna Herschel. The musical taste which he exhibited early in life appears to have been inherited from his father, who formed one of the band of the Hanoverian Guards in 1731. The eldest son Jacob was a clever musician, and first violin in the Court orchestra in 1759; he afterwards joined his brother William in this country, and on returning to Hanover carried on a correspondence with him on musical subjects till his death in 1792. The youngest brother Dietrich also shared in the musical abilities of the family, and at fifteen years of age was so far advanced as to be admitted into the Court orchestra. Towards the end of 1755, when the Hanoverian Guards were ordered to England, Herschel accompanied them as one of the band, and remained in this country about a year, when he returned to Hanover. During part of the disastrous campaign of 1757 he was on active service with the regiment, but after the defeat at Hastenbeck in July, it became evident that he had not the physical strength for the service, and his parents resolved to remove him. In connection with this circumstance Prof. Holden recalls a statement made by Sir George Airy, that the "removal" was a desertion, as he was told by the Duke of Sussex that on Herschel's first visit to the king after the discovery of the *Georgium Sidus*, "his pardon was handed to him by the king himself, written out in due form."

Herschel returned to England, though at what time does not appear. In fact from 1757 to 1760 we know nothing of his life. It is related in the Memoirs of Caroline Herschel that several pages referring to this period had been torn out in both her original Recollections and in the unfinished Memoir commenced in 1840. In 1760, however, he is again heard of, at Pontefract, as a young German in the band of the Durham militia, who spoke English almost as well as a native, and who was an excellent performer on the violin. It is conjectured that till his appointment as organist at Halifax in 1765, pupils and public concerts must have filled up his time; during a portion of this interval of five years he resided at Leeds, and in April, 1764, we are told he returned to Hanover on a very brief visit. In 1766 he obtained an engagement at Bath, and soon after was appointed organist at the Octagon Chapel. In this year, says Prof. Holden, he began a life of unceasing activity. His engaging manners made him friends, while "his talents brought him admirers and pupils, and pupils brought him money"; at this time he was giving thirty-five or more musical lessons in a week. In August, 1772, he proceeded to Hanover to take back to England his sister Caroline, afterwards his untiring assistant and companion in his surveys of the heavens. At this time his residence was in New King Street, Bath, and here in 1774 he had made himself a Gregorian telescope, probably on the model of Short's. In the preceding year, it is related of him, that he used to retire to bed with Smith's Harmonics and Optics, Ferguson's Astronomy, &c., and his first thoughts on rising were how to obtain instruments for viewing the objects of which he had been reading. We are told no optician had settled in Bath at that time.

Prof. Holden mentions that in *Journal* No. 1, preserved at the Royal Society, is a copy of Herschel's first observation of the nebula of Orion, made with his 5½-feet Gregorian reflector on March 4, 1774. In 1775, with a Newtonian telescope of 4½ inches aperture, and power of 222, also made by himself, he made his first review of the heavens, consisting in the examination of every star of first to fourth magnitudes and the planets; no records of these observations are now known to be in existence. In the same year the first 7-feet reflector was finished, and in 1777 one of 10 feet and one of 20 feet had been projected, and a grass-plot behind a house near Walcot turnpike, to which Herschel had removed at midsummer, 1774, was prepared for its reception: this house offered more room for workshops, and the roof was available for observations. Of his early attempts at the construction of telescopes he wrote to Lichtenstein: "When, in the

[1] "Sir William Herschel, his Life and Works." By Edward S. Holden, U.S. Naval Observatory, Washington. (New York: Charles Scribner's Sons, 1881.)

course of time, I took up astronomy, I determined to accept nothing on faith, but to see with my own eyes everything which others had seen before me. Having already some knowledge of the science of optics, I resolved to manufacture my own telescopes, and after many continuous, determined trials, I finally succeeded in completing a so-called Newtonian instrument, seven feet in length. From this I advanced to one of ten feet, and at last to one of twenty, for I had fully made up my mind to carry on the improvement of my telescopes as far as it could possibly be done." A very good twenty-feet reflector was finished in 1783, but the celebrated forty-feet instrument was not commenced until 1785. Herschel tells us in his description of the latter telescope that in all he made "not less than 200 7-feet, 150 10-feet, and about 80 20-feet mirrors, not to mention those of the Gregorian form, or of the construction of Dr. Smith's reflecting microscope," of which he also made a great number.

In or about 1779 Herschel removed to 19, New King Street, which was his last change of residence at Bath, and it was at this house that the planet Uranus was discovered. His first astronomical paper, on the variable star Mira Ceti, was written from thence, and appeared in the *Philosophical Transactions* for 1780: he had previously contributed a paper (his first publication) to the *Ladies' Diary* in 1779, in answer to a prize question proposed by Landen, viz. "the length, tension, and weight of a musical string being given, it is required to find how many vibrations it will make in a given time, when a small given weight is fastened to its middle, and vibrates with it." In the same volume of the *Phil. Trans.* he published observations relating to the mountains in the moon; at this time and subsequently he measured the heights of about 100, on three different methods. Most of these measures were never printed, and as Prof. Holden remarks at this date they would probably be of no material service to science.

His next paper presented to the Royal Society on January 11, 1781, is entitled "Astronomical Observations on the rotation of the Planets round their Axes, made with a view to determine whether the Earth's Diurnal Motion is perfectly equable," a paper which Prof. Holden views as affording the first obvious proof of the truth of the statement made by Herschel thirty years later, when he said, "A knowledge of the construction of the heavens has always been the ultimate object of my observations." It marks too an advance in practical astronomy: not only are the results given, but careful estimates of the errors to which they may be liable is made, with a discussion of the source of such errors.

On March 13 following Herschel made his great discovery of the planet *Uranus*, that *Georgium-Sidus*, as it was his wish it should be called, which made his name at once familiar throughout Europe. The discovery was announced in a paper communicated to the Royal Society on April 26 by Dr. Watson of Bath, an intimate friend of Herschel's, and strange as it may now appear to us, it is entitled "Account of a Comet." His own words referring to the circumstances of the discovery are as follows:—"On Tuesday, the 13th of March, between ten and eleven in the evening, while I was examining the small stars in the neighbourhood of H Geminorum, I perceived one that appeared visibly larger than the rest: being struck with its uncommon magnitude, I compared it to H Geminorum and the small star in the quartile between Auriga and Gemini, and finding it so much larger than either of them, suspected it to be a comet. I was then engaged in a series of observations on the parallax of the fixed stars, ... and those observations requiring very high powers, I had ready at hand several magnifiers of 227, 460, 932, 1536, 2010, &c., all of which I have successfully used upon that occasion. The power I had on when I first saw the comet was 227. From experience I knew that the diameters of the fixed stars are not proportionally magnified with higher powers as the planets are; therefore I now put on the powers of 460 and 932, and found the diameter of the comet increased in proportion to the power, as it ought to be, on a supposition of its not being a fixed star, while the diameters of the stars to which I compared it were not increased in the same ratio. Moreover, the comet being magnified much beyond what its light would admit of, appeared hazy and ill-defined with these great powers, while the stars preserved that lustre and distinctness which from many thousand observations I knew they would retain." The observations given in this paper extend to April 19, and Herschel adds he was "happy to surrender it to the care of the Astronomer-Royal" (Dr. Maskelyne) and others as soon as he found they had begun their observations upon it: so little idea had he six weeks after he first glimpsed the object of the great discovery he had made.

It is certain that at the date of this discovery the name of Herschel was unknown to the principal astronomers on the Continent, and it is almost ludicrous to read of the various guesses that were made respecting it. Prof. Holden transcribes the amusing passage from Bode's account of the discovery of *Uranus*: "In the *Gazette Littéraire* of June, 1781, this worthy man is called MERSTHEL; in Julius' *Journal Encyclopédique*, HERTSCHEL; in a letter from Mr. Maskelyne to M. Messier, HERTHEL; in another letter of Maskelyne's to Herr Mayer at Manheim, HERRSCHELL [doubtless mis-readings]; M. Darquier calls him HERMSTEL. What may his name be? He must have been born a *German*." In the first notice of the discovery in the *Connaissance des Temps* he is called HOROCHELLE.

The telescope which Herschel was using on the evening of March 13, 1781, was that with which his second review of the heavens was made, a reflector[1] of 85·2 inches focus, 6·2 inches aperture, and power, 227. This survey, he writes in 1783, "extended to all the stars of Harris's maps and the telescopic ones near them, as far as the eighth magnitude. The catalogue of double-stars and the discovery of the *Georgium Sidus* were the results of that review."

Arago says if Herschel had directed his telescope towards the constellation Gemini eleven days earlier (March 2 instead of March 13) the proper motion of the planet would have escaped him, for the planet was on the 2nd near one of its stationary points, and adds, "On voit par cette remarque à quoi peuvent tener les plus grandes découvertes astronomiques." This implies a total misconception of the case: as Prof. Holden remarks:—"The

[1] When Sir John Herschel contemplated presenting one of his father's 7-feet telescopes to the Royal Astronomical Society, Caroline Herschel wrote: "Its only being painted deal was because it should look like the one with which the Georgium Sidus was discovered."

new planet was detected by its appearance and not by its motion." Herschel, referring to his discovery in his communication to Lichtenberg, says: "This was by no means the result of chance, but a simple consequence of the position of the planet on that particular evening, since it occupied precisely that spot in the heavens which came in the order of the minute observations that I had previously mapped out for myself. Had I not seen it just when I did I must inevitably have come upon it soon after, since my telescope was so perfect that I was able to distinguish it from a fixed star in the first minute of observation." It is not to be supposed that so striking an object would have been viewed once and forgotten, even if no motion were immediately detected.

As is well known, Herschel feeling deeply his indebtedness to the liberality of George the Third, desired to testify his gratitude by giving his planet a name which would mark the epoch of its discovery, and in his letter on the subject addressed to Sir Joseph Banks, then president of the Royal Society, writes, "I cannot but wish to take this opportunity of expressing my sense of gratitude by giving the name Georgium Sidus,

Georgium Sidus
——jam nunc assuesce vocari,

to a star, which (with respect to us) first began to shine under his auspicious reign."

Prof. Holden dwells upon the changes which may be considered to have been effected in the state of astronomy not only in England but in the whole world, simply by the discovery of Uranus. "Herschel's researches would have gone into the *Philosophical Transactions* as the work of an amateur astronomer, Mr. Herschel, of Bath. They would have been praised and they would have been doubted. It would have taken a whole generation to have appreciated them. They would have been severely tried, entirely on their merits, and finally they would have stood where they stand to-day—unrivalled. But through what increased labours these successes would have been gained! . . . Certainly, if Herschel's mind had been other than it was, the discovery of Uranus, which brought him honours from every scientific society in the world, and which gave him authority, might have had a hurtful effect. But as he was, there was nothing which could have aided his career more than this startling discovery. It was needed for him. It completed the solar system far more by affording a free play to a profoundly philosophical mind, than by occupying the vacant spaces beyond Saturn. His opportunities would have been profoundly modified, though his personal worth would have been the same." We think there are few astronomers who will not be able to follow Prof. Holden in the views he has thus forcibly expressed.

At the hands of Sir Joseph Banks, Herschel received the Copley Medal of the Royal Society in 1781, for his "discovery of a new and singular star," and was formally admitted a Fellow of the Society on May 30, 1782. It was during this visit to London that Herschel was received by the king, and as he wrote to his sister the same day, met with a very gracious reception. Prof. Holden reproduces from the Memoirs of Caroline Herschel his letter of July 3, in which he describes his visit to the Court with a 7-feet reflector, and the evening having been very fine, how the instrument had given general satisfaction; the king in particular, he states, "enjoys observations with telescopes exceedingly." Herschel returned to Bath in the last week of July, and immediately prepared for removing to Datchet.

Here, at the end of his second chapter, we close our present notice of Prof. Holden's welcome volume, reserving for another week his third chapter on "Life at Datchet, Clay Hall, and Slough," and the concluding one on the general scientific labours of Herschel. It should be stated that while taking Prof. Holden's work as our text, particulars have been included in this notice which are not specially referred to in it, in view of the interest attaching to them at the present time, when, as stated above, a hundred years have elapsed since Herschel's discovery of *Uranus* doubled the known extent of the planetary system.

J. R. HIND

EXTINCT BRITISH ANIMALS

British Animals Extinct within Historic Times; with some Account of British Wild White Cattle. By J. E. Harting, F.L.S. (London: Trübner, 1880.)

THE wild animals formerly inhabiting Britain, which disappeared before the advance of the hunter and farmer in historic times, have hitherto only been treated in a disconnected fashion, in essays scattered through various periodicals, or in portions of books relating to other subjects. Mr. Harting has collected together in the present volume his own essays in the *Field* and in the *Popular Science Review*, and has brought to bear upon his subject a knowledge of records, and an acquaintance with sport, which render his work extremely valuable. His references are accurate, and he has availed himself of nearly every source of information. Consequently we have before us a work dealing with the bear, wolf, beaver, reindeer, and "wild cattle," worthy to be classed between Bell's "British Quadrupeds" on the one hand, and White's "History of Selborne" on the other, relating not merely to the animals, but to the forests in which they lived and to the mode in which they were hunted.

The common brown bear made its appearance on the Continent in the Pleistocene age, and crossed over to Britain while the areas of the North Sea and of the English Channel were fertile valleys abounding in animal life. Its remains occur both in the river-deposits and in the caves, and have been met with in the turbaries and alluvia of England and of Scotland, which belong to the prehistoric period. It was hunted by the Neolithic inhabitants of Britain, and used for food by the inhabitants of Colchester and Richmond in Roman times. From the "Penitentiale" of Archbishop Egbert (A.D. 750), in which the flesh of any animal torn by dog, wolf, fox, or bear, or any other wild animal is forbidden to be used for human food, it is clear that it was alive in this country at that time. In the days of Edward the Confessor Norwich furnished annually one bear to the king and six dogs for the baiting of it. This however does not prove the existence of wild bears in Britain at that date, because bear-baiting was almost a national sport among the English until bears became too costly and the public taste too refined for such brutal exhibitions. Fitz-Stephen tells us, in the reign of Henry II., that the young Londoners amused themselves in the forenoon of every holiday in the winter

season with boar-fights, or bull- and bear-baiting. A grand exhibition of bear-baiting took place at Hatfield House when Queen Mary visited her sister, the Princess Elizabeth, during her confinement there, "with which their Highnesses were right well content." Soon after the ascension of the latter to the throne she entertained the Spanish ambassadors with bulls and bears, and some years afterwards she received the Danish ambassador at Greenwich, and entertained him with bear-baiting, "tempered with other merry disports." On one occasion at Kenilworth no less than thirteen bears were baited before the queen with large ban-dogs. From these notices it is evident that Queen Elizabeth was very fond of this sport. Some of the great nobles and ecclesiastics also kept bears and bear-wards. Latterly there were travelling bear-wards dependent upon their patrons. The bear was probably extinct in Britain about the time of the Norman Conquest, and is not known to have existed in Ireland within the historic period.

The wolf abounded in Britain in the Pleistocene and prehistoric periods, and varied in numbers in the historic age in proportion to the waste lands. It was a subject of many legal enactments, and grants of land were held for its capture. To the numerous references which Mr. Harting gives we may add an extract from the Litany of Dunkeld current in Scotland in the eleventh or twelfth century: "A cateranis et latronibus, a lupis et omni mala bestia, Domine, libera nos."

The animal had a price set upon its head by statute in 1621; the price paid for one wolf in Sutherlandshire was six pounds, thirteen shillings, and fourpence. In Ireland, in 1683, "for every bitch wolfe the price was six pounds, for every dog wolfe five pounds, for every cubb which preyeth for himself forty shillings, and for every suckling cubb ten shillings." It is obvious from these large prices that the wolf was becoming rare in Scotland and Ireland in the middle of the seventeenth century. The last of the British wolves was killed in Scotland in 1743 by MacQueen, a man remarkable for his stature and courage, who died in the year 1797. The memory of the exploit is still preserved by tradition. In Ireland the animal lingered until 1770. Mr. Harting deserves great credit for having collected together the evidence by which these dates can be fixed. The wolf became extinct in England in the reign of Henry VII.

The wild boar still lingered in Lancashire in 1617, and the last notice of the animal in the south of England is of the hunting of the wild boar at Windsor by James I. and his court. Mr. Harting considers that an entry in an account book of the steward of the manor of Chartley "1683.—February. Pd. the cooper for a paile for ye wild swine, 0 . 2 . 0.," proves that it was not extinct in England at that date. It seems however to us very unlikely that wild boars would have such attention paid to their wants, and more probable that they were domestic swine turned out into the woodlands to get the greater part of their own living.

The reindeer, so abundant in the late Pleistocene age, and so generally found along with Palæolithic implements, and so strangely associated with the remains of hippopotamus in the hyæna-dens of this country (a fact which proves the two animals to have been contemporaneous), was rare in the prehistoric period, and disappeared altogether from its last foothold in Caithness about the latter half of the thirteenth century. We may remark that the recent attempts to introduce the animal into Switzerland have failed, apparently from the great heat of summer.

The beaver was living in the River Teivi, according to Girald du Barry, in 1159; and, according to Boethius, was taken in Lochness for the sake of its fur towards the end of the fifteenth century. We would call the attention of our readers to the remarkably interesting account of its reintroduction by the Marquis into the Island of Bute, where they are now increasing rapidly and building their dams. There is evidently no difficulty in naturalising them in this country.

We close this review regretting that it is impossible to do justice to the careful account of the different breeds of the "wild white cattle," which we believe to be the descendants of the domestic cattle introduced by the English, and which have always lived in uninclosed lands.

W. BOYD DAWKINS

OUR BOOK SHELF

Notes of Observations of Injurious Insects. Report, 1880. By Eleanor A. Ormerod. 8vo. pp. 1-48. (London: W. Swan Sonnenschein and Allen. Edinburgh: J. Menzies, 1881.)

MISS ORMEROD and her assistants are to be congratulated on this very excellent Report, which is far more bulky than its predecessors, and correspondingly useful and interesting, and well illustrated. At the outset a very significant fact is mentioned. The season of 1880 was remarkably suitable for vegetation, and the attacks of insects consequently less severe; a high condition of vitality enabled the plants to more successfully cope with their insect enemies. The most injurious species for the year was the well-known larva of *Tipula* (daddy-long-legs), which not only attacked its more usual food, the roots of grasses, but proved itself extremely injurious to peas, so that in one field of twenty acres the prospective value in March was reduced to a realised value of only about one half in June; other crops were also attacked. Stimulating remedies, such as guano, salt, ammoniacal liquor, &c., had a good effect, but the grubs appeared to be remarkably indifferent to ordinary poisonous solutions. An experiment at the Kew Observatory as to the amount of cold they can endure showed that some survived 42° of frost. Another very injurious species was *Tephritis onopordinis* (the celery-fly); a dressing of gas-lime, unslaked lime, and soot had a good effect. The singularly misnamed *Psila rosæ* (the carrot fly) was also obnoxious; sowing the seeds in a mixture of leaf-mould, ashes, &c., proved of excellent service in this case. *Sitones lineatus* was very injurious to peas. We think Miss Ormerod acts injudiciously in calling this insect the "pea-weevil." Its larva is certainly very much given to attacking peas and many other plants, by eating the young shoots, but the true pea-weevil is *Bruchus pisi*, which destroys the peas themselves by feeding inside them. For the gooseberry saw-fly nothing proved so effectual as digging out the earth round the bushes when the larvæ and pupæ are underground, the removed portion being taken away and burnt; a suggestion that if pieces of woollen cloth be placed on the bushes the parent fly will deposit her eggs thereon seems far-fetched. Miss Ormerod has great faith in the efficacy of paraffine. In future it is proposed to extend the Report to insects not hitherto specially mentioned as desirable for observation, such as the larch-aphis and pine saw-fly. We are glad to note that the authoress has a Manual of Economic Entomology in the press.

Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux. 2e série, tome iv., 1me cahier. (Paris: Gauthier-Villars, 1880.)

THIS number contains Conférences de Géométrie supérieure by M. Saltel, in which is given an exposition of the method of analytical correspondence with two applications, the object of the one being to find the number of common solutions in k equations between k unknowns, and of the other to find the degree of a geometrical locus defined by certain algebraic conditions. The methods employed are based on that of M. Chasles's "Principe de Correspondance." The next paper, by M. Imchenetsky, "Détermination en fonction des coordonnées de la force qui fait mouvoir un point matériel sur une section conique," is an interesting one, and is founded upon a remark of M. Bertrand's ("Sur la possibilité de déduire d'une seule des lois de Kepler, le principe de l'attraction, *Comptes rendus*, April 2, 1877), "il serait intéressant de résoudre la question suivante. En sachant que les planètes décrivent des sections coniques, et sans rien supposer de plus, trouver l'expression des composantes de la force qui les sollicite en fonction des coordonnées de son point d'application." The author arrives at his result by taking his equation in the form—

$$px^2 + qy^2 + 2rxy = (ax + by + c)^2.$$

Prof. Teixeira of Coimbra has a short note "Sur les principes du calcul infinitésimal," which calls for no special comment. Dr. G. Sous follows with what appears to us a good article entitled "Phakomètre et Optomètre." For the uninitiated "Les phakomètres sont des instruments destinés à mésurer la distance focale d'une lentelle quelconque." The principle of construction of Silbermann's and of Snellen's is, when an object is placed at twice the focal distance from a converging lens, the real image of the same size as the object is situated also at double the focal distance from the lens. The objection to Silbermann's appears to be its length, which renders it awkward to carry, and to Snellen's that it is not applicable to diverging lenses.

Dr. Sous gives a form which is not liable to either of these defects, and the construction of which is based upon a physical theory, not hitherto, he states, applied to these instruments; but we must refer those interested in optics to the paper itself (fourteen pages in length). The rest of the book is devoted to "Morphologie de la membrane de Schrapnell," Dr. Coyne; "Études d'Optique Physiologique; Influence du Diamètre de la Pupille et des Cercles de Diffusion sur l'acuité visuelle," Dr. Badal; "Les Températures de la Mer dans l'estuaire Girondin et à Arcachon en décembre, 1879, et janvier, 1880," M. Hautreux; "Des Os et de leur Emploi dans la Fabrication du noir Animal, du Suif, du Sulfate d'ammonique, des Boutons," &c., M. Huyard.

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.]

Aberration of Instinct

CASES of individual variations of instinct are of importance in relation to Mr. Darwin's theory of the development of instincts by natural selection. Under the belief that aberration of instinct may be regarded as a case, more or less extreme, of variation, I think that the following instance is worth publishing in NATURE. It has been communicated to me by a correspondent on whose trustworthiness I have reason to rely:—

"A white fantail pigeon lived with his family in a pigeon-house in our stable-yard. He and his wife had been brought originally from Sussex, and had lived, respected and admired, to see their children of the third generation, when he suddenly became the victim of the infatuation I am about to describe. . . .

"No eccentricity whatever was remarked in his conduct until one day I chanced to pick up somewhere in the garden a ginger-beer bottle of the ordinary brown stone description. I flung it into the yard, where it fell immediately below the pigeon house. That instant down flew paterfamilias, and to my no small astonishment commenced a series of genuflexions, evidently doing homage to the bottle. He strutted round and round it, bowing and scraping and cooing and performing the most ludicrous antics I ever beheld on the part of an enamoured pigeon. . . . Nor did he cease these performances until we removed the bottle; what proved that this singular aberration of instinct had become a fixed delusion was this, whenever the bottle was thrown or placed in the yard—no matter whether it lay horizontally or was placed upright—the same ridiculous scene was enacted; at that moment the pigeon came flying down with quite as great alacrity as when his peas were thrown out for his dinner, to continue his antics as long as the bottle remained there. Sometimes this would go on for hours, the other members of his family treating his movements with the most contemptuous indifference, and taking no notice whatever of the bottle. At last it became the regular amusement with which we entertained our visitors, to see this erratic pigeon making love to the interesting object of his affections, and it was an entertainment which never failed, throughout that summer at least. Before next summer came round he was no more."

GEORGE J. ROMANES

Prehistoric Europe

A FEW last words with Prof. Dawkins, and I have done:—

1. Having discovered that a certain absurd opinion which he attributed to me is nowhere to be met with in the volume he was supposed to be criticising, Mr. Dawkins now imagines that he has found grounds for his assertion in my "Great Ice Age," written and published some years ago. Here again he is quite mistaken. The passage cited by him, even if it be considered apart from its context, will not bear the interpretation he puts upon it. Had he read the page he quotes from with intelligent attention he would have seen that I was referring to the well-known fact that the ossiferous and Palæolithic gravels of East Anglia are represented in the North by the equivalent ossiferous *Cyrena*-beds near Hull, which dovetail with and are overlapped by glacial deposits. In other words, they rest upon a *lower*, and are covered by an *upper* boulder-clay. But I have nowhere said, nor would any candid reader infer from what I have written, that this upper boulder-clay (that of Hessle) ever extended south so as to cover the Palæolithic gravels throughout East Anglia. I am surprised that a professor of geology does not apparently understand the meaning of the term "overlap." Were I to state that in certain districts in Scotland the Carboniferous strata are overlapped by a conformable series of Red Sandstones, should I be understood to imply that these Red Sandstones formerly covered the entire area now occupied by the Carboniferous rocks of Great Britain?

2. Mr. Dawkins has accused me of having suppressed evidence which told against my views, and he now repeats this offensive accusation, citing in justification my description of the Victoria Cave, from which, he says, I have omitted all reference to the discovery of reindeer in the lower cave-earth. Now it is not true that I have ignored this alleged discovery, for I remark that "it seems doubtful whether the remains of that animal, said to have been obtained from the lower earth, really belonged to that deposit." My reasons for this doubt (which I share with other geologists) I did not consider it necessary to give, but they are simply these:—

(1) The explorations in the cave were carried on at first, under Mr. Dawkins's superintendence, by means of shaft-digging, a very unsatisfactory system of "cave-hunting," and one which, even with the most conscientious care, is liable to give false results.

(2) During the subsequent prolonged and scientifically-conducted explorations no recognisable reindeer remains were ever obtained in the lower stratum. These facts alone are sufficient to justify my scepticism. I quite agree with Mr. Dawkins, however, that the mere occurrence or non-occurrence in this particular cave of reindeer associated with hippopotamus is not of paramount importance. Even the most inattentive reader of "Prehistoric Europe" can hardly miss the statement, again and again repeated, that the southern and northern forms are often

enough commingled in one and the same accumulation. It is to account for this remarkable commingling that a large portion of my book was written.

3. Mr. Dawkins seems to be ignorant of the fact that the ossiferous deposits of Mont Perrier occur on two separate and distinct horizons. The *lower* bed, characterised by the presence of *Mastodon arvernensis* and other extinct forms, is unquestionably true Pliocene. It is overlaid by the "pumiceous conglomerate," with its far-transported and glacially-striated erratics. Upon the denuded surface of this well-marked morainic accumulation rests the *upper* bed, which contains a very different mammalian fauna—*Elephas meridionalis, Rhinoceros leptorhinus* (Cuv.), hippopotamus, tapir, horse, cave-bear, hyæna, hedgehog, &c. The flora associated with this fauna is not Pliocene but Pleistocene. The upper bed is overlaid in turn by a newer set of glacial moraines and erratics. The list of Upper Pliocene Mammalia from Mont Perrier and Issoire, given by Mr. Dawkins in his "Early Man in Britain," consists of a "hash-up" of the species derived from those two separate and distinct horizons.

4. The most recent list of mammalia from the lignite-beds of Leffe and Borlezza is quoted by me from Prof. Stopanni, on the authority of Dr. Forsyth Major. All the species in that list, without exception, have frequently occurred in Pleistocene beds, the age of which is generally admitted. The plants and shells associated with these species are all likewise Pleistocene forms. Moreover, as Stopanni has demonstrated, and as I can testify, the stratigraphical evidence proves that the beds pertain to the Glacial series. Prof. Mayer, no mean authority, has shown that the upper beds of the so-called Pliocene of the Val d' Arno (containing *Elephas meridionalis* and hippopotamus) are not the equivalents of the marine Pliocene, as has hitherto been the belief of palæontologists, but must be classified as Quaternary or Pleistocene.

5. All that I say with regard to the age of the skull of Olmo occurs on p. 318 of my book, and what I say is simply this, "It pertains to Pleistocene times—to the period during which *Elephas meridionalis* belonged to the European fauna." I do not assert its Interglacial age. It may be either Preglacial (*i.e.* early Pleistocene) or Interglacial as the Leffe beds are.

I was not aware that geological classification is always based on zoology alone. I am under the impression that botanical evidence, when it can be obtained, is not despised, and that stratigraphical and other physical evidence is not usually ignored. In trying to work out the historical geology of the Pleistocene, I have considered the palæontological as fully as the physical evidence. Mr. Dawkins would have me rest contented with that of the mammalia alone, as interpreted by himself.

Perth, February 19. JAMES GEIKIE

As my name has been imported into the controversy between Prof. Dawkins and Dr. James Geikie, will you kindly permit me to state that I am quite prepared, after re-reading the account given by Dr. Geikie of the Victoria Cave, to accept all responsibility for its correctness.

Without entering into the general question, in the particular case of the Victoria Cave the evidence for the contemporaneity in the same area of the reindeer and hippopotamus is not very cogent; a review of all the evidence from that source indeed points the other way. The specimen mentioned by Prof. Dawkins was, according to his Report,[1] found in digging a shaft, a method of exploration unfortunately at that time (1872) employed by the Committee. The subsequent explorations, which were not conducted in this manner, but by carefully removing the deposits, layer by layer, to prevent any possibility of accidental mixture of the remains, gave abundant evidence of reindeer in the upper beds, but not any satisfactory evidence of its presence in the lower beds, containing *Hippopotamus, Elephas antiquus, Rhinoceros leptorhinus*, &c. This is a point, amongst others, to which, as Reporter to the Committee, I paid careful attention, and the details were impartially given in the Reports.[2] The absence of reindeer from a lower bed, the only one containing the same fauna in the Creswell caves explored by the Rev. M. Mello and Prof. Dawkins, is worthy of note as bearing on the same subject.

As regards the evidence for the antiquity of man from the Victoria Cave, Dr. Geikie has fairly stated both sides of the question, and he certainly does not deserve the accusation that he "has only called those witnesses which count on his side." Prof. Dawkins, in dismissing the whole of this evidence as "founded on a mistake," must be aware that he is using a convenient formula which can only apply fairly to a part of it, the doubtfulness of which has already been fully conceded. He entirely shelves other evidences which are the result of a long and careful exploration.[1]

To state that he doubts their cogency would be to take a course of which no one would complain; but to say as if it were a matter of general agreement that they are "founded on a mistake," looks like an attempt to stifle discussion.

But his remarks are so obviously polemical that to most geologists they will probably carry more amusement and less conviction than the writer contemplated.

Hastings, February 19 R. H. TIDDEMAN

[1] Report on the Victoria Cave; British Assoc. Report, 1872, Sections, p. 179.

[2] Victoria Cave; British Assoc. Reports, 1874-78.

Les lettres d'Outre-mer

IN the Notes, published in NATURE of January 13, p. 254, the last paragraph gives, as a fact, an announcement of "the simplest post-office in the world" in Magellan Straits, as still in existence.

At least fourteen years ago there was published a graphic account of this unique establishment by the most eminent of all living French writers, M. Victor Hugo, who introduces the circumstance into his famous work of fiction, "Les Travailleurs de la Mer"; and ever since reading the account I have wondered where the great author obtained his circumstantial relation, which refers to the year 1823. Nor can I believe that such a system of oceanic exchange ever really was in existence, at least on the spot indicated, for a very good reason; that at the point indicated, viz. the neighbourhood of Port Famine, when the *Beagle* was there in 1834 (see Darwin's "Naturalist's Voyage," chap. xi.), "the Fuegians twice came and plagued" the crew; so that an open barrel would hardly be safe. Darwin, also, who ascended Mount Tarn, the most elevated point in this district, would surely have mentioned this famous barrel post-office, had it existed (?).

I am therefore curious to know whence the note in NATURE was compiled, but I fancy the account is apocryphal. That there were however other oceanic post-offices somewhat similar in principle is a fact in reality.

In 1673 Ascension was visited by the Dominican, Father Navarette, who speaks of it then as the "*Sailor's Post-Office.*" "Mariners of all nations being accustomed at that time to leave letters here, sealed up in a bottle, in a certain known cranny of some rock, to be taken away by the first ship which passed in an opposite direction" (Mrs. Gill's "Six Months in Ascension," p. 61). And again in 1769 we find the following extract:—

"1769, *Febry.* 3-4

"Ascension island.

Bougainville.

Louis de Bougainville, Colonel of Foot and Commodore of the Expedition in the Frigate *La Boudeuse.*

Arrd. and anchored in the North-west creek or '*Creek of the Mountain of the Cross.*'

Anchorage according to Abbé la Caille.

7° 54′ s.—16° 19′ west, of Paris.

Variation 9° 45′ NW.

Three creeks caught turtle.

N.E. creek. N.W. creek. English creek, S.W.

"In the afternoon the bottle was brought to me which contains the paper whereon the ships of every nation generally write their name, when they touch at Ascension Island.

"This bottle is deposited in a cavity of the rocks of this bay, where it is equally sheltered from rain and the spray of the sea. In it I found written the *Swallow*, that English ship which Captain Carteret commanded, and which I was desirous of joining.[2] He arrived here the 31st of January, and set sail again on the 1st of February; thus we had already gained six days upon him, after leaving the Cape of Good Hope. I inscribed the *Boudeuse* and sent back the bottle."

At page 4 of Melliss' "Account of St. Helena (1875) is a wood-cut of the South Atlantic Post Office of 1645. Speaking of the island of St. Helena, Mr. Melliss says:—

"It became about this time—little more than a century after its discovery—a resort of Dutch and Spanish ships, as well as

[1] Victoria Cave Report, *op. cit.* 1877, pp. 218-220, and 1878; *Journ.* Anthrop. Inst. vol. vii pp. 166-173.

[2] *La Boudeuse* caught up the *Swallow*, 25th February.

English; and Portuguese authority seems to have been lessened, through that Power being interested in acquiring possessions elsewhere, and the island was for a while deserted, though still used by the captains and crews of ships as a South Atlantic post-office. It was customary to place letters under huge boulders of stone, marked in a conspicuous manner, so that the crews of ships returning from India might obtain news from home. An interesting record of this period is still to be seen on a rude block of lava measuring nearly five feet high and two feet six inches wide, which has been preserved by being subsequently built into a large mass of masonry in the Jamestown burial-ground."

In the Galapagos Islands there is a bay named Post-Office Bay, which seems to indicate an analogous nautical exchange station.

I subjoin Victor Hugo's description, and shall be much obliged to any of your readers who can refer me to any account of the earlier voyagers whence this scene was derived.

S. P. OLIVER

2, Eastern Villas, Anglesey, Gosport, February 28

P.S.—If any one can give me a reference, also, where I can find an account of the wreck of the *Grosvenor* on the south-east coast of Africa in 1782, I shall be extremely obliged.

"*Les Travailleurs de la Mer*, édition illustrée (1866). Livre cinquième, ix.

—Renseignement utile aux personnes qui attendent, ou craignent, des lettres d'outre-mer" (p. 91).

"Ne disiez-vous pas, Capitaine Gertrais que la *Tamaulipas* ne relâchera point?

—Non. Il va droit au Chili.

—En ce cas il ne pourra pas donner de ses nouvelles en route.

—Pardon, Capitaine Clubin. D'abord il peut remettre des dépêches à tous les bâtiments qu'il rencontre faisant voile pour Europe.

—C'est juste.

—Ensuite il a *la boite aux lettres de la mer*.

—Qu'appelez-vous la boite aux lettres de la mer?

—Vous ne connaissez pas ça, Capitaine Clubin?

—Non.

—Quand on passe le detroit de Magellan.

—Eh bien?

—Partout de la neige, toujours gros temps, de vilains mauvais vents, une mer de quatre sous.

—Après?

—Quand vous avez doublé le cap Monmouth.

—Bien. Ensuite?

—Ensuite vous doublez le cap Valentin.

—Et ensuite?

—Ensuite vous doublez le cap Isidore.[1]

—Et puis?

—Vous doublez la pointe Anna.[1]

—Bon. Mais qu'est ce que vouz appelez la boite aux lettres de la mer?

—Nous y sommes. Montagnes à droite, montagnes à gauche. Des pingouins partout, des pétrels-tempêtes. Un endroit terrible. Ah! mille saintes mille singes! Quel bataclan, et comme ça tape! La bourrasque n'a pas besoin qu'on aille á son secours. C'est là qu'on surveille la lisse de hourdi! C'est là qu'on diminue la toile! C'est là qu'on te vous remplace la grande voile par le foc, et le foc par le tourmentin! Coups de vent sur coups de vent. Et puis quelque-fois quatre, cinq, six jours de cape sèche. Souvent d'un jeu de voiles tout neuf il vous reste de la charpie. Quelle danse! des rafales à vous faire sauter un trois-mâts comme une puce. J'ai vu sur un brick anglais, le '*True Blue*,' un petit mousse occupé à la '*gibboom*' emporté à tous les cinq cent mille millions de tonnerres de Dieu et la '*gibboom*' avec. On va en l'air comme des papillons, quoi! J'ai eu le contre-maître de la *Revenue*, une jolie goëlette, arraché de dessus le *fore-crosstree*, et tué roide. J'ai eu ma lisse cassée, et mon serre-gouttière en capilotade. On sort de là avec toutes ses voiles mangées. Des frégates de cinquante font eau comme des paniers. Et la mauvaise diablesse de côte! Rien de plus bourru. Des rochers déchiquetés comme par enfantillage. On approche du Port-Famine. Là c'est pire que pire. Les plus rudes lames que j'ai vues de ma vie. Des parages d'enfer. Tout à coup on aperçoit ces deux mots écrits en rouge: POST OFFICE.

—Que voulez-vous dire, Capitaine Gertrais?

—Je vous dire, Capitaine Clubin, que toute de suite après qu'on a doublé la pointe Anna on voit sur un caillou de cent pieds de haut un grand bâton. C'est un poteau qui a une barrique au cou. Cette barrique, c'est la boîte au lettres. Il a fallu que les anglais écrivent dessus: POST OFFICE. De quoi se mêlent ils? C'est la poste de l'océan; elle n'appartient pas à cet honorable gentleman, le roi d'Angleterre. Cette bôite aux lettres est commune. Elle appartient à tous les pavillons. POST OFFICE, est-ce assez chinois? Ça vous fait l'effet d'une tasse de thé que le diable vous offrirait tout à coup. Voici maintenant comment se fait le service. Tout bâtiment qui passe expédie au poteau un canot avec ses dépêches. Le navire qui vient de l'Atlantique envoie ses lettres pour l'Europe, et le navire qui vient du Pacifique envoie ses lettres pour l'Amérique. L'officier commandant votre canot met dans le baril votre paquet et y prend le paquet qu'il y trouve. Vous vous chargez de ces lettres-la; le navire qui viendra après vous se chargera des vôtres. Comme on navigue en sens contraire, le continent d'ou vous venez, c'est celui ou je vais. Je porte vos lettres, vous portez les miennes. Le baril est bitté au poteau avec une chaîne. Et il pleut! Et il neige! Et il grêle! Une fichue mer! Les satanicles volent de tous côtés. Le *Tamaulipas* ira par là. Le baril a un bon couvercle à charnière, mais pas de serrure ni de cadenas. Vous voyez qu'on peut écrire à ses amis. Les lettres parviennent.

—C'est très-drôle, murmura Clubin rêveur."

[1] Sta. Anna Pt. is at entrance of Port Famine, but Cape S. Isidro is past to the south.

Explosive Gas in a Lake

A FRIEND, on whom I can rely, informs me that during the late frost, Loch Ken in Kirkcudbrightshire was frozen over, affording pastime to curlers and skaters. Here and there, however, small spots of the surface, near to the shore, resisted the frost longer, and when they did freeze the ice was very thin. These pot-holes were dangerous to skaters, the largest being about size enough to admit an ordinary curling stone. Gas was emitted from them, and when the ice for the first time was formed over them one person got his face severely burned by boring a small hole in the thin ice and setting fire to the gas thus liberated, with a match. After a while the gas seemed to lose its power of combustion and the experiment could be repeated with impunity, a feeble flame only being evoked, when the hole was first drilled.

J. SHAW

Dumfriesshire, March 4

Colours of British Butterflies

THE sober colouring of the under-wings of many of our butterflies is universally accepted as being "protective." Let the gorgeous "peacock," for instance, but close his wings, and it takes a sharp eye to see him. Why then should he and so many other kinds flaunt their most brilliant hues in the brightest sunshine, and often be rendered even more conspicuous by perching on a yellow flower? One would think that this was the exact way to attract birds, especially as the colours are not likely to be "warning" ones, for if so, why the sober hues of the under sides of the wings? The colours can hardly be "warnings" to particular kinds of birds and "protective" against the attacks of others. The explanation may be that the facilities for recognition, and thus for the continuation of the species, are so much greater in bright light, as to render it advantageous on the whole to run the chance of easier capture in the brighter parts of the day: or it may be that relatively few birds feed at the times that butterflies choose to display their beauties.

In watching butterflies it appears clear that they are, so to speak, shortsighted, for it is the commonest thing possible to see two entirely different sorts circle round each other for some time as if they had to decide whether they are of the same kind or not. In doing this it will be observed that they fly, as it were, over and over each other, so that for quite half the time the gambols are going on, the dark side of the "protected" kinds is shown to the insect below. Here steps in a provision which seems admirably adapted for enabling recognition to take place. It will be found that though the wings of protectively coloured butterflies appear very dark at a casual glance, yet that if they are held up to the light, in many cases there are bright spots or colourings or semi-transparent spaces, that, by enabling the sun to shine through, make even the dark wings very conspicuous. The bright spots on the "peacock" are a case in point. I have not an opportunity of actually handling a complete collection of our British butterflies just now, but in thirty of our commonest sorts I find fifteen that have distinctly protectively

coloured under-wings. Of these fifteen all have some more or less transparent spaces or colourings. In some cases portions of the under-wings are brightly coloured, though not transparent, but both in this case and when there are transparent places they appear chiefly on parts that are apparently invisible when the wings are closed. If these observations are correct, the insects are carefully protected when at rest or when they are laying their eggs. Whether they pair on the ground or with shut wings I do not actually know, for after carefully watching every butterfly I have come across for two summers, I have not succeeded in seeing any of the protectively coloured sorts pairing. It seems likely enough therefore that their protective colours come into play then. My opportunities for observation are however extremely limited, and it is to draw the attention of those more favourably situated to the subject of the colours of our common butterflies that I write this. In the fifteen protectively-coloured butterflies mentioned above I did not include the "fritillaries," because of the strange metallic lustre on their under-wings. Still they seem suddenly to disappear when they settle, and the metallic spots may take the place of the transparent or coloured ones in other sorts by throwing off the light, and thus enable the insects to recognise each other. Eight kinds more or less transparent but not seemingly protectively coloured, and two common "Blues," make up the thirty kinds I have been able to handle. The under-wings of the "Blues" are certainly protectively coloured, but there seems to be no transparency or bright markings in them.

J. INNES ROGERS

Putney, February 24

Dust, Fogs, and Smoke

THE present endeavours to alleviate the smoke nuisance in London give some interest to the description of the effects of coal smoke on London life in former ages.

I do not mean to speak of the well-known petition presented to Edward the First by the nobility and gentry against the use of sea-coal in London and the consequent proclamation of that monarch interdicting its use. But I allude to the following lines written and published by Evelyn in 1661 in his "Fumifugium," but which I borrow from the "History of London," by Noorthouck, London, 1773.

"The immoderate use of, and indulgence to sea-coale alone in the city of London, exposes it to one of the fowlest inconveniences and reproaches, that can possibly befall so noble, and otherwise incomparable city: and that, not from the culinary fires, which for being weak and lesse often fed below, is with such ease dispelled and scattered above, as it is hardly at all discernible, but from some few particular tunnells and issues, belonging only to brewers, diers, lime-burners, salt, and sope-boylers, and some other private trades one of whose spiracles alone, does manifestly infect the aer, more than all the chimnies of London put together besides. And that this is not the least hyperbolie, let the best of judges decide it, which I take to be our senses: whilst these are belching it forth their sooty jaws, the city of London resembles the face rather of Mount Ætna, the court of Vulcan, Stromboli, or the suburbs of hell, than an assembly of rational creatures, and the imperial seat of our incomparable monarch. For when in all other places the aer is most serene and pure, it is here ecclipsed with such a cloud of sulphure, as the sun itself, which gives day to all the world besides, is hardly able to penetrate and impart it here; and the weary traveller, at many miles distance, sooner smells, than sees the city to which he repairs. This is that pernicious smoake which sullyes all her glory, superinducing a sooty crust, or furr upon all that it lights, spoyling the moveables, tarnishing the plate, gildings, and furniture, and corrodding the very iron bars and hardest stones with those piercing and acrimonious spirits which accompany its sulphure; and executing more in one year than exposed to the pure aer of the country it could effect in some hundreds. It is this horrid smoake which obscures our churches and makes our palaces look old, which fouls our clothes, and corrupts the waters, so as the very rain and refreshing dews which fall in the several seasons precipitate this impure vapour, which with its black and tenacious quality, spots and contaminates whatever is exposed to it. It is this which scatters and strews about those black and smutty atomes upon all things where it comes, insinuating itself into our very secret cabinets, and most precious repositories: finally, it is this which diffuses and spreads a yellownesse upon our choysest pictures and hangings; which does this mischief at home, is Avernus to fowl, and kills our bees and flowers abroad, suffering nothing in our gardens to bud, display themselves or ripen; so as our anemonies and many other choycest flowers will by no industry be made to blow [*sic*] in London, or the precincts of it, unlesse they be raised on a hot-bed and governed with extraordinary artifice to accellerate their springing; imparting a bitter and ungrateful tast to those few wretched fruits, which never arriving to their desired maturity seem, like the apples of Sodome, to fall even to dust when they are but touched. Not therefore to be forgotten is that which was by many observed, that in the year 1644 when Newcastle was besieged and blocked up in our late wars, so as through the great dearth and scarcity of coales, those fumous works many of them were either left off, or spent but few coales in comparison to what they now use; divers gardens and orchards, planted even in the very heart of London (as in particular my lord Marquesse of Hertford's in the Strand, my lord Bridgewater's and some others about Barbican), were observed to bear such plentiful and infinite quantities of fruits, as they never produced the like either before or since to their great astonishment: but it was by the owners rightly imputed to the penury of coales and the little smoake, which they took notice to infest them that year; for there is a virtue in the aer to penetrate, alter, nourish, yea and to multiply plants and fruits, without which no vegetable could possibly thrive."

The improvement mentioned by Evelyn, when the use of coal was for a time less extensive in London, is particularly worthy of notice, and ought, I think, to be considered as an encouragement to persist in the attempt of rendering London as smokeless as possible.

CHATEL

Jersey, February 25

THE GERMAN CHEMICAL SOCIETY

ON November 11, 1867, a meeting of about eighty chemists was held in Berlin to take steps for inaugurating a new Chemical Society. On January 13 of the succeeding year (1868) the first meeting of the Society was held, when Prof. A. W. Hofmann was elected president, and the roll-call of the Society contained 105 names. During the first year of its existence 97 papers were read before the Society; at the close of the year the membership had increased to 275, and the Society found that a volume of 282 pages was needed to contain the papers communicated to it.

Since 1868 the German Chemical Society has steadily increased in size and in usefulness; the *Berichte* for 1880 consists of two large volumes numbering, between them, 2473 pages, and containing the 563 papers communicated to the Society during the year, besides numerous abstracts of papers published elsewhere. The income of the Society for 1880 amounted in round numbers to the sum of 2000*l.*, and of this about 1400*l.* was set against the cost of publishing the *Berichte*.

During the thirteen years of its existence the German Chemical Society has published in its *Berichte* most of the important discoveries in pure chemistry made in that period. It has been the aim of the Society to publish papers communicated to it with as little delay as possible. Meetings are held twice monthly during the session, and the papers read at one meeting are published in the *Berichte*, which appears on the day on which the next meeting takes place. Papers appearing within so short a time after they are communicated are necessarily brief and concise; but this rapid publication confers a great benefit on all chemists, as they are thus put in possession of at least the leading facts concerning all recent work almost as soon as these facts have been established by the workers. If papers in the *Berichte* are sometimes wanting in completeness and symmetry, many of them are full of life and stir, telling as they do of work actually proceeding in the laboratory; appearing sometimes in short abrupt snatches, they convey something of the enthusiasm of the worker as he compels nature, bit by bit, to yield her treasured secrets.

The system of printing abstracts of papers published in the various chemical journals has recently been adopted

by the Society; formerly a correspondent in London or Paris, &c., sent a general account of chemical work published in the country from which he wrote. The abstracts of the German Society are on the whole shorter than those which have for many years made the *Journal* of our own Chemical Society of such great value to the student; they are, however, published at a shorter interval after the appearance of the original paper.

Brief accounts are given of recent chemical patents, but little space is devoted to purely technical chemistry. Is not the *Journal* of the Chemical Society sometimes overburdened by abstracts which might better find a place in a book professing to collect receipts for the purely "practical man"?

The German Chemical Society in 1877 appointed Dr. C. Bischof of Berlin to prepare a general index for the first ten volumes of the *Berichte*. The arduous task has been admirably fulfilled. Fellows of the Society have now in their hands not only an index to the *Berichte*, but a volume which is really a general guide to the chemical work published during the period 1868–1877.

The "Generalregister" extends to 1020 pp.; of these, 162 pp. are devoted to an index of authors, 732 pp. to an index of subjects, 42 pp. to an index of patents, and 84 pp. to a systematic classification of the carbon compounds referred to in the index.

Under an author's name are given, not the exact title of his paper, but a very succinct statement of the leading points in the paper. The same method is pursued in the subjects-index. Taking, for instance, such a general subject as "Dissociation," one finds, first, references to work on the general Theory of Dissociation, *e.g.* connection between dissociation and temperature, tension, &c.; then follow special instances of dissociation, inorganic compounds preceding organic. In the case of individual elements or compounds, the references begin with those papers on the existence of the substance in question, then follow its preparation and formation, its properties, its action on other substances, the action of other bodies on it, its estimation, &c., &c.

A systematic nomenclature is adopted, more especially for the carbon compounds: the principles which guided the compiler are stated in a few introductory pages.

The "Generalregister" cannot but be of the greatest value to chemists generally. Almost every chemist is a Fellow of the German Society; many possess the *Berichte* complete up to date; with the *Berichte* and this admirable guide which Dr. Bischof has supplied, they can find almost everything that has been done in experimental chemistry within the period 1868–1877. M. M. P. M.

IRISH ESPARTO GRASS

IT is now over two years ago since attention was called in our pages to the importance of the purple Molinia (*Molinia cærulea*) as a material for making paper. Mr. Christie of Edinburgh sent a small quantity of it to be operated on by Mr. T. Routledge of Sunderland, and the report on this was most favourable. In January, 1879, a notice appeared in the *Times* also calling attention to the subject, and referring to the above favourable report; it expressed the hope that some effort would be used to have this grass collected on an extensive scale. It would seem to be ripe for gathering in the early autumn, when some hands could be spared for such work, and as the ground on which it flourishes—wet or partially drained bogs—pays, at least in Ireland, little if any rent, the crop would cost little over the expense of reaping it. Since the first notice appeared in our columns, the Spanish and African Esparto grass has been getting more difficult to obtain, and the demand for it has been steadily on the increase. It is said that the greater part of what is gathered in Morocco finds its way to the *Times* paper-mills, and its value for paper-making is now known in America. Several analyses of specimens of the dried hay made from this grass are given in a paper by Dr. Cameron, "On the Composition of a Crop of Hay" (*Proc.* Roy. Dub. Soc., n.s., vol. ii. p. 101); we select one of these, which yielded as follows:—

100 parts contained—

Water	27·95
Albuminoids	7·49
Fats	2·70
Non-nitrogenous substances	30·00
Woody fibre	31·26
Mineral water	0·60
	100·00

And of this the ash contained—

Lime	28·86
Magnesia	4·76
Potash and soda	42·17
Phosphoric acid	12·36
Sulphuric acid	5·98
Oxide of iron and alumina	1·00
Chlorine	4·32
Silica	0·55
	100·00

This freedom from silica of the purple Melic grass is very remarkable.

From a paper by Mr. W. Smith in the recent number of the *Proceedings* of the Royal Dublin Society, we learn that a very successful trial has been made in the county of Galway to grow this grass in some quantity. As a native plant it is found in every county in Ireland, both on wet heaths and boggy pastures. It flowers in July and August, and its seeds are ripe early in September; it would seem to grow well on partially drained bogs, and if the surface of these has been burnt, the purple Melic grass grows thereon most luxuriantly. It seems fond of growing in tufts, of somewhat large size, and it does not form a sod like so many other grasses. It would appear that in Ireland alone there are over 1,000,000 acres at the present moment not worth sixpence a year each for any agricultural purpose; each acre would easily grow half a ton weight of dried Melic grass, which at its lowest value would be worth 2*l.* Would not this crop, in time, more than compensate for the loss of the potatoe? It seems a pity that the manufacturer should have to go to the Port of Mogador for what he might get with so much greater ease at the Port of Dublin.

SIBERIAN METEOROLOGY

UP to the present time Yakutsk, in North-east Siberia, has often been cited as the place of our earth where the winter is coldest, while the minima observed during Arctic expeditions are believed to be the lowest known. Neither the one nor the other is true. In Maak's book, "Olekminski Okrug," I find many data which prove that the coldest winter as well as the lowest well-authenticated minima were observed at Werkhojansk, to the north-east of Yakutsk. The name of the author gives us some guarantee that the observations are trustworthy. I give below the minima at some places cited by Maak, and compare them with those observed in Central and Western Siberia, and the Arctic Archipelago of America:—

North-East Siberia

Serdze-Kamen.	67° N.	173° E.	(Nordenskjöld)	– 50·3 F.
Yakutsk	62° N.	130° E.	(Maak)	– 77·3 F.
Wiljuisk	64° N.	122° E.	(Maak)	– 76·3 F.
Werkhojansk	67½° N.	134° E.	(Maak)	– 81·0 F.

Central and West Siberia

Yenisseisk	58½° N.	92° E.		– 73·5 F.
Barnaul	53½° N.	84° E.		– 61·4 F

Arctic Archipelago

British Expeditions, 1875-76. { 83½° N. Floeberg Reach (Nares) – 73·7 F. / 81½° N. Discovery Bay (Nares) – 70·7 F.

The temperature at Werkhojansk is the lowest of all given here, and it must be borne in mind that the observations lasted but one year, while we have more than thirty-five years at Yakutsk, and eight and a half at Yenisseisk.

The mean temperatures are as follows :—

	Year	July	Nov.	Dec.	Jan.	Feb.	March
Serdze Kamen 1 yr.	—	—	2·1	– 9·0	–13·1	–13·2	– 6·9
Ustjansk 2 years	2·8	52·7	– 2·2	–33·0	–38·9	–36·9	–17·5
Werkhojansk 1 year	4·3	60·1	–29·2	–46·8	–55·5	–54·5	–29·0
Yakutsk 10 years [1]	12·2	66·5	–20·5	–41·9	–46·8	–37·7	– 0·0
Yakutsk 24 years [2]	12·4	63·3	–19·1	–37·8	–41·4	–30·8	– 8·7
Floeberg Beach 1 yr.	– 3·5	38·3	–16·8	–22·2	–33·0	–38·0	–39·8
Discovery Bay 1 yr.	– 4·2	37·2	–18·4	–24·5	–40·7	–35·0	–37·4

Though the observations were made only during one year at Werkhojansk, it is probable that it would have the coldest winter of all observed till now, as even at Yakutsk, which is the next coldest, January and February were in no single year colder than at Werkhojansk in 1869. From a comparison with the other stations of North-east Siberia it is probable that here in 1869 February was too cold and December too warm.

Now as to the reason why the winter should be colder in North-east Siberia than on the North American Archipelago farther to the north, it is to be found in the extent of the continent, the distance from any sea open in winter, and the prevailing calms. How important is the last reason is best seen by the comparison of the December and January temperatures of the last British expedition. The more northerly Floeberg Beach is warmer, because more exposed to winds. Now in Eastern Siberia calms prevail to a large extent in winter, except near the coast.

There is a phenomenon to be considered, which is noticed everywhere in winter in high latitudes : during calms with clear sky the valleys are colder than the surrounding hills and slopes, because the cold air sinks downwards and stagnates there. This is confined to the night where the mid-day sun rises high enough, but in high latitudes during some months the mid-day heat of the sun is too small and the day too short to interfere much with the equilibrium of the strata of air established during the night. Even in middle latitudes (45°–50°), when calms and clear weather prevail very largely in December, the valleys are regularly colder than the hills. So it was felt in December, 1879, in Central Europe. What is an exception here is the rule in North-East Siberia, because calms and clear sky are the rule in winter; the valleys are much colder than the hills. On this account the exceedingly low temperature of Werkhojansk in winter is probably not common to the whole surrounding country, and especially in the mountains rising to a short distance south we may expect a much higher temperature. The more we consider the conditions of the winter temperature of North-East Siberia, the more difficult it seems to draw isotherms. We know that plains and valleys there are colder than hills and mountain-slopes, but how much, and what conditions are most favourable to that so-called interversion of temperature? I consider it as highly probable that both at Yakutsk and at Werkhojansk the local topographical conditions are very favourable to winter cold. This being the case, it is quite natural that the latter place is colder in winter than the former, being situated 5° farther to the north, and yet far enough from the west to have a continental climate.

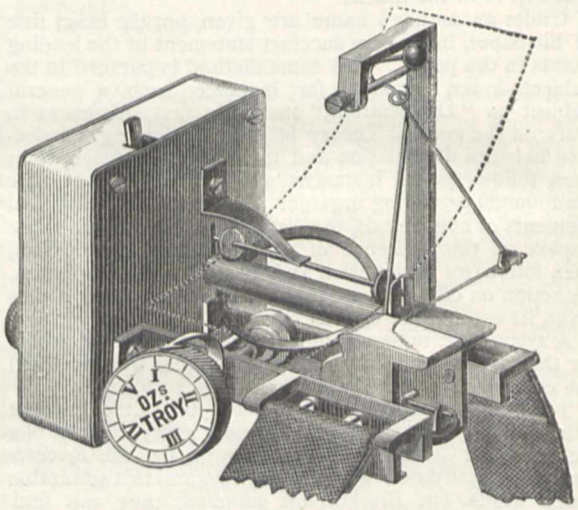
A. WOEIKOF

[1] According to Maak.
[2] Older series of Neverof (1829-54).

SPHYGMOGRAPHY

THE pulse has in all ages been held by physicians to be a valuable aid to the diagnosis of disease, but until the invention of the sphygmograph, or pulse-writer, the determination of the character of the pulse was left to the tutored tact of the doctor's finger, which varies much in delicacy of perception in different operators, and in the same practitioner at different times. At most the finger, even of the most experienced, can only detect, regarding the pulse, that it is soft or hard, quick or slow, jerky or languid, regular or irregular ; but the finger is incapable of analysing the beats, and detecting any departure from the normal standard of each of their component elements. The sphygmograph, which is quite a modern invention, causes the pulse to write its own autograph, enables us to see at a glance the peculiar characters of the pulse, and to ascertain how and where it differs from the healthy or normal pulse.

Hitherto, however, the sphygmograph has been but little used, for those that have been introduced are large and expensive instruments, requiring a great amount of skill and trouble to fix them on the arm and bring them into action ; and for these reasons they are not available for general or private practice. Hence their use has almost been confined to hospital practice; but even here



they are not always available, for Dr. B. Bramwell, who is a strong advocate for employing the sphygmograph, relates that a patient of his was so terrified by the proposal to employ the instrument that he preferred leaving the hospital to allowing it to be fixed on his arm.

The objections to the general use of the sphygmograph do not apply to the instrument recently introduced into medical practice by Dr. Dudgeon, and from its portability called "the pocket sphygmograph." Though this instrument is so small as to deserve the name of "pocket," it is not inferior in sensitiveness to the most elaborate and complicated of the cumbrous instruments hitherto in use, indeed in some respects it is greatly superior in accuracy to any that have yet appeared. Its size is 2½ by 2 inches ; its weight only four ounces. It magnifies the movements of the artery exactly fifty times. The spring that presses on the artery can be regulated to press with a weight of from one to five ounces, and the pressure can be altered at will while the instrument is *in situ*. It requires no wrist-rest ; all the other sphygmographs have to be used with wrist-rests of more or less complexity. It can be used with equal facility whether the patient is standing, sitting, or lying. With it an accurate and extremely distinct tracing of the pulse can be made almost as quickly as the pulse can be felt with the finger. Its

construction is so simple that if accidentally broken any watchmaker can repair it. The smoked paper on which the pulse is recorded runs through the instrument in ten seconds, so that the number of the beats per minute can be reckoned by multiplying the pulse-tracings on the paper by six. The patient's name, the date, the disease, the pressure of the spring, and some conventional sign to indicate his position when the tracing was made, may be written on the marked paper with any sharp-pointed instrument, such as a pin or a toothpick, and the whole permanently fixed by dipping the paper in some quickly-drying varnish, such as is used by photographers. In this way a series of pulse-tracings taken during the course of the disease may be preserved for future study and comparison.

Dr. Dudgeon's pocket sphygmograph is manufactured by Mr. John Ganter, 19, Crawford Street, W. The woodcut represents its actual size.

NOTES

WE understand that the fifth volume of the Catalogue of Birds in the British Museum will shortly be published. According to the classification followed in this work the families to be described will be the Thrushes and Warblers, and the volume will be written by Mr. Henry Seebohm, whose co-operation Dr. Günther has been fortunate in obtaining. Mr. Seebohm has devoted a close study of several years to these families of birds, and may now be considered the best living authority on the subject.

M. FLAMMARION, the author of several works in popular astronomy, has been made a Knight of the Légion d'Honneur. Admiral Mouchez, director of the Paris Observatory, has consented to act as his *parrain*, and to hand over to him the star and ribbon. This liberal determination has created some sensation in the French astronomical world. The work of transformation of the Observatory will begin very shortly, all the legal difficulties having been solved. The area of the establishment is now 30,000 square metres. The magnetical instruments will be placed in the deep trenches separating the old ground from the newly annexed buildings.

WE regret to have to announce the death of M. Eugène Cortambert, author of a number of geographical works, honorary president of the Geographical Society of Paris, and head of the geographical department in the National Library.

ABOUT a year ago Admiral Mouchez asked for a credit of 4000 francs per year in order to publish a monthly astronomical review. M. Jules Ferry refused the grant, but a similar review is now being published at Brussels under the name *Ciel et Terre*. It appears twice a month, and is devoted to meteorology and astronomy.

ALTHOUGH our Government has declared the interest which it takes in the forthcoming International Exhibition of Electricity at Paris, still it sees no necessity for appointing a Special Commissioner to take measures with regard to the participation of British subjects in the Exhibition which is to open in Paris on August 1 next in the Champs Elysées Palace. The French Government is nevertheless disposed to welcome all British subjects wishing to participate in the Exhibition. M. Berger, the Commissaire-Général, has placed himself unreservedly at the disposal of intending exhibitors to afford every information and assistance. He would be thankful if they would fill up and return to his address the printed form of demand of admission which accompanies the copy of the general regulations. English exhibitors will be placed in every respect on the same footing as French exhibitors. M. Berger will form a special section for the group of English exhibitors, and requests that all demands be forwarded within the briefest delay possible. The Exhibition rooms and dependencies will be considered as real Custom-house stores, so that all the articles sent there shall be exempt from the duties to which they would otherwise have been liable. The French railway companies have consented to an abatement of 50 per cent. on the ordinary rates of transport, whether by fast or by slow trains, for all packages or boxes forwarded to the Exhibition Hall, and bearing the official labels. The Postmaster-General has been authorised by the British Government to exhibit in the name of the latter.

A COMMITTEE has been formed at Dijon for erecting a statue to Carnot, the celebrated French geometer and politician, who was born in Nolay, a small country town of Burgundy, in 1753. The youngest son of Carnot is now living, one of the members of Senate, and his grandson is M. Sadi Carnot, the present Minister of Public Works. The other son of Carnot died fifty years ago, after having written a small essay, "Sur la Puissance motive du feu." M. Carnot's brother has just published a new edition of this work, with a number of essays, mostly unpublished, by the same author, and a history of his life.

AT the conclusion of the proceedings of the Quekett Microscopical Club on February 25 occasion was taken to present to Mr. J. E. Ingpen a memorial of the esteem in which he is held and the appreciation of his services as honorary secretary for the last eight years. After an able address by Dr. Matthews, setting forth the reasons which had led to this movement on the part of the members, and short speeches by Dr. Cobbold, Mr. Crisp, and Mr. Michael, Mr. T. C. White handed to Mr. Ingpen a beautifully illuminated and framed memorial, together with a valuable microscope by Zeiss and a handsome silver tea-service, which were accepted and acknowledged amidst hearty demonstrations of good feeling on the part of the meeting. The attendance of members was unusually large, and in the course of the evening telegrams were received from Dr. M. C. Cooke and Mr. Henry Lee, expressing their regret at unavoidable absence.

AT the ordinary meeting of the Meteorological Society, to be held at 25 Great George Street, Westminster, on Wednesday, the 16th inst., at 7 p.m., there will be an exhibition of instruments, consisting of various kinds of hygrometers and of such new instruments as have been brought out since January 1, 1880. During the evening the President will give a historical sketch of the different classes of hygrometers, and will also describe such forms as are exhibited.

THE town of Casamicciola, in the Island of Ischia, has been almost entirely destroyed by an earthquake. More than 200 houses have been thrown down, and many others are so much damaged as to be uninhabitable. The number of persons thus far ascertained to have been killed is 104, and very many more have been injured. The total number of victims is estimated at 300. This dreadful catastrophe was the result of two shocks—the first at half-past one in the afternoon of the 4th inst., lasting seven seconds; the second after an interval of an hour and a half. The whole upper part of the town has been destroyed. The handsome Albergo della Grande Sentinella is a mass of ruins. Clefts and fissures opened in the streets 50 centimetres in width. It was at first supposed that this disaster was connected with the partial eruption of Vesuvius on the 3rd inst., but Prof. Palmieri has stated that the seismographic instruments having given no indications, he is inclined to think the catastrophe is due to some local phenomenon, possibly to a sudden sinking of the ground through subterranean corrosion caused by the continual working of the mineral waters. Shortly before the first shock of earthquake the mineral springs were observed to be in a state of ebullition. Another shock was felt at midnight.

SHOCKS of earthquake occurred at St. Ivan-Zelina (Hungary) on February 26 at 3h. 54m., in the night of February 26-27 at

12h. 30m., and on February 27 at 5h. 28m. a.m. At Agram a rather severe shock was felt on February 25 at 3h. 45m., duration two seconds, direction west-south-west; and another at noon of March 4. Earthquakes are also reported from Kirchberg (Austria), on February 28, at 2h. 20m. a.m., duration two seconds, and from different parts of Switzeriand on March 3, *e.g.* Zürich and its environs, at 3h. 35m. a.m.; Aussersiehl, at 3h. 42m., direction west to east, duration two seconds; Riesbach, Selnau, Knonau, Aaran, Zofingen, Hunzenschwyl, Rapperschwyl, Glarus, Zug, Berne. The earthquake shock felt at Berne on Thursday morning last shortly after three o'clock was a very smart one. The area of disturbance was wide, extending as far as the Lakes of Geneva and Bienne.

MR. H. J. JOHNSON-LAVIS writes to us from Naples, under date March 2:—Vesuvius has to-day been covered with snow, and this evening, during a short interval between the mantling of clouds, a splendid stream of lava is pouring down the northern side and has reached the Atrio del Cavallo. The stream is very liquid and very abundant, and from this it may be concluded that its course will be progressive.

M. JULES FERRY has established a number of colleges for females in several parts of France; some of them have been already opened.

THE authorities of the British Museum will very soon issue their scheme for publishing the great catalogue of printed books. The projected issue, at the rate of five volumes a year, is not expected to be completed in less than forty years. The work, however, can of course proceed no faster than the Government grant of 1600*l.* a year for this special purpose will permit. Altogether the catalogue is likely to comprise about 3,000,000 titles, which to put in type will cost from 4*d.* to 6*d.* each. It has already been announced that the publication will commence with volumes specially devoted to certain subjects, or rather sub-headings, which have now become too voluminous for convenient handling in their present form. Meanwhile the Trustees have adopted the plan of printing and publishing the titles of all additions to the library. It may be interesting to know that in this case all titles are stereotyped on separate "plaques," and are therefore susceptible of any amount of re-arrangement.

AN important experiment in electric lighting is about to be made in the City. Hitherto the electric light has been used, as on the Thames Embankment and Waterloo Bridge, in conjunction with gas; but in the City the thoroughfares selected are to be lighted by electricity alone, which will be continued all night. The first district begins with Blackfriars Bridge, and extends along Bridge Street, Ludgate Hill, the north side of St. Paul's Churchyard, and down Cheapside as far as King Street. The distance is 1648 yards, and is to be lighted by the Brush system. At King Street the Siemens system will begin, and will extend along the rest of Cheapside, the Poultry, Mansion House Street, King William Street, and Adelaide Place, and across London Bridge. The same system will be extended down King Street, Queen Street, and Mansion House Street. The whole length of street covered by the Siemens light will be 1521 yards. Another district to the south of these will be lighted by the Jablochkoff lamps, like the Embankment. It will include Southwark Bridge, Queen Victoria Street, Queen Street Place, and part of Queen Street, a distance of 1703 yards. The experiment is to be continued for a year, at an outlay of about 8000*l.*

PROF. BLACKIE being unable to lecture through illness, Mr. Shelford Bidwell, M.A., LL.B., will give a discourse on Selenium and its Applications to the Photophone and Telephotography, at the Royal Institution, on Friday evening next March 11), at 9 p.m.

THE Calendar of the Mason Science College, Birmingham, is a volume of respectable size, but then it contains a full report of proceedings and addresses at the opening meeting. We are glad to see that a large number of new chairs are about to be added, including Greek, Latin, and modern languages; so that the College will shortly be as well equipped as that at Manchester. As the curriculum is being extended to include really literature, science, and art, might it not be well to drop the "science" from its designation? it looks so one-sided.

THE *Proceedings* of the last Congress of Russian Naturalists, which was held at St. Petersburg, have just appeared as a separate bulky volume.

A PAPER has been published by Gustav Hauser of Erlangen, on the organs of smell in insects, in which he describes several experiments. Numerous species of insects, on approaching vessels containing turpentine or acetic acid, showed—by retreating and moving their antennæ—a distinct perception of the smell. After the ends of the antennæ had been cut off, the same insects placed close to the vessels appeared quite insensible to it. A number of flies, which had been attracted by a piece of putrid meat, showed no inclination to approach it after the third segment of the antennæ had been cut off.

WE have received a pleasant report of the Queenwood College Mutual Improvement Society for the year ending Christmas, 1880. The Society seems to have a comprehensive programme.

UNDER the title of the *Northern Microscopist*, and under the editorship of George E. Davis, a monthly periodical has been started, beginning with January of this year, the chief aim of which is to keep a record of the proceedings of the chief microscopical societies in the North of England, and thereby to furnish each individual member of these societies with as much permanent information as such members would obtain if the society to which they belonged published its own Transactions. There ought to be abundant support for a little journal like this, and numerous subscribers ought to be obtained from large centres like Liverpool, Leeds, Chester, Bolton, Manchester, Nottingham, Newcastle-on-Tyne, and the like. If the various Northern societies were to do nothing more than prepare local lists of all the varied species of animal and vegetable life, which come under the well-known denomination of "microscopical forms," and if this journal were to be the medium of publishing these, it would become a journal of importance, one that would be constantly referred to; and it would in the meantime be doing a good work in advancing the study of the biological sciences. We wish it every success, and trust that it will steadily pursue the path that it has marked out for itself.

A STENOGRAPHIC piano has been experimented on by the daughter of the inventor, in the French Chamber of Deputies, the Senate, and to the Municipal Council of Paris, with great success. The system consists of a combination of signs through which every sound is represented. The reproduction is as rapid as speaking, and the same operator can continue the work for hours. The signs used in this system being printed by machinery, the reading is immediate, and can be made by other people than the operator. The State stenographers propose to be trained in the use of the instrument. It is an affair of a few months of practice.

A SCIENTIFIC society has been formed at Scarborough, called "Scarborough Scientific Society and Field Naturalists' Club." President-elect, Mr. J. Woodall, M.A.; Secretary, Mr. G. Massee.

THE excavations in the 9th region of Pompeii are being prosecuted with alacrity, and yield unexpected results. Besides a second mosaic fountain and valuable frescoes recently found,

there were excavated the other day some vases of Egyptian manufacture, which will greatly interest archæologists. They are made of a particular kind of paste, composed of white clay and glass, and are extremely brittle. All round they have high relief representations of the animals worshipped by the ancient Egyptians.

A PHONOGRAPH of a new construction will be tried in the New Polyglot Institute of Paris, for the purpose of teaching pupils the art of pronouncing correctly the difficult words of foreign languages.

A SCHOOL for clockmakers has been organised in Paris, and was inaugurated yesterday by a meeting at the Conservatoire des Arts et Métiers.

THE new part of the *Transactions* of the Asiatic Society of Japan contains a paper by Dr. Edkins on the influence of Chinese dialects on the Japanese pronunciation of the Chinese part of the Japanese language.

WE have received part 3 of the *Transactions* of the Epping Forest Club, containing the address of the president, Mr. Meldola, proceedings, and list of members.

WE have to acknowledge the receipt of a postal order for 2*s.* 6*d.* from "Bullphumpus" for the John Duncan Fund.

THE additions to the Zoological Society's Gardens during the past week include an Indian Leopard (*Felis pardus*) from India, presented by the Duke of Buckingham and Chandos; an Entellus Monkey (*Semnopithecus entellus*) from India, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Blue-fronted Amazon (*Chrysotis festiva*) from Brazil, deposited; four Indian Rat Snakes (*Ptyas mucosa*) from India, a Matamata Terrapin (*Chelys matamata*) from Upper Amazons, purchased; two Calandra Larks (*Melanocorypha calandra*), European, a Chinese Quail (*Coturnix chinensis*) from China, two Fire-tailed Finches (*Erythrura prasina*) from Java, received from Paris.

OUR ASTRONOMICAL COLUMN

THE SOLAR PARALLAX.—M. Faye has just communicated to the Academy of Sciences a paper on the actual state of our knowledge of the sun's parallax, of which we subjoin some particulars, without professing to regard his mean result as necessarily so definitive as he appears to view it himself.

M. Faye considers that there is no other scientific constant, the determination of which depends on an equal number of results completely independent of one another, and obtained by methods so totally different, and subdivides the various values assigned for the sun's mean parallax as follows:—

Geometrical methods, 8″·82	8″·85	by Mars (Cassini's method) ...	Newcomb.
	8·79	by Venus, 1769 (Halley's method)	Powalky.
	8·81	by Venus, 1874 ,, ,,	Tupman.
	8·87	by Flora (Galle's method)	Galle.
	8·79	by Juno ,, ,, ...	Lindsay.
Mechanical methods, 8″·83	8·81	by the lunar inequality (Laplace's method)	—
	8·85	by the monthly equation of the earth	Leverrier.
	8·83	by the perturbations of Venus and Mars	Leverrier.
Physical methods, 8″·81	8·799	Velocity of light (Fizeau's method)	Cornu.
	8·813	Velocity of light (Foucault's method)	Michelson.

With regard to the first value by "mechanical methods," M. Faye mentions that he has obtained it by adopting for the coefficient of the inequality 125″·2, the mean between the results of Sir George Airy from the Greenwich observations, and that of Prof. Newcomb, from the observations made at Washington, taking for the moon's mean parallax, 57′ 2″·7, and for her mass $\frac{1}{80{\cdot}8}$. Leverrier found the value 8″·95 from the said equation, which was reduced after correction by Mr. Stone for two small errors to 8″·85. The value from the perturbations of Venus and Mars assigned by Leverrier was 8″·86, but one of the numbers requiring a small correction, it is reduced to 8″·83. Michelson, after bringing to bear upon Foucault's method improvements which M. Faye says completely surmounted all difficulties, found for the velocity of light 299940 km., while Helmert altered Cornu's result to 299990 km. With Struve's constant of aberration the corresponding values for the solar parallax are 8″·799 and 8″·813, as above.

The general mean in which it may be considered that the errors of the individual results, obtained by so many methods, are to a great extent compensated is 8″·82, and to this value M. Faye, for reasons given, attributes a probable error of ± 0″·016. The mean value by the physical methods is 8″·806, and by astronomical methods 8″·825. He then considers which of these values is the more reliable, and states that he does not hesitate in giving the preference to the physical result, and arrives at the conclusions:—

1. That the method of the physicists is superior to all others, and ought to be substituted.

2. That the value of solar parallax, 8″·813 (by physical methods), is now determined to about $\frac{1}{100}$ of a second.

3. That the seven astronomical methods of procedure converge more and more towards that value, and tend to confirm it without equalling it in precision.

M. Faye adds that he has no idea of attempting to diminish the importance of the observation of the approaching transit of Venus: but as Leverrier pointed out, "il faut que les efforts des astronomes aient pour but d'obtenir une précision toute nouvelle dans leur prochaines expéditions." Without neglecting the contacts, he considers it will be desirable to employ to a greater extent than was done in 1874 "les procédés si puissants de la photographie," to which, be it observed, M. Faye from his own experiences drew attention a quarter of a century back. He thinks it will be very surprising if that admirable method of procedure, which has already succeeded so well in measuring delicate stellar groups, should fail for the transit of Venus, or under circumstances more favourable for its application. The value 8″·813 for the sun's parallax, which appears to him definitive, is in accordance with that adopted by Laplace in the *Mécanique céleste*, 27·2 centesimal seconds or 8″·812.

SWIFT'S COMET, 1880 *e*.—Mr. Winslow Upton of the Naval Observatory at Washington, sends us elements of this comet, which, as he remarks, afford a further confirmation of the 5½-years' period already assumed. He employed two observations made with the meridian circle of the Washington Observatory on October 25 and November 23, and one with the 26-inch equatorial on December 22. The elements are as follow:—

Epoch 1880, October 25·5 M.T. at Washington.

Mean anomaly	357°	48′	49″·3	
Perihelion from node	106	18	13·8	M. Eq. 1880·0
Ascending node	296	41	55·4	
Inclination	5	31	3·5	
Angle of eccentricity	42	31	39·7	
Log. semi-axis major	0·518438			

The corresponding period is 2189 days, or a little less than six years. The middle place is represented within the small errors of − 1″·2 in longitude and − 0″·6 in latitude.

PHYSICAL NOTES

MR. T. C. MENDENHALL of Japan has measured with a so-called "invariable pendulum" the acceleration of gravity at the top of the extinct volcano Fujiyama, which plays so prominent a part in the mythology and in the art of Japan. The value found for the summit of the mountain was $g = 9{\cdot}7886$, whereas at Tokio the value was found to be 9·7984. The average barometric pressure at the summit was 19·5 inches, the mountain itself being an almost perfectly symmetrical cone of vertical angle 138°, and of a height of 2·35 miles. It rises alone out of a plain of considerable extent, and appears to be composed of a uniform rock of porous nature. Tradition states that the mountain was thrown up in a single night in the year B.C. 286. The density of the rock in the lump was 1·75, but when reduced to powder the density was 2·5; competent geologists conclude the mean density of the mountain mass to be 2·12. Assuming the mountain to be a cone of semi-vertical angle of 69°, and density 2·12, Mr. Mendenhall calculated its attraction upon a particle

placed at the vertex, and comparing it with his result, deduced for the mean density of the earth the value $D = 5{\cdot}77$. If however the accepted density of the earth as determined by Bailly at 5·67 be adopted, it follows that the mean density of Fujiyama is only 2·08.

A CAPITAL summary of the recent thermochemical investigations of Julius Thomsen appears in the current number of the *Am. Journ. Sci.* from the pen of Prof. Josiah P. Cooke (of Cambridge, Mass.). The peculiar significance of these researches in their bearing upon the problems of molecular structure in general and upon the supposed ring-structure of the benzene molecule in particular, is pointed out in a clear and emphatic manner.

M. ROSENSTIEHL has freshly determined the tints corresponding to the three primary colour-sensations, on the principle of rotating disks originally devised by Clerk-Maxwell. Constructing a disk with seventy-two sectors of gradating tints of as nearly equal saturation as could be judged of by the eye, he found that a sensation of red more powerful than any single red tint could be compounded from blue, violet, red, orange, and orange-yellow, with a maximum intensity in the orange. Similarly a sensation of green more powerful than the brightest green tint, could be compounded out of a set of tints having a greenish-yellow for their maximum point, and the sensation of blue culminated in a tint named "third blue" by M. Rosenstiehl. Hence M. Rosenstiehl proposes to accept as the primary-sensation tints of the Young-Helmholtz theory the orange, the yellow-green, and the ("third") blue tints, in which the three sensations of red, green, and blue find their respective maxima; further arguments on this point are promised shortly by M. Rosenstiehl.

ACCORDING to Wiedemann Swedish filter-paper, pyroxylised by steeping in mixed strong nitric and sulphuric acids, forms an excellent source for electricity by friction. Prof. Guthrie's films of collodion and gutta-percha, in five or six alternate layers, realise the same end, namely that of utilising for the generation of electricity the most powerfully *negative* electric known pyroxylin.

DURING a hailstorm in Geneva on January 19 Prof. Colladon observed the hailstones as they fell to repel each other mutually and to bound about after lying quiet for a moment or two on the ground exactly after the fashion of the pith balls in Newton's well-known experiment of the *electric hail*. The observation would appear to have a bearing on Volta's somewhat neglected theory of the formation of hail.

COMMANDER O. J. SHERMAN has taken some observations of deep-sea temperatures during the summer of 1880 on the Arctic steamer *Gulnare*, when becalmed at about lat. 61° N., long. 56° W., at a point where a branch of the warm Gulf Stream current is represented on the maps as being overlapped by an Arctic current whose direction is to the eastward coast of Greenland. The temperatures at the surface being in two observations respectively 41°·9 (F.) and 45°·0, those at the depth of sixty fathoms were found to be 39°·0 and 40°·0 respectively. At 150 fathoms a temperature of 38°·2 was observed, but at lower depths the temperature was again higher, reaching 40°·8 at 300 fathoms.

M. PAUL SÉGUY, whose experience as a constructor of vacuum-tubes is very great, gives the following results of observation upon the effect of cold upon the discharge through exhausted tubes. A tube cooled (naturally by being placed in a cold room) exhibits increased resistance, sometimes double its usual resistance, and may even require to be warmed at the fire or over a spirit-lamp to bring it to its usual working condition. But then the tube does not at once recover itself, but only gradually as the passage of the spark liberates heat and warms the glass and the electrodes. This experiment is best shown with a long thin tube and with a feeble induction-coil. With Crookes's high-vacua tubes the effects of heat are more pronounced, and can be readily observed by arranging a discharger in a branch circuit, the spark leaping between the poles of the discharger when the air-resistance is less than that of the tube. A cooled Crookes's tube does not transmit a spark equivalent to a 3-centimetre spark in air; but when warmed, the "radiant" effects appear to give place in turn to ordinary stratified discharges as the temperature rises. The inverse order of phenomena should take place on cooling, but does not if care has not been taken in the construction of the tube to expel residual occluded gases from the aluminium electrodes by heating them during the exhaustion. The effects of extreme artificial cold upon vacuum-tubes was not tried by M. Séguy. In conclusion M. Séguy asserts the existence of a curious phenomenon, namely, that in a tube used frequently and for a long time, the vacuum may grow more perfect, so as at last to be almost absolute. M. Séguy attributes this effect to the gradual occlusion by the electrodes of the residual gases.

IT has been proved by Herren Strouhal and Barus (*Wied. Ann.*, No. 13, 1880), from experiments in which steel wire was treated so as to show all degrees of hardness between the glass-hard and annealed states, that the thermo-electric and galvanic properties of steel vary with the degree of hardness in a very sensitive manner. Their researches throw some useful light on the nature of the annealing process and on the magnetic behaviour of steel in relation to its hardness and other properties.

HERR HOLTZ has been able (*Wied. Ann.*, i. 1881) to measure the modulus of elasticity of rods of carbon used for the electric light (Carré's, of Paris) by the acoustical method; the rod being held in the middle with two fingers, and stroked lengthwise with two other fingers on which colophonium has been rubbed. The modulus increases with the density, which is, as a rule, greater in the thinner rods. The tone of thin rods alters a good deal, on repeated rubbing, through heat being generated. On an average the modulus is equal to that of lead. As to the proved increase of electric conductivity of carbon rods with rise of temperature, Siemens has tried to account for it by supposing allotropic modification (as is probably the case with selenium); Herr Holtz, however, shows that pyrolusite, a metallic oxide, behaves similarly, but such an explanation would not here apply. Nor does pyrolusite conduct as an electrolyte; there is no polarisation. For carbon Herr Holtz adheres to his hypothesis (of closer pressure of molecules caused by heat, improving the conduction), in default of a better.

A CENTIGRADE photometer devised by S. Coglievina is described in the *Rivista Sci. Ind.* for January 31. He seeks to remedy the imperfections of ordinary methods by substituting for a single source of light, defined by the substance of the combustible or its hourly consumption, a flame of variable size, which can be reduced to a particular degree of illuminating force. He means to apply the same principle to the electric and other light sources.

AN interesting phenomenon of polarisation of light was observed by Herr Sörrensen in the recent cold weather (*Naturf.*, No. 9). Some of the ice on a window-pane had melted, the water forming a small pool at the bottom. In this pool various bright and beautiful colours appeared; on looking closer they were seen to be only in the grotesque images of frost flowers on the lower part of the window, reflected in the water. The reflecting water surface was here the analyser, while the thin ice crystals, varying according to position and thickness in the ice flowers, played the part of polychromatic gypsum and mica plates. To find the polariser Herr Sörrensen took a Nicol prism, and observed that the daylight itself was strongly polarised; and this he accounts for by the presence of a light mist of ice particles reflecting the sunlight. The temperature outside was about − 12°.

WITH reference to the physical conditions of heavenly bodies Herr Lohse (*Wied. Ann.* 1) has experimentally studied the phenomena of glow on various metallic electrodes (magnesium, zinc, iron, cadmium, copper, &c.) in a hydrogen atmosphere of varying pressure. Quantitative data as to the relation of vapour formation to the density of the gas are furnished; and it is proved, *inter alia*, that with progressive rarefaction of hydrogen the luminous power of metallic vapours in the more refrangible parts of the spectrum increases (a sign of exalted temperature).

M. PELLAT gives, in the *Journal de Physique* (February), results of an inquiry into the apparent difference of potential of two metals in contact. This difference he finds to depend essentially on the nature of their superficial layer, and to vary (sometimes considerably) with chemical or simply physical changes of the surface. When an inert gas surrounding the metals is rarefied, the apparent difference of potential increases, and it recovers its former value on the pressure being restored. Further, the said difference has the same value as the electromotive force of a battery element formed by alcohol and the same metals (not yet altered).

DR. PULUJ has made the following experiment to prove his suggestion that radiant matter consists of electrode particles

pulled off by the action of electricity. The cathode of a vacuum-tube was covered with chalk. It exhibits phosphorescence of orange-yellow colour, while in a short time the tube-wall becomes covered by a very delicate layer of chalk, without losing its clearness and transparency, and phosphoresces like chalk. Puluj believes that the yellow-coloured phosphorescence observed on metallic cathodes is caused by the phosphorescence of the oxides covering the metal.

GEOGRAPHICAL NOTES

AT its annual meeting the Russian Geographical Society elected as vice-president M. Semenoff, and Baron Osten-Secken as his "aid." The great Constantine medals were awarded to M. Moushketoff, for his geological researches in Central Asia, and to M. Yanson, for his remarkable work on "Comparative Statistics of Russia," the two first volumes of which have already appeared; the Lütke gold medal was awarded to Baron Kaulbars for his papers on the Lowlands of the Amu-daria; the two great gold medals instituted last year for ethnographical and statistical researches were awarded to Dr. Pyasetzky for his work, "Travels to China during the Years 1875-77," and to M. Roussoff for his statistical description of the Nyejin district. Small gold medals were awarded to M. Nordkvist, who took part in Nordenskjöld's expedition; to M. Potanin for his travels in Mongolia; to M. Tyaghin, for meteorological observations on Novaya Zemlya, and to M. Maïnoff for anthropological explorations among the Mordovians. Silver medals were awarded to Mme. Treskina and to MM. Andrianoff, Unterberger, Polonsky, Orloff, Skassi, Karatin, Zinovieff, Krasovsky, and Mikhalenko.

WE learn from the last number of the *Izvestia* of the Russian Geographical Society that the Society sends this spring M. Polyakoff with an assistant for the exploration of Sakhalin Island. M. Polyakoff will start from Odessa, on board of a Russian ship, and proceed to Sakhalin, where he will stay during a year; thence he will go to the Mantchurian shore of the Pacific for further explorations.

THE explorer Begaert has arrived at Lisbon. He was sent by the King of the Belgians to make scientific researches on the route of Mr. Stanley at Vivi and other parts of Zaire.

WE are glad to learn that the U.S. Congress have decided to appropriate 175,000 dollars to send out an expedition in a whaling vessel in search of the missing steamer *Jeannette*, which was sent out in 1879 by Mr. Gordon-Bennett to carry on Arctic exploration by way of Behring Strait. The initiative in this matter is due to Chief-Justice Daly, President of the American Geographical Society.

IN addition to two papers descriptive of the visits of Mr. Leigh Smith to Franz-Josef Land and Mr. Delmar Morgan to Kuldja, the new number of the Geographical Society's *Proceedings* gives Mr. F. C. Selous' notes on some of his many journeys in South Central Africa, those dealt with here being to the north of the Zambesi between the 27th and 29th meridians, and in the neighbourhood of the River Chobe which empties into the great river above the Victoria Falls. We gave last week the text of the interesting note on Col. Prejevalsky, in addition to which we may refer to the record of some altitudes recently determined in Matabele Land, and a note of Dr. Otto Finsch's explorations in Polynesia. The maps this month are of the South Coast of Franz-Josef Land and the Central Zambesi region.

WE observe that M. Henri Duveyrier's interesting observations on the question of the sources of the Niger appear in the last (December) number of the French Geographical Society's *Bulletin*, but we regret to find that they are published without a map.

IN last week's issue of *Les Missions Catholiques* Mgr. Lavigerie, Archbishop of Algiers, commences an account of the missions of Equatorial Africa, with the direction of which he has been charged. There is also a letter from Père Antonin de Reschio in Brazil, in which will be found some notes on curious traditions among the Indians.

MARQUIS ANTINORI and the other members of the Italian expedition to Shoa are expected shortly at Zeila. It is also stated that Signor Libman, an Italian traveller, has gone to Assab in order to make an attempt to open commercial relations with the interior and to survey some of the little-known regions in the neighbourhood. Signor Giuletti, who accompanied the Italian official representative to Assab in January, is charged by the Italian Geographical Society to undertake a journey through the country of the Danakil and Adel tribes, and to study the best means for opening a trade-route between Assab and Abyssinia. His mission has considerable geographical importance, as the region to be traversed is unknown, and he will have an opportunity of solving the problem of the River Gualima, which probably he found to empty into some lake in the interior, as the Hanash does, if indeed it be not part of the latter river-system.

CAPT. NEVES FERREIRA, Governor of Benguela, and other Portuguese officers, have placed their services at the disposal of the Lisbon Geographical Society for a scientific expedition across Africa, to start from the West Coast.

THE *Sydney Morning Herald* of January 17 publishes a telegram from their Queensland correspondent as follows, dated January 14:—"Skuthorpe arrived two days ago from his exploring trip out west. He reports having travelled 200 miles inside the South Australian boundary, and in the Herbert River discovered relics of Leichhardt, consisting of his diary and Classen's diary; also a telescope with presentation engraving, compasses, and other things. These, he alleges, are in two packs which he has brought with him. The diary of Classen is to the effect that he left Leichhardt at the Saltwater Creek while he searched for water, and that on his returning he found the party dead, and then joined the blacks, with whom he lived until three years ago. Skuthorpe will not allow any one to inspect the alleged relics, and here it is considered doubtful whether they are genuine."

INTELLIGENCE has been received at the Foreign Office from Her Majesty's Consul at Mozambique, which confirms the report of the deaths of Capt. Phipson-Wybrants and Messrs. Carr and Mears, of the Wybrants' expedition. Mr. Mayes is stated to be at Umzeilas, and Mr. Owen to have left with the remainder for Inhambane, whither Her Majesty's ship *Ruby* will proceed forthwith.

ON THE VISCOSITY OF GASES AT HIGH EXHAUSTIONS[1]

II.

INFLUENCE of Aqueous Vapour on the Viscosity of Air.—In the foregoing experiments many discrepancies were traced to the presence of moisture in the gas. The influence of aqueous vapour does not appear to be great when present in moderate amount in gas of normal density, but at high exhaustions it introduces errors which interfere with the uniformity of the results. A series of experiments were accordingly undertaken to trace the special action of aqueous vapour when mixed with air.

Up to a pressure of about 350 millims. the presence of aqueous vapour has little or no influence on the viscosity of air. The two curves are in fact superimposed. At this point, however, divergence commences, and the curve rapidly bends over, the viscosity falling from 0·0903 to 0·0500 between 50 and 7 millims. pressure. Here it joins the hydrogen curve, and between 7 millims. and 1 millim. they appear to be identical.

These results are partly to be explained by the peculiar action of water vapour in the apparatus. At the normal pressure the amount of aqueous vapour present in the air, supposing it to be saturated, is only about thirteen parts in a million, and the identity of the log dec. with that of dry air shows that this small quantity of water has no appreciable action on the viscosity. When the pump is set to work the air is gradually removed, whilst the aqueous vapour is kept supplied from the reservoir of liquid. As the exhaustion approaches the tension of aqueous vapour, evaporation goes on at a greater rate, and the vapour displaces the air with increasing rapidity; until, after the pressure of 12·7 millims. is passed, the aqueous vapour acts as a gas, and, being constantly supplied from the reservoir of water (as long as it lasts), washes out all the air from the apparatus, the log dec. rapidly sinking to that of pure water gas.

This explanation requires that the viscosity of pure aqueous vapour should be the same as that of hydrogen, at all events between 7 millims. and 1 millim. pressure. The facts can, however, be explained in another way. During the action of the Sprengel pump sufficient electricity is sometimes generated to render the fall tubes luminous in the dark. It is conceivable

[1] Abstract of a paper read before the Royal Society, February 17, 1881. by William Crookes, F.R.S. Continued from p. 423.

that under such electrical influence the falling mercury may be able to decompose aqueous vapour at these high exhaustions, with formation of oxide of mercury and liberation of hydrogen. Of these two theories the latter appears to be the more probable.

The presence of water vapour shows itself likewise in the very slight amount of repulsion produced by radiation. Repulsion commences in air at a pressure of 12 millims., whilst at a higher exhaustion the maximum effect rises to over 40 divisions. Here, however, repulsion does not begin till the exhaustion is higher than the barometer gauge will indicate, whilst the maximum action after long-continued pumping is only 9 divisions.

Viscosity of Kerosoline Vapour.—The rapid diminution of viscosity in the last experiment after reaching the pressure of 400 millims., is probably due to the aqueous vapour in the air being near its liquefying point. It was thought advisable to test this hypothesis by employing a somewhat less easily condensible vapour, which could be introduced into the apparatus without any admixture of air. An experiment was accordingly tried with a very volatile hydrocarbon, commercially known as Kerosoline, boiling at a little above the ordinary temperature. The vapour of this body was introduced into the well-exhausted apparatus, when the gauge at once sank 82·5 millims. After the usual precautions to eliminate air a series of observations were taken.

The loss of viscosity is more rapid than with any other gas examined except aqueous vapour. Conversely a very great increase of viscosity occurs on increasing the pressure from 8 to 82·5 millims. The explanation of this is that the vapour of kerosoline is very near its liquefying point, and therefore very far from the state of a "perfect" gas.

The negative bend in the curve at about 10 millims. pressure, already noticed with other gases, is strongly marked with this hydrocarbon vapour.

Discussion of Results.—When discussing the viscosity results obtained with the different gases experimented with, the author gives the following approximate comparison of viscosities, such as is afforded by a comparison of the log decs. of each gas and that of air, comparing the ratio with that obtained by Graham, Kundt and Warburg, and Maxwell.

	Graham.	Kundt & Warburg.	Maxwell.	Crookes.
Air	1·0000	1·0000	1·0000	1·0000
Oxygen	1·1099	—	—	1·1185
Nitrogen	0·971	—	—	0·9715
Carbonic oxide... ...	0·971	—	—	0·9715
Carbonic anhydride ..	0·807	0·806	0·859	0·9201
Hydrogen	0·4855	0·488	0·5156	0·4439

Graham's numbers are the theoretical results deduced from his experiments on transpiration of gases. They are, he says,[1] the numbers to which the transpiration times of the gases approximate, and in which they have their limit. Graham concludes that the "times of oxygen, nitrogen, carbonic oxide, and air are directly as their densities, or equal *weights* of these gases pass in equal times. Hydrogen passes in half the time of nitrogen, or twice as rapidly for equal volumes. The result for carbonic acid appears at first anomalous. It is that the transpiration time of this gas is inversely proportional to its density when compared with oxygen."

The proportion between air and oxygen, nitrogen, or carbonic oxide is not very different at any degree of exhaustion to that which it is at 760 millims. Carbonic anhydride, however, is different; the proportion between it and air holds good between 760 and 650 millims. Then it gets lower and lower as the pressure sinks, until 50 or 55 millims is reached, when the proportion between it and air again becomes constant.

Hydrogen, however, is entirely different to the other gases; its log dec. remains the same to a very high exhaustion, and, that of other gases sinking, it is evident that the proportion between this gas and any other is different for each pressure.

It must not be forgotten that the pressure of 760 millims. is not one of the constants of Nature, but is a purely arbitrary one, selected for our own convenience when working near the level of the sea. In the diagrams accompanying his R.S. paper the author has started from this pressure of 760 millims., and has given the log dec. curves which approximately represent the viscosities through a wide range of exhaustion. But the curves might also be continued, working downwards instead of upwards. From the shape and direction in which they cut the 760 line, it is reasonable to infer their further progress downwards, and we may assume that an easily liquefiable gas will show a more rapid increase in viscosity than one which is difficult to liquefy by pressure. For instance, hydrogen, the least condensible of all gases, shows scarcely any tendency to increase in log dec by pressure. Oxygen and nitrogen, which are only a little less difficult to condense than hydrogen, show a slight increase in log dec. Carbonic anhydride, which liquefies at a pressure of 56 atmospheres at 15° C., increases so rapidly in log dec. that at this pressure it would have a log dec. of about 1·3, representing an amount of resistance to motion that it is difficult to conceive anything of the nature of gas being capable of exerting.

Kerosoline vapour is rendered liquid by pressure much more readily than carbonic anhydride. Its curve shows a great increase in density for a very slight access of pressure.

Again, aqueous vapour is condensible to the liquid form with the greatest readiness; and the almost horizontal direction of the curve representing aqueous vapour mixed with air carries out the hypothesis.

It follows, then, that Maxwell's law holds good for perfect gases. The disturbing influence spoken of in the commencement of this paper as occasioning a variation from Maxwell's law, is the tendency to liquefaction, which prevents us from speaking of any gas as "perfect," and which hinders it from obeying Boyle and Mariotte's law. The nearer a gas obeys this law the more closely does it conform to Maxwell's law.

Maxwell's law was discovered as the consequence of a mathematical theory. It presupposes the existence of gas in a "perfect" state—a state practically unknown to physicists, although hydrogen gas very nearly approaches that state. An ordinary gas may be said to be bounded, as regards its physical state, on the one side by the sub-gaseous or liquid condition, and on the other side by the ultra-gaseous condition. A gas assumes the former state when condensed by pressure or cold, and it changes to the latter state when highly rarefied. Before actually assuming either of these states there is a kind of foreshadowing of change, with partial loss of gaseity. When the molecules, by pressure or cold, are made to approach each other more closely, they begin to enter the sphere of each other's attraction, and therefore the amount of pressure or cold necessary to produce a certain density is less than the theoretical amount by the internal attraction exerted on each other by the molecules. The nearer the gas approaches the point of liquefaction the greater is the attraction of one molecule to another, and the amount of pressure required to produce any given density will be proportionally less than that theoretically required by a "perfect" gas.

A noteworthy point in connection with the elasticity of glass is observed on the curves of viscosity. They are not continued beyond the 0·02 M exhaustion, but the general form of the curves indicates that, if they were produced beyond the limits of the observations, they would cut the line representing the absolute vacuum. The curve representing the repulsion accompanying radiation evidently goes up to the zero point, showing that at an absolute vacuum there would be no repulsion. The curves of viscosity cannot, however, be supposed to end at the zero point without a sudden change in direction. They evidently touch the top line of zero pressure long before the log dec. of 0·00 is reached. This means that in an absolute vacuum there would still be a measurable amount of viscosity. This is probably due to the viscosity of the glass torsion fibre, for it has been ascertained that glass is not perfectly elastic, but will take a permanent *set* if kept under constraint for a considerable time.

The author gives an instance which has come under his own notice. In 1862 he purchased a piece of glass lace, and some spun glass from which the lace was made. The spun glass is in long straight threads, about 0·001 inch diameter, and has occasionally been used for torsion fibres. The fibres of which the lace was made were originally straight, but the twists and bends in which they have been kept for eighteen years have permanently altered their direction, and on dissecting a portion of the lace the component fibres remain distorted and bent, even when free to resume their original shape.

Were glass perfectly elastic the log dec in an absolute vacuum would probably be equal to *zero:* there would then be no diminution in the arc of vibration, and the torsion fibre once set swinging would go on for ever.

The Ultra-Gaseous State of Matter.—A consideration of the curves of viscosity of the gases, especially hydrogen, which are

[1] *Loc. cit.* pp. 178, 179.

given in the foregoing pages, confirms the supposition that a gas, as the exhaustions become extreme, gradually loses its gaseous characteristics, and passes to what the author has ventured to call an ultra-gaseous state. Certainly it ceases to possess many of the properties usually held to be the essential attributes of gaseity.

For instance, Maxwell's law that the viscosity of a gas is independent of pressure holds good to a certain point, and then it rapidly breaks down. All gases appear to obey Maxwell's law between some limits of exhaustion, and diverge from it at others. Thus the nearly perfect gas hydrogen shows signs of increasing in viscosity as the pressure approaches 760 millims., and it is very improbable that its viscosity would remain the same if the pressure were to be considerably increased. Between 5 and 35 millims. the respective viscosities of carbonic anhydride, carbonic oxide, nitrogen, oxygen, and air scarcely vary at all, showing that between these limits they are practically as "perfect" gases as hydrogen is throughout the whole barometric range from 760 millims. to 1 millim., and here therefore they obey Maxwell's law as perfectly as hydrogen does. The change to the ultra-gaseous state commences to be assumed at about an exhaustion of half a millim. In hydrogen the change then proceeds slowly, but in the less perfect gases experimented with, the change to ultra-gas takes place with greater rapidity.

In gases, variation of pressure in different parts of a closed vessel equalises itself with great rapidity, but in the ultra-gaseous state differences of pressure may exist for twenty minutes or more in different parts of the apparatus.

In gases, electrically charged bodies do not permanently retain their charge, but gradually discharge themselves. In ultra-gas, however, a pair of electrified gold leaves have remained repelled at absolutely the same angle for thirteen months.[1]

Another property of gases is that of facilitating the cooling of bodies immersed in them, by communicating an increase of motion to the molecules of the gas which carry it to the walls of the containing vessel,—*i.e.* by *carriage* instead of *convection*. There is little difference in the rate of cooling with increased exhaustion, so long as we work with such ordinary good vacua as can be obtained by air-pumps. For if, on the one hand, there are fewer molecules impinging on the warm body (which is averse to the carriage of heat), yet, on the other hand, the mean length of path between collisions is increased so that the augmented motion is carried farther; the number of steps by which the temperature passes from the warmer to the cooler body is diminished, but the value of each step is correspondingly increased. Hence the difference of velocity before and after impact may make up for the diminution in the number of molecules impinging.

In gases, therefore, the rate of cooling is little affected by rarefaction, the law in this case being analogous to that governing the viscosity.

In a paper which the author has recently read before the Royal Society,[2] he shows that when the exhaustion is carried to so high a point that the mean free path is comparable with the diameter of the containing vessel, the rate at which heat is conveyed across is much diminished. The molecules are now in the ultra-gaseous state, and further exhaustion produces a notable fall in the rate of cooling, an increase of exhaustion from 20 M to 2 M retarding the carriage of heat more than all the previous exhaustion from 760 millims. to 20 M.

The author has shown elsewhere[3] that the property of gaseity is pre-eminently a property dependent on collisions. A given space full of air at the ordinary pressure contains millions of millions of molecules rapidly moving in all directions, each molecule momentarily encountering millions of other molecules in a second. In such a case the length of the mean free path of the molecules is exceedingly small compared with the dimensions of the containing vessel, and those properties are observed which constitute the ordinary gaseous state of matter—properties which depend upon constant collisions.

The gaseous state continues so long as the collisions are almost infinite in number, and of inconceivable irregularity. But in such high vacua as are now described the free path of the molecules is made so long that the hits in a given time may be disregarded in comparison to the misses, and the average molecule is allowed to obey its own motions or laws without interference; and when the mean free path is comparable to the dimensions of the containing vessel, the properties which constitute gaseity are reduced to a minimum, and the matter then becomes exalted to an ultra-gaseous state.

In the ultra-gaseous state properties of matter which exist even in the gaseous state are shown *directly*, whereas in the state of gas they are only shown *indirectly*, by viscosity and so forth.

The ordinary laws of gases are a simplification of the effects arising from the properties of matter in the ultra-gaseous state; such a simplification is only permissible when the mean length of path is small compared with the dimensions of the vessel. For the sake of simplicity we make abstraction of the individual molecules, and feign to our imagination *continuous* matter of which the fundamental properties—such as pressure varying as the density, and so forth—are ascertained by experiment. A gas is nothing more than an assemblage of molecules contemplated from a simplified point of view. When we deal with phenomena in which we are obliged to individually contemplate molecules, we must not speak of the assemblage as *gas*.

An objection has been raised touching the existence of ultra-gaseous matter in highly-exhausted electrical tubes, that the special phenomena of radiation and phosphorescence which the author has considered characteristic of this form of matter can be made to occur at much lower pressures than that which exhibits the maximum effects. For the sake of argument let us assume that the state of ultra-gas with its associated phenomena is at the maximum at a millionth of an atmosphere. Here the mean free path is about 4 inches long, sufficient to strike across the exhausted tube. But it has been shown by many experimentalists that at exhaustions so low that the contents of the tube are certainly not in the ultra-gaseous state, the phenomena of phosphorescence can be observed. This circumstance had not escaped the author's notice. In his first paper on the "Illumination of Lines of Molecular Pressure and the Trajectory of Molecules"[1] the author drew attention to the fact that a molecular ray producing green phosphorescence can be projected 102 millimetres from the negative pole when the pressure is as high as 0·324 millim. or 427 M. In this case the mean free path of the molecules is 0·23 millim.; and it is not surprising that with more powerful induction discharges, and with special appliances for exalting the faint action to be detected, the above-named phenomena can be produced at still higher pressures.

It must be remembered that we know nothing of the *absolute* length of the free path or the *absolute* velocity of a molecule; these may vary almost from zero to infinity. We must limit ourselves to the *mean* free path and the *mean* velocity, and all that these experiments show is that a few molecules can travel more than a hundred times the *mean* free path, and with perhaps a corresponding increase over the *mean* velocity, before they are stopped by collisions. With weak electrical power the special phosphorogenic action of these few molecules is too faint to be noticed; but by intensifying the discharge the action of the molecules can be so increased as to render their presence visible. It is also probable that the absolute velocity of the molecules is increased so as to make the mean velocity with which they leave the negative pole greater than that of ordinary gaseous molecules. This being the case, they will not easily be stopped or deflected by collisions, but will drive through obstacles and so travel to a greater distance.

If this view is correct, it does not follow that gas and ultra gas can co-exist in the same vessel. All that can be legitimately inferred is, that the two states insensibly merge one into the other, so that at an intermediate point we can by appropriate means exalt either the phenomena due to gas or to ultra gas. The same thing occurs between the states of solid and liquid and liquid and gas. Tresca's experiments on the flow of solids prove that lead and even iron, at the common temperature, possess properties which strictly appertain to liquids, whilst Andrews has shown that liquid and gas may be made to merge gradually one into the other, so that at an intermediate point the substance partakes of the properties of both states.

Note on the Reduction of Mr. Crookes's Experiments on the Decrement of the Arc of Vibration of a Mica Plate oscillating within a Bulb containing more or less Rarefied Gas[2]

THE determination of the motion of the gas within the bulb, which would theoretically lead to a determination of the coefficient of viscosity of the gas, forms a mathematical problem

[1] *Proceedings* of the R. S., No. 193, 1879, p. 347.
[2] *Proc.* R. S., No. 208, 1880, p. 239.
[3] *Proc.* R. S., No. 205, 1880, p 469.

[1] *Phil. Trans.* part 1, 1879, the Bakerian Lecture.
[2] Abstract of a paper read before the Royal Society, February 17, by Prof. G. G. Stokes, Sec.R.S.

of hopeless difficulty. Nevertheless we are able, by attending to the condition of similarity of the motion in different cases, to compare the viscosities of the different gases for as many groups of corresponding pressures as we please. Setting aside certain minute corrections which would have vanished altogether had the moment of inertia of the vibrating body been sufficient to make the time of vibration sensibly independent of the gas, as was approximately the case, the condition of similarity is that the densities shall be as the log decrements of the arc of vibration, and the conclusion from theory is that when that condition is satisfied, then the viscosities are in the same ratio. Pressures which satisfy the condition of similarity are said to "correspond."

It was found that on omitting the high exhaustions, the experiments led to the following law :—

The ratios of the viscosities of the different gases are the same for any two groups of corresponding pressures. In other words, if the ratios of the viscosities of a set of gases are found (they are given by the ratios of the log decrements) for one set of corresponding pressures, these pressures may be changed in any given ratio without disturbing the ratios of the viscosities.

This law follows of course at once from Maxwell's law, according to which the viscosity of a gas is independent of the pressure. It does not however by itself alone prove Maxwell's law, and might be satisfied even were Maxwell's law not true. The constancy however of the log decrement, when the circumstances are such that the molar inertia of the gas may presumably be neglected, proves that at any rate when the density is not too great that law is true; and the variability of the log decrement at the higher pressures in all but the very light gas hydrogen is in no way opposed to it, though Mr. Crookes's experiments do not enable us to test it directly, but merely establish a more general law, which embraces Maxwell's as a particular case.

The viscosities referred to air as unity which came out from Mr. Crookes's experiments were as follows :—

Oxygen	1·117
Nitrogen and carbonic oxide	0·970
Carbonic anhydride	0·823
Hydrogen	0·500

The viscosity of kerosoline vapour could not be accurately deduced from the experiments, as the substance is a mixture, and the vapour-density therefore unknown. Assuming the relative viscosity to be 0·0380, the vapour-density required to make the experiments fit came out 3·408 referred to air, or 49·16 referred to hydrogen.

When once the density is sufficiently small, the log decrement may be taken as a measure of the viscosity. Mr. Crookes's tables show how completely Maxwell's law breaks down at the high exhaustions, as Maxwell himself foresaw must be the case. Not only so, but if we take pressures at those high exhaustions which are in the same ratios as "corresponding" pressures, the log decrements in the different gases are by no means in the ratios of the densities.

It would appear as if the mechanical properties of a gas at ordinary pressures and up to extreme exhaustions (setting aside the minute deviations from Boyle's law, &c.) were completely defined by two constants, suppose the density at a given pressure and the coefficient of viscosity; but that specific differences come in at the high exhaustions at which the phenomena of "ultra-gas" begin to appear; and that to include these, an additional constant, or perhaps more than one, requires to be known.

ANIMAL REMAINS IN THE SCHIPKA CAVERN

ON December 6, 1880, Prof. Schaaffhausen gave a lecture to the Lower Rhine Society in Bonn, on the discoveries made by Prof. Maschke in the Schipka Cavern, near Stramberg, in Moravia. In this cavern were found remains of Bos, Ursus, Elephas, Rhinoceros, Leo, and Hyæna, besides roughly-hewn implements of quartzite, basalt, and flint, and some incisor teeth of Ursus, which were cut into on both sides at the beginning of the crown, perhaps because people did not yet know how to bore a hole into the root. Carbonised animal bones in numerous small fragments were met with. A solitary human relic was found in a protected place at the wall of a side passage of the cavern, and near a fireplace. It was the fragment of a lower jaw, amid ashes and inter-breccia of lime. The same layer contained mammoth remains and stone implements. Of the jaw only the front part with incisors, one canine, and the two premolars, of the right side remained. The latter three teeth were still in the jaw undeveloped, but were visible, because the front wall of the jaw was wanting. The largeness and thickness of the jaw, first of all, were remarkable. The teeth-development corresponds to the first year of life, but the jaw and the teeth are as large as those of an adult. As is the rule with man, the first pre-molar seemed nearest being cut; next to it came the canine, then the second pre-molar.

The height of the jaw in the line of symphysis measures, to the alveolar border, 30 mm., to the end of the incisors 39 mm. (In the jaw of a child seven years old the corresponding measurements were 23 mm. and 30 mm.; in a girl nine years old 24 mm. and 33 mm.; in a boy of 12, 22 mm. and 31 mm. The jaws of eight adults measured in height, to the alveolar border, on an average, 31 mm.) The jaw fragment, at its lower border, in the line of symphysis, is 14 mm. thick; under the canine tooth the thickness is 15 mm. (In an ordinary adult jaw the thickness in the line of symphysis is about 11 mm.) Now when the cutting surface of the incisors is placed horizontally, the under part of the prognathous jaw bends so much back that one misses the chin as a prominence. A vertical from the front alveolar border falls 4 to 5 mm. in front of the lower border of the jaw. The hinder surface of the symphysis is placed obliquely, as occurs in a high degree in the anthropoids, and in lower degree in savage races, but has also before been observed in fossil human remains, as in the jaw of La Naulette, to which this jaw from the Schipka Cavern has much similarity. The form of the incisors is adapted to the thick prognathous jaw; the broadest part of the root measures from front to back 8½ mm., whereas the ordinary measurement here is 6 mm. Further the teeth are bent convex in front. The curvature corresponds to a radius of 27 mm. The *spina mentalis interna* is absent, and instead there is, as in the anthropoids, a cavity, at the lower border of which some unevenness can easily be felt. The prominences for attachment of the *Musculi digastrici* are well marked, implying a correspondingly strong development of the antagonistic muscles, the masticatory. All these features were also met with on the jaw of La Naulette, but more developed. It is probable that the jaw of the Schipka Cavern also had the pithecoid peculiarity, that its tooth-line was not horizontal, but rose from the premolars to the incisors, and its body was higher in front than at the sides, because the cutting-surface of the outer incisors sinks obliquely outwards. The size of the canine tooth is remarkable, its enamel crown being 13·5 mm. long. (In the fossil lower jaw of Uelde the canine tooth exceeds the premolars about 3·5 mm. According to measurement on ten European adult skulls with the teeth hardly, or not at all, worn down, the crown of the canine tooth was 11·5 mm. long. Only once, among more than fifty skulls, was it found 14 mm.) It cannot well be supposed that this jaw, caught in dentition, belonged to an individual of giant growth, since in such individuals the excessive growth, according to Langer, first begins about nine to ten years of age. The assumption that some pathological cause had hindered the development of the three teeth that remained within the jaw seems quite groundless. As little can we suppose that in the prehistoric time the teeth development was retarded, and that the change of teeth occurred at a later age, since a quicker development corresponds to a lower organisation. (All mammals come into the world with teeth, and the orang changes its teeth sooner than man.)

The size of the front part of the jaw however may in itself be regarded as pithecoid; and there is more reason for this in that other pithecoid characters are present. The aspect of the grey-yellow bone with small dark branching spots on it is met with often in cavern bones. The enamel of the teeth is quite like that of the Quaternary cave animals; it shows longitudinal fissures with dark infiltration; while near these appear bluish, and in some places yellow, spots.

SOME REMARKS ON PERIPATUS EDWARDSII, BLANCH.

SINCE I learnt from Mr. Moseley's notes on the species of *Peripatus* (*Ann. and Mag. of Nat. Hist.*, v. ser., iii., 263), that one of them, referred by Grube to *P. Edwardsii*, had been obtained from this country, in the neighbourhood of Colony Tovar[1]), I tried to get specimens of this highly interesting

[1] Not Colony *Towar*, as the name is printed in Mr. Moseley's paper.

animal. But all my efforts being unsuccessful for a long time, I finally lost all hopes, and the pressure of other business, scientific and not scientific, caused me to lay the matter on the shelf, little thinking that I had my *desideratum* close at my elbows.

There is within our University building a large square yard, where stones, old bricks, and other such refuse had been accumulating in the course of years. About a month ago it was fortunately resolved to transform this very ugly place into a garden, and I engaged the workmen to bring me any kind of animal they might turn up under the heaps of rubbish. How great was my satisfaction to find in the very first gatherings half a dozen of *Peripatus* among some common beetles, centipedes, and earthworms! I offered immediately a prize for every other specimen of the former, and so good proved the locality that in a few days I was in possession of more than fifty of these unexpected *cives academici* of ours, the supply being apparently far from exhausted.[1]

As there are still some points in the natural history of *Peripatus* which are not well settled, I beg leave to offer the following remarks based on the careful examination of living or dissected specimens.

The number of females appears to be much larger than that of males; for among fifty-three specimens I found only five males, which are about half the size of the females. These are

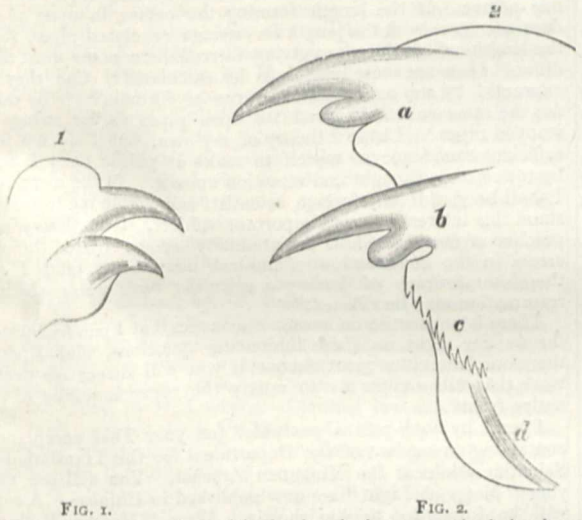


FIG. 1. FIG. 2.

FIG. 1.—Horny claws of one of the foot-jaws in the young animal when born. FIG. 2.—The same, from an adult female. *a*, first claw; *b*, second claw; *c*, horny saw; *d*, pigment-line.

sometimes nearly 1 decimetre long, 5 to 6 millimetres broad, and somewhat tapering on both extremities. The colour is brownish black, with a diffused black line on the middle of the back; the ventral side is dark flesh-coloured. Full-grown animals have thirty-one pairs of ambulatory feet, the new-born animals have but twenty-nine; the length of the latter is about 25 millimetres, their breadth two, the tentacles measure 3 mm.; their colour is reddish, with a line of somewhat lozenge-shaped figures of a paler tint running down the middle of the back.

I twice observed the birth of a young *Peripatus*. The mother raised slightly the hind part of the body, moving it slowly from one side to the other. After some minutes the head of the embryo protruded from the sexual porus, and in half an hour half the body came out, twisting around all the while in every direction. The old animal remained rather quiet, moving occasionally its head, but not crawling about. As soon as the process was advanced thus far, the young *Peripatus* clung with its feet to the nearest surface in its reach; and the mother walking off, the hind part of the embryo came forth in a few seconds.

In one case a young *Peripatus* was born in a tumbler of water, in which I had placed the mother, in order to kill it in an extended condition, as recommended by Moseley in his well-known paper in the *Phil. Transactions*. I did not see the birth, but found the young animal already crawling on the back of the mother, and there floated in the water close by a very thin skin of

[1] Those desirous of obtaining specimens from me in exchange for books or papers on zoological topics, will be good enough to write to me.

the size of the young animal, exhibiting its whole form, even the tentacles. I suppose it must have been shed soon after birth, but have failed hitherto to see anything alike in the other cases of birth, which I watched very carefully.

I could not well make out the number of articulations in the tentacles; there are, however, more than thirty in those of the young animal, having each a ring of short spiny bristles at the base. The slime-glands of the young *Peripatus* are already well developed. It has twenty-nine pairs of feet; and as the adult animal has never more than thirty-one, there must be specimens with the intermediate number of thirty, which would settle Mr. Moseley's question (*Ann. and Mag. of Nat. Hist.*, l. c.) It is probable that *Peripatus* goes through several moultings, and that the new feet then make their appearance.

This may be further surmised from the development at the horny claws of the foot-jaws, which are simple, and not indented in the young animal, but of a much more complicate structure

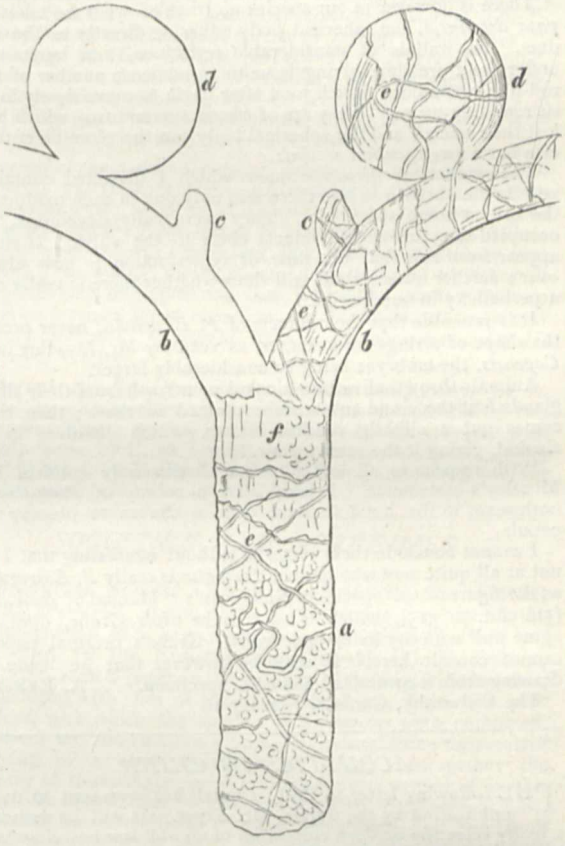


FIG. 3.—Schematic sketch of ovary (*a*), beginning of oviducts (*b*), cæca (*c*), receptacula seminis (*d*), covered by tracheal tubes (*e*), zone of ovary without tracheal tubes (*f*).

in the old one. The annexed figures represent these claws in both conditions.

In the adult animal there is first a large pointed tooth, then follows a shorter one, which is obtuse; both are formed apparently of three to four superposed lamellæ, the outlines of which are distinctly visible by changing the focus of the microscope. The second maxillary claw has likewise two teeth of the same shape and structure, but bears behind them a kind of saw, composed of ten small teeth of the same amber-yellow colour as the inner parts of the larger teeth. This saw is followed by an oblique line of a yellowish pigment, perhaps the rudiment of another developing saw, or a reservoir of horny matter.

The structure of the sexual organs may deserve a few remarks. There can be no doubt that the sexes are separate. The male organs are very much like those described by Moseley in his paper; only the *vesiculæ seminales* are not nearly so spirally twisted as in his figure on plate lxxii. The testes contain spermatozoa of the same shape as those of *P. Capensis*. I noticed

that the slime-glands were much less developed in the males than in the females.

The structure of the female organs in our Caracas species agrees pretty well with Prof. Hutton's drawings (*Ann. and Mag. of Nat. Hist.*, iv. ser., vol. 18, pl. xvii., fig. 8); but I am not prepared to accept his interpretation. The following sketch will give an idea of what I saw.

Moseley's Fig. 1 on pl. lxxiv. is very different from the shape of the ovary in our species; nor can I well understand the existence of ova on the *outside* of the ovary as they appear in his drawing. The ovary in *P. Edwardsii* is rather long, and abundantly covered by fine tracheal tubes, with the exception of a narrow zone close to the branching out of the oviducts. I could not satisfy myself as to its being divided by a septum, nor could I find any ova in it; most likely it is not now the right time. At a very short distance from the beginning of the oviducts there is a kind of obtuse *cæcum* on each of them, which is followed by a spherical body covered by tracheal tubes. These bodies are the organs described by Prof. Hutton as testes.

There is however in our species no trace of what he takes for *vasa deferentia*, the spherical body adhering directly to the oviduct. Its wall is of considerable resistance, and bursts only under great pressure, giving issue to an immense number of thin rod-like corpuscula, which soon after begin to move slowly in the surrounding water. They are of course spermatozoa which have lost their nuclei, and the spherical body can therefore be nothing else but a *receptaculum seminis*.

The oviducts of three specimens which I dissected contained very few embryos; in one there was only one in each oviduct, in the others there were two. They were fully developed, and occupied the part of the oviducts close to the vulva. It would appear from this that the time of reproduction is now almost over; further observations will show whether there is really such a periodicity in our species.

It is probable that the oviducts of *P. Edwardsii* never present the shape of strings of sausages, as seen by Mr. Moseley in *P. Capensis*, the embryos being so considerably larger.

Animals thrown alive into alcohol pour forth from their slime-glands first the viscid substance contained in these; then there comes out a slightly reddish matter, which dissolves in the alcohol, giving it the same colour.

With respect to all other points I can only confirm Mr. Moseley's statements. I keep alive a colony of *Peripatus* of both sexes in the hope to have once a chance to observe the copula.

I cannot conclude these remarks without confessing that I am not at all quite sure whether our *Peripatus* is really *P. Edwardsii*, as the figure of this species in Nicholson's "Manual of Zoology" (5th edit. p. 315), which is said to be after Grube, does not agree well with my living specimens. Grube's original paper I cannot consult here. It may be however that he made his drawing from a contracted alcoholic specimen. A. ERNST

The University, Carácas, January 16

ACOUSTICS IN CHINA

THE following letter to Prof. Tyndall has been sent to us for publication by the writer, Mr. Fryer. It will be seen that a really scientific modern correction of an old law has singularly turned up from China, and has been substantiated with the most primitive apparatus. Dr. W. H. Stone, to whom the letter has been submitted, has kindly appended a note.

TO PROF. TYNDALL, LL.D., F.R.S., &c.

DEAR SIR,—My friend Mr. Hsü has brought some interesting facts relating to acoustics before my notice. As he is the father of the native official who translated with me your work "On Sound," and as he refers particularly to that work, I venture to forward you a translation of his remarks, in the hope that you will satisfy his mind on a subject in which he takes such deep interest. He says:—

"In ancient Chinese works on music it is stated that strings or pipes produce an octave or twelve semitones higher or lower by halving or doubling their length.

"In a work written during the Ming dynasty by Chen-toai-yoh it is stated that this rule will only hold good with strings, but not with open pipes such as the flute or flageolet.

"Some years ago I tried to investigate the cause of this difference and its exact amount. A round open brass tube, say nine inches long, gave a certain note by pressing the end of it against the upper lip and blowing through an *embouchure* made there. Cutting off half the tube, the remaining four and a half inches would not sound the octave; but by cutting off half an inch more, thus leaving four inches in length, the octave was sounded accurately. This experiment was tried on tubes of various lengths and diameters with a similar result, viz. that four-ninths of the length always sounded the octave more or less exactly. Looking at a foreign keyed flute I noticed the same principle carried out in the arrangements for producing octaves. I could not however see the reason why open pipes should not follow the same rule as strings and closed pipes.

"When I read the translation of Prof. Tyndall's treatise 'On Sound,' I was surprised to find the old Chinese idea strictly maintained. It says (p. 214): 'In both stopped and open pipes the number of vibrations executed in a given time is inversely proportional to the length of the pipe,' &c. According to this, as the octave of any note has to execute exactly double the number of vibrations in a given time, an open pipe ought to be exactly halved to make it sound an octave higher. This I have shown to be erroneous by my experiments.

"Fearing that I have misunderstood the English professor's meaning, I beg that he may be written to on this subject, and that my doubts may be thereby cleared up. What I want to know is the exact proportion in length that exists between any open pipe and a pipe of similar diameter sounding its octave higher. Also the exact proportions in length for each of the open pipes sounding the twelve semitones which form a scale of one octave. If the length forming the octave in open pipes does not agree with the length for strings or closed pipes, then the lengths of all the pipes giving intermediate notes must also differ. How are these lengths to be calculated? Can they be expressed by any mathematical curve or formula? Why does not the same rule hold good for open pipes as for strings or stopped pipes? I have a theory of my own, but I do not feel sufficient confidence in myself to make it public until I have bestowed more thought and attention upon it. In the meantime I shall be glad if any foreign scientists can enable me to understand this interesting and important subject. The theory and practice of music in China has gradually become vitiated through errors in the construction of musical instruments, and I am therefore desirous of having a scientific basis upon which a reformation may be effected."

There is no treatise on music or acoustics that I can find which throws any light on these interesting questions, and I shall therefore deem it a great favour if you will direct me to any work that will enable me to satisfy the eager inquiries of my native friend.

I send by book-post a pamphlet for your kind acceptance, containing an account of the Department for the Translation of Scientific Books at the Kinagnan Arsenal. You will see that your "Notes on Light" are now published in Chinese. A copy will be forwarded to you shortly. Your "Heat a Mode of Motion" I hope to begin to translate at no very distant time. Your "Notes on Electricity" in Chinese will be published shortly.

I remain, dear Sir, yours faithfully,

Shanghai, June 1, 1880 JOHN FRYER

November 25th, 1880

P.S.—I have sent a copy of this letter to the Editor of NATURE, and shall feel greatly obliged if you will forward your reply, if any, to him for publication.—J. F.

MR. FRYER is perfectly correct in his observations. You will find the explanation and formula needed at p. 167 of my little book on Sound, under the heading "Correction of Bernouilli's Law." "It has long been known," I there say, "that if an open pipe be stopped at one end its note is not exactly an octave below that given by it when open, but somewhat less, the interval being about a major seventh instead of an octave."

Then follows the mathematical statement, from which the corrections needed by Mr. Fryer could easily be obtained. M. Bosanquet's excellent experimental investigation of the subject is briefly described. His results give the correction for the open end of the pipe as ·635 of radius of pipe, and ·59 r for the mouth. Mr. Bosanquet remarks that in Bernouilli's theory the hypothesis is made that the change from the constraint of the pipe to a condition in which no remains of constraint are to be perceived takes place *suddenly* at the point where the wave system leaves the pipe. It is however evident that the divergence which takes place may be conceived of as sending back to the pipe *a series* of reflected impulses, instead of the single

reflected impulse which returns from the open end of the pipe according to Bernouilli's theory, and that these elementary impulses, coming from different distances, may be altogether equivalent to a single reflected impulse from a point at a little distance from the end of the pipe. It is not a little interesting that a confirmation of this little-known fact should have come from so far off, and have been obtained by such simple experimental means. W. H. STONE

14, Dean's Yard, S.W., January 8

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 13, 1880.—On currents of motion in polarised platina, by H. Helmholtz.—On the course of polarisation currents, by A. Witkowski.—On the changes of form and volume of dielectric bodies wrought by electricity, by W. C. Röntgen.—On Lichtenberg figures and elęctric valves, by W. von Bezold.—On the electromotive forces of some zinc-copper elements, by Fr. Fuchs.—On the measurement of electric conductivities, by G. Kirchhoff.—Some experiments on induction in conductors, by F. Himstedt.—On the discharge of electricity in rarefied gases, by E. Goldstein.—On the production of harmonic tones through vibrations of a fundamental tone, by R. Koenig.—Researches on the law of dispersion, by O. Hesse.—On fluorescence, by S. Lamansky.—On the law of heat-radiation and the absolute emission-power of glass, by L. Graetz.—On annealing of steel and measurement of its hardness, by V. Strouhal and C. Barus.—On the height of the atmosphere (continued), by A. Ritter.—Researches on the volume-constitution of liquid compounds, by H. Schröder.—On variations of the sea-surface by reason of geological changes, by K. Zöppritz.—On the theory of Volta's fundamental experiment, by F. Exner.—The theory of the galvanic element, by the same.—Note on the quantities of heat carried away by currents of an unequally heated liquid, by A. Oberbeck.—Note on Herr Siemens' recent paper on electric conductivity of carbon and temperature, by J. Borgmann.

No. 1, 1881.—New researches on Newton's rings, by L. Sohncke and A. Wangerin.—On vapour-tension of homologous esters, by O. Schumann.—On the elasticity and the electric conductivity of carbon, by W. Beetz.—Thermal theory of the galvanic current, by J. L. Hoorweg.—On electric light phenomena in gases, by E. Goldstein.—On the phenomena of glow at metallic electrodes within a hydrogen atmosphere of varying pressure, by O. Lohse.—Note on Riecke's paper on the electric elementary laws, by H. Lorberg.—Clausius' law and the motion of the earth in space, by J. Fröhlich.—On the application of the proposition of the virial in the kinetic theory of gases, by H. A. Lorentz.—On the influence of expansion of molecules on the pressure of a gas, by D. J. Korteweg.—On the velocity of light in various quartz surfaces, by W. Hallock.—Reply to Herr Dorn, by E. Edlund.—On tones arising through intermittent radiation on a gas, by W. C. Röntgen.—On phenomena of diffraction before the border of a screen, by O. Tumlirz.

THE *Journal of Physiology*, vol. iii. No. 2, January, contains: Dr. S. H. Vines, on the proteid substances contained in the seeds of plants. To this important paper is appended a classification of aleurone grains and a classified list of the plants whose seeds were examined.—Dr. Sydney Ringer, the influence of season and of temperature on the action and on the antagonisms of drugs.—Dr. C. S. Roy, the elastic properties of the arterial wall, with plates v.-vii.—Dr. J. Ott, on crossed hyperæsthesia, and notes on inhibition.

Journal of the Royal Microscopical Society, ser. ii. vol. i. part 1, February, contains: Dr. C. T. Hudson, on *Œcistes janus* and *Floscularia trifolium*, two new species of Rotifers (plates 1 and 2), and the usual summary of current researches relating to zoology and botany, microscopy, &c.—The minutes of the proceedings of the Society are given at the end of the part.

Journal of the Franklin Institute, February.—On the revolution of a fluid ellipsoid with three unequal axes, by T. Craig.—A newly-discovered property of the ellipse, and its application to the "oval chuck," by F. M. Leavitt.—A simple-transmission-dynamometer, by E. Thomson.—Methods for judging of the wholesomeness of drinking-water, by R. Haines.—The basic dephosphorising process, by J. Reece.—Riehla Brothers' improved vertical testing machine, 50,000 pounds capacity.

THE *American Naturalist*, February, 1881.—L. F. Ward, incomplete adaptation as illustrated by the history of sex in plants.—Sarah P. Monks, a partial biography of the green lizard.—G. K. Morris, a new leaf-cutting ant.—S. V. Clevenger, comparative neurology (continued).—Justin Spaulding, the bee's tongue, and glands connected with it.—Wm. E. Doyle, history of the buffalo.

Revue Internationale des Sciences biologiques, January 15, 1881.—Prof. Hanstein, protoplasm considered as the basis of animal and vegetable life.—D. Debierre, an introduction to the earth's history.—Ch. Letourneau, the ethics of egoism (Schopenhauer's "Aphorisms on Moderation in Life").—J. L. de Lanessan, digestion in vegetables.

The Proceedings of the Linnean Society of New South Wales, vol. iv. part 4, Sydney, 1880.—John Brazier, synonomy of, and remarks upon, Port Jackson, New Caledonian, and other shells, with their distribution; list of land-shells found on Thursday Island, with description of new species; Port Jackson and New South Wales brachiopods; mollusca recently dredged at Port Jackson Heads; on the locality of *Oniscia ponderosa*.—E. P. Ramsay, on an undetermined species of Lalage; contribution to the zoology of New Guinea, part 6.—W. A. Haswell, supplementary note on Australian Leucosiidæ; on Australian *Brachyura Oxyrhyncha*, plates 25, 27.—C. Jenkins, on the geology of Yass Plains (3).—W. Macleay, on the Mugilidæ of Australia.—C. S. Wilkinson, on the Abercrombie caves.

Journal of the Asiatic Society of Bengal, vol. xlix. part 2, No. 2, August 30, 1880, contains:—Alexander Pedler, on the past and present water supplies of Calcutta.—R. Lydekker, on the zoological affinities of the bharal or blue sheep of Tibet. While forming a very closely connecting link between the sheep and the goat; the author thinks it cannot be referred to either of the genera Ovis or Capra, and that Hodgson's genus Pseudovis should be retained for its reception.—J. Wood-Mason, on a new butterfly (*Hebomoia Roepstorfii*) from South Andaman, near *H. sulphurea*, Wallace.

Journal de Physique, February.—On radiophony, by E. Mercadier.—Researches on the differences of potential of two metals in contact; results, by H. Pellat.—Dr. Cusco's lens with variable focus, by C. M. Gariel.—On the correction of cooling in calorimetry, by M. Berthelot.—Edelmann's universal support for physical experiments, by A. Terquem.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, March 1.—Prof. W. H. Flower, F.R.S., president, in the chair.—The Secretary exhibited the cast integument of a large spider (*Mygale bistriata ?*) which had been shed in the Society's Gardens.—Mr. G. E. Dobson, C.M.Z.S., read a paper on the anatomy of the family *Erinaceidæ*, commencing with that of the curious and rare form *Gymnura Rafflesii*, with which the species of *Erinaceus* were compared. *Gymnura* was shown to be a peculiarly central form, the survivor probably of a once widely-spread group. Altogether the anatomy of thirteen species of Erinaceidæ was treated of in this paper.—A communication was read from Mr. F. Moore, F.Z.S., containing the descriptions of some new genera and species of Asiatic nocturnal lepidoptera. The characters of 150 new species were given, representing eighty-two genera, of which twenty-nine were new to science.—A communication was read from Mr. R. Collett, C.M.Z.S., containing an account of the breeding habits of the grey seal (*Halichoerus grypus*), as observed on the Fro Islands, off Trondhjem's Fiord, in Norway.—Mr. R. Bowdler Sharpe, F.Z.S., read a note on the fantail flycatcher of Western Australia (*Rhipidura presssi*), of which he had lately had for the first time an opportunity of examining a specimen.

Geological Society, February 23.—Robert Etheridge, F.R.S., president, in the chair.—William Henry Goss was elected a Fellow of the Society.—The following communications were read:—A letter from Dr. John Kirk, communicated to the Society by the Right Hon. Earl Granville, dated H.M. Agency and Consulate General, Zanzibar, December 20, 1880. "It may be of interest to record the occurrence here of an earthquake shock felt in the island of Zanzibar at 6.58 a.m., mean time, on the morning of the 18th inst. Although the shock was very distinct no damage appears to have been done to any buildings in town. It is now twenty-four years since a similar shock has been here noticed; but on the mainland, espe-

cially in the vicinity of Ujiji, they are both more common and more severe than at the coast. Shortly after the cable was laid between Mozambique and Delagoa Bay, the communication was suddenly interrupted after one of these earthquake shocks, which seems to have caused the falling in of rocks by which the cable was crushed."—The Permian, Triassic, and Liassic rocks of the Carlisle Basin, by T. V. Holmes, F.G.S. The district discussed in the author's paper was worked over by him when engaged on the geological survey, and consists of those parts of Cumberland and Dumfriesshire which adjoin the Solway. Its southern boundary is, approximately, a line ranging from Maryport to Rose Castle on the River Caldew, and touching the Eden about two miles above Wetheral. On the east and north-east its limits are the immediate neighbourhoods of the junction of the rivers Eden and Irthing, Hethersgill on the Hether Burn, Brackenhill Tower on the Line, and the border boundary on the Rivers Esk and Sark; and in Dumfriesshire the small tract south of a line ranging from the junction of Scots Dyke with the Sark on the north-east, to Cummertrees on the south-west. The lowest bed in this area is the great Upper Permian or St. Bees Sandstone, which occupies a belt of country in the neighbourhood of the outer boundary. Directly above St. Bees Sandstone, in the west of the district, lies a formation consisting of shales with gypsum, which, though 700 feet thick in the neighbourhood of Abbey Town, is nowhere visible, but is known solely from borings, the country west of the Caldew, and of the Eden below the junction of the two streams, being thickly drift-covered and almost sectionless. In the east of the district the St. Bees Sandstone is overlain directly by a soft, red, false-bedded sandstone, called by the author Kirklinton Sandstone, from the locality in which the rock is best seen, as well as its relations to the under- and overlying beds. But while there is no evidence of any unconformity between the St. Bees Sandstone and the overlying Gypseous Shales in the west, there is evidence of a decided unconformity between the St. Bees and Kirklinton Sandstones in the east. In Carwinley Burn (for example), which runs into the Esk at Netherby, only from 200 to 300 feet of St. Bees Stone was seen below the outcrop of the Kirklinton, instead of the 1000 to 1500 feet which probably exist about Brampton on the one hand, and in Dumfriesshire on the other. Yet Carwinley Burn affords an almost continuous series of sections, from the (non-faulted) Permian-Carboniferous junction to some distance above the outcrop of the Kirklinton Sandstone. As, in addition, the shales underlying the St. Bees Sandstone are gypseous, both near Carlisle and at Barrowmouth, close to St. Bees Head, the author classed the (Upper) Gypseous Shales as Permian, and the Kirklinton Sandstone as Bunter. Resting unconformably on the Kirklinton Sandstone, in the district between Carlisle and Kirklinton, are the Marls seen on the Eden, between Stanwix and Beaumont, and on the line between Westlinton and Cliff Bridge, Kirklinton. Their unconformity is shown by the fact that on the line they rest on the lower, or red, beds, and between Stanwix and Beaumont on the upper, or white, beds of the Kirklinton Sandstone. The Marls have therefore been classed as Keuper. So far as the evidence goes they appear to be very thin, and to extend but a very small distance south of the Eden. Lastly, the Lias appeared to the author to be unconformable to all the beds below, and to rest partly on the Gypseous Shales, partly on the Kirklinton Sandstone, and partly on the Keuper Marls. Of the existence of Rhætic beds there was no evidence, all fossils hitherto found having been determined by Mr. Etheridge (the president) to be Lower-Lias forms. But the Lias-sections are so small and few in number, and the ground so persistently drift-covered, that only a boring could settle the question.—On *Astroconia Granti*, a new Lyssakine Hexactinellid from the Silurian formation of Canada, by Prof. W. J. Sollas, M.A., F.G.S. This paper contained a description of a new fossil Hexactinellid sponge from the Niagara chert beds of Hamilton, Ontario. It is the second oldest known example of the Lyssakina.

Anthropological Institute, February 8.—Major-General A. Pitt-Rivers, F.R.S., president, in the chair.—The election of the following new members was announced: A. G. Geoghegan, E. H. Man, Owen Roberts, and Bruno Müller.—Mr. W. L. Distant exhibited some Carib chisels from Barbadoes, which had been sent to him by Mr. W. J. Sollas, of Bristol. They were taken with about 100 more from a cave, and were found six or eight inches below the surface. The cave is about 350 feet above the sea level, and is situated at a distance of two miles from the coast.—Mr. A. L. Lewis read a paper on two stone circles in Shropshire. Between five and six miles west of Minsterly is a circle of small stones known as the "Hoarstone." The largest stone is in the centre and is surrounded by thirty-three stones and fragments arranged in a circle about 74 feet in diameter. About a mile and a half in a south-westerly direction from the Hoarstone is another circle called in Gough's "Camden's Britannia" "Madge's Pinfold." Here thirteen stones and three fragments stand and lie in an oval ring, the diameters of which are about 86 feet and 92 feet, the longest diameter running north-west and south-east.—Miss A. W. Buckland read a paper on surgery and superstition in neolithic times; the object of which was to bring before the Institute the frequent use of trepanning in Neolithic times, as proved by the late Dr. Broca; to call attention to the proofs he has given of the facts, and to his explanation of the reason of the practice, and of the superstitions associated with it, as also its connection with the use of cranial amulets.

Physical Society, February 26.—Prof. Fuller in the chair. The former resolution regarding the moneys of the Society for investment was adopted.—Dr. O. J. Lodge exhibited a mechanical apparatus illustrating the fact that conductors of electricity are opaque to light, and showed by means of a Wheatstone's photometer, which combines two circular motions into a harmonic one, how the plane of polarisation of a beam of light passing through a magnetic medium is rotated.—Mr. C. V. Boys exhibited his new integrating machine, which is the only one illustrative of the mathematical process of integration, and is therefore specially valuable for teaching purposes.—Mr. Shelford Bidwell read a paper on the telegraphic transmission of pictures of natural objects. The process is explained as follows:—The positive pole of a battery is connected through a set of resistance-coils to a piece of platinum wire, and the negative pole to a plate of zinc, upon which is placed a sheet of paper moistened with a solution of potassium iodide. The negative pole of a second battery is connected through a selenium cell with the same platinum wire, and the positive pole to the zinc plate. The point of the platinum wire is pressed upon the paper, and the selenium being exposed to a strong light, the variable resistance is so adjusted that the currents from the two batteries which pass through the paper in opposite directions exactly neutralise each other. The platinum point will now make no mark when drawn over the paper; but if the selenium is shaded, its resistance is immediately increased: the current from the first battery then predominates, and the path of the platinum point across the paper is marked by a brown line due to the liberation of iodine. The line is fainter the feebler the light is. This arrangement has been applied by Mr. Bidwell in his "telephotograph," exhibited to the meeting. The transmitter consists of a brass cylinder mounted on a screw spindle which carries the cylinder laterally $\frac{1}{64}$ inch at each revolution. A pin-hole in the middle of the cylinder allows light to fall upon a selenium cell placed behind it within the hollow cylinder. The cell is connected in circuit with a battery and the line. The receiver consists of a similar metal cylinder mounted so as to rotate synchronously with the first, and having a platinum point pressing upon a sheet of chemical paper wrapped round the cylinder. This receiver and transmitter are connected up as described above with two batteries and a set of resistance-coils. The image to be transmitted is focussed upon the cylinder of the transmitter and the resistance adjusted, and the receiving cylinder covered with sensitised paper. The two cylinders are caused to rotate synchronously, the pin-hole in the course of its spiral path covering successively every point of the focussed picture. The amount of light falling upon the selenium will be proportional to the illumination of that particular spot of the projected image which is for the time being occupied by the pin-hole, and the intensity of the line traced by the platinum point in the receiver will vary in the same proportion. These variations will produce a picture which, if the instrument were perfect, would be a counterpart of that projected upon the transmitter. Simple designs cut out of tin-foil and projected by a lantern have been successfully transmitted. With selenium and paper of greater sensitiveness more perfect results might undoubtedly be obtained.—Professors Ayrton and Perry showed an experiment illustrating their plan for sending light and shade images by electricity. A selenium cell was connected in circuit with a battery and a coil of wire surrounding a tube along which a beam of light passed. A shutter having a small magnet attached was suspended in the tube like a galvanometer mirror, so that when a current traversed

the coils the shutter was deflected so as to close or partially close the tube and shut off the beam of light. It will be understood that when a ray of light fell on the cell and diminished its resistance, the current in the coils would increase to a degree proportional to the intensity of the ray, and thus the shutter would proportionally cut off the light in the receiver. If now a number of these elementary circuits were combined so as to provide a mosaic of cells to transmit the reflected image of an object, and a screen to receive the corresponding beams of light controlled by the shutters at the other end of the line, there would be a means of sending light and shade images by wire. A rapidly rotating arm carrying a row of cells upon it might answer for a stationary mosaic transmitter, and need fewer cells, while a Japanese mirror having its curvature altered by electromagnets behind might be made to act as a receiver; the "magic" images of that mirror being due to inequalities of curvature. Prof. Ayrton agreed with Mr. Bidwell in his conclusion that selenium cells of high resistance were more sensitive to light than cells of low resistance. Dr. Coffin suggested that Mr. Bidwell should adopt other than the cylindrical form of receiver, and move an image of the object across the pin-hole. Prof. G. C. Foster advised bringing the light always on one and the same part of the selenium cell.

Quekett Microscopical Club, February 25.—T. C. White, president, in the chair.—Ten new Members were elected, and numerous donations received.—A communication was made by Mr. A. D. Michael, announcing the discovery by Mr. Beaulah of *Myobia musculi* upon a mole, this parasite having been previously regarded as one confined to mice. A discussion ensued as to the frequent errors in classification and nomenclature arising from insufficient observation.—The Rev. J. E. Fase exhibited and described a convenient form of grooving slide, which could be used either with high- or low-power objectives.

Institution of Civil Engineers, February 22.—Mr. Abernethy, F.R.S.E., president, in the chair.—The paper read was on the weight and limiting dimensions of girder bridges, by Mr. M. am Ende, Assoc. M. Inst. C.E.

EDINBURGH

Royal Society, February 7.—Prof. Maclagan, vice-president, in the chair.—After reading the obituary notices of Lord Ormidale, Dr. Sharpey, Mr. Lassell, and other deceased Fellows, the chairman called on Prof. George Forbes to communicate his paper on a simple and accurate method of determining the longitude of a place by a single observer without the aid of any instrument for measuring time. The method consisted in taking advantage of the daily change in the moon's declination, which for four or five days during each lunation was sufficiently rapid to be measured with considerable accuracy by means of a sextant and artificial horizon. The calculations and reductions were too intricate to be effected save by a method of approximation and interpolation such as that which the author had given in his paper.—Mr. J. Y. Buchanan read a short paper from Prof. Liversidge descriptive of a specimen of Stilbite that had been brought by the *Challenger* from Kerguelen's Island.—Prof. J. Blyth gave an interesting account of certain experiments which he had made with a simple form of selenium cell. Two ordinary metal combs with every alternate tooth broken away were set close together, so that each remaining tooth in either fitted without touching into the interstice between two remaining teeth in the other. The two combs were then brought into electrical contact by the selenium, which was poured in between the teeth; and thus a selenium cell was formed with a large surface and small resistance. In one special form of cell the combs were bent round a glass tube, inside which a singing flame was set. The accompanying rhythmic fluctuations in the luminosity of the flame were reproduced as sound in the telephone receiver. The difficulty of getting good selenium at the time induced the author to try if amorphous phosphorus would serve as a substitute. A "radial cell," in which the interstices between the dove-tailing electrodes were filled with phosphorus, was found to be not sensitive to light; but such an arrangement was discovered to be a battery in itself, giving rise to currents which varied with the pressure that was brought to bear upon the phosphorus. This property at once suggested a phosphorus cell as a possibly useful transmitter in a telephonic circuit. Another curious effect was noted, viz. that phosphorus under the action of a variable current glowed with a beautifully varying phosphorescence.—Mr. Aitken communicated further experiments on the formation of fogs. His former experiments he had repeated at as low temperatures as 8° F., invariably finding that in filtered air no fog formed. Discussing the production of dry fogs, *i.e.* fogs that are formed in *non-saturated* air, the author pointed out that certain kinds of fog-forming dust were much more efficient in their action than others. Some, in virtue probably of their deliquescent properties, formed clouds in non-saturated air; others only acted in saturated air; while a third class required the air to be super-saturated. In connection with the change of state of moisture in the atmosphere, Mr. Aitken explained the formation of the various forms of ice-crystals by application of the principle that the slower the crystallisation the more regular and simple it is. Hence complex types of crystals betoken a rapid crystallisation. The paper ended with a few instructive remarks upon liquid surface-tension as an important factor in the growth and coalescence of raindrops as they descend towards the earth.—Prof. Tait, in a short note on thermal conductivity, intimated that he had solved the equation for conduction, taking into account the temperature-variations of the conductivity and specific heat. He further pointed out that, at least in the case of iron, most of the decrease with temperature that apparently takes place in the value of the conductivity is in all likelihood referable at once to the change in specific heat; so that perhaps after all conductivity varies very slightly indeed with temperature, and is practically constant through ordinary ranges. Prof. Tait also gave a simple experimental illustration of the diminution in the surface-tension of water produced by heating. A red-hot poker was held close over a level water surface on which Lycopodium dust was sprinkled, when at once the dust was drawn away to cooler regions as if violently repelled by the strongly-heated metal.—Dr. Haycraft communicated a paper in which he showed that the hepatic cells of man and other domestic animals, several of which he had examined, are possessed of true cell-walls. These may be demonstrated by placing a few scrapings from a fresh organ on a slide, and pressing the cover-glass down so as to crush them. The membranes are then to be seen projecting from the half-broken cells, or scattered about the preparation.

BOSTON, MASS., U.S.A.

American Academy of Arts and Sciences, February 9.—The president, Prof. J. Lovering, in the chair.—Prof. H. P. Bowditch presented some observations on the senses of sight and touch. An observer having noticed the position of a point at the centre of a target, shut his eyes, and after a measured interval of time attempted to touch this point again. It was found that the attempts were more successful when two seconds had elapsed than in the cases when more or less time had intervened.—Mr. N. D. C. Hodges read a paper upon the thermodynamic basis for the kinetic theory of gases. By means of the fundamental equations of thermodynamics the mathematical analysis of the kinetic theory results at once; and an expression is obtained for the absolute mass of a molecule.—Prof. Pickering, in a paper on variable stars, discussed their changes in brilliancy and grouped them according to a new law.—Mr. Arthur Searle gave some of the results of his observations on the zodiacal light.—Mr. Harold Whiting, in an abstract of a forthcoming paper, stated that he had found the rate of propagation of what may be called the magnetic wave to vary from 30 feet to 300 feet per second.—Prof. Goss presented some observations on the strength of fir beams.

PARIS

Academy of Sciences, February 21.—M. Wurtz in the chair.—The following papers were read:—Meridian observations of small planets at Greenwich and Paris Observatories during the fourth quarter of 1880, communicated by M. Mouchez.—On the parallax of the sun, by M. Faye. He indicates in a table nine methods of determining the earth's distance from the sun. He holds that the method of physicists is best; that the sun's parallax, 8″·813, is now determined by them to within $\frac{1}{100}$ of a second; and that the seven astronomical methods converge more and more towards this result, and tend to confirm it, without having equal certainty.—Male eels, compared with the females, by M. Robin.—General considerations on the Crustacean fauna of great depths in the Carribbean Sea and the Gulf of Mexico, by M. Alph. Milne-Edwards. This deals with some results of the cruises in the *Blake*. Many new Crustacean species were obtained, and certain groups previously thought foreign to American waters were found abundantly at great depths. Anomouran and macrouran Crustacea there abound. Numerous forms intermediate between groups that have been thought very distinct are discovered (and the author cites several examples).—New clinical researches tending to prove that the cerebellum

is the co-ordinating nerve-centre for movements necessary to standing and walking, considered in all their forms, by M. Bouillaud.—On the systems of faults or diaclases which traverse the series of stratified formations; new examples furnished by Cretacean strata in the environs of Etretat and Dieppe, by M. Daubrée.—On Fuchsian functions, by M. Poincaré.—A letter of Ampère was presented.—On a class of Abelian integrals and on certain differential equations, by M. Picard.—On an integrator, or instrument for graphic integration, by M. Abdank-Abakanowicz.—On the cooling power of gases and vapours, by M. Witz. He infers equality of the cooling powers of dry air and air saturated with moisture. The cooling power of coal-gas compared with that of air is equal to 3·48, that of sulphurous acid does not exceed 0·61 (the pressure being 760 mm.). The velocities of cooling increase more quickly than the 1·233 power of the excesses. For steam they increase proportionally to the 0·83 power.—On the surfaces of revolution limiting liquids deprived of weight, by M. Terquem.—On radiophony: third note by M. Mercadier. He proves that the radiophonic effects are due to vibratory motion caused by alternate heating and cooling through intermittent radiations, principally in the gaseous layer adherent to the solid wall struck by these radiations; the anterior wall in opaque receivers, the posterior in transparent receivers.—Magic mirrors of silvered glass, by M. Laurent. He uses either pressed glass (polishing the surface opposite to the projections), or thin glass of commerce (engraving a hollow design on it).—On pyridic bases, by M. de Coninck.—On the hystolysis of the muscles of larva during the post-embryonic development of Diptera, by M. Viallanes. This relates to the phenomena of disappearance of muscles as the insect passes into the state of *pupa*.—On a new larva of Cestoïdes belonging to the type of the Cysticercus of Arion, by M. Villot.—On a new form of segmentary organ in Trematodes, by M. Macé.—Researches on the circulation and respiration of Ophiures, by M. Apostolidès. The circulatory system is formed of the general cavity and the spaces connected with it; and the respiratory sacs, by their alternate contraction and expansion, draw the blood into the peristomachal cavity, then drive it to the periphery. This explains how the sanguineous liquid, bathing all the organs, respires, and is set in motion.—On a method of coloration of Infusoria and anatomical elements during life, by M. Certes. Placed in a weak solution of chinoline blue, or cyanine, Infusoria take a pale blue colour, and may continue to live twenty-four to thirty-six hours. After twenty-four hours in a moist chamber, the white corpuscles of a frog's blood, coloured with cyanine (in serous solution) show amœboid movements. Chinoline blue is, *par excellence*, the reagent of fatty matter (which is quite absent in nuclei and nucleoli).—On the permanence of prussic acid during a month in the bodies of animals poisoned with this substance pure, by M. Brame. A rabbit and a cat were poisoned with 1 gramme of the substance each. In such dose it seems to preserve the animals perfectly at least a month, remaining in the tissues (especially those of the stomach), with which it seems to become intimately united.

February 28.—M. Wurtz in the chair.—The following papers were read:—On the attenuation of virus and its return to virulence, by MM. Pasteur, Chamberland, and Roux. The bacterium of *charbon* in artificial cultivation produces true germs (unlike the microbe of chicken cholera, which multiplies by division), whose virulence is not affected by air. This spore-production can be hindered by cultivation at 16° or at 42° to 43°. The mycelian product, in the latter case, becomes sterile after about a month; up to that point reproduction is easy, but the virulence is gone after the first eight days, in which time it passes through various stages of attenuation. The secret of causing a return of virulence consists in successive cultivation in the bodies of certain animals. The facts throw light on the etiology of epidemics.—Action of hydracids on halogen salts containing the same element, by M. Berthelot. Compounds so formed exist both in the case of alkaline salts, where they are denoted by absorption of gas, liberation of heat, and special reactions, and in the case of metallic salts properly so called, where they are obtained crystallised.—M. de Lesseps presented a fifth series of documents relating to the history of the Suez Canal.—On the disinfectant and anti-putrid action of vapours of nitrous ether, by M. Peyrusson. Its action is shown both from laboratory and hospital observations. It has the advantage of an agreeable and harmless smell.—On a new definition of the surface of waves, by M. Darboux.—On the development of the infinite product $(1-x)$, $(1-x^2)$ $(1-x^3)$ $(1-x^4)$ . . . by Mr. Franklin.—On radiophony, by M. Mercadier. He makes *thermophonic piles*, or *phonic thermomultipliers* (after the analogy of electric thermo-multipliers), for study of radiant heat, a single element consisting of a short glass tube containing a thin plate of smoked foil or mica, and several such being connected by caoutchouc or metal tubes. The air in these tubes vibrates longitudinally, and by lengthening them he gets *thermosonorous* pipes, having the same properties as ordinary sounding-pipes.—Application of Talbot's fringes to determination of the refractive indices of liquids, by M. Hurion.—On the displacement of the soda of chloride of sodium by hydrate of copper, by M. Tommasi. This takes place even at a low temperature (4° to 5°). With pure sodium chloride the reaction is almost instantaneous. Potassium chloride gives like results.—On the heats of combustion of some alcohols of the allylic series and of aldehydes which are isomeric with them, by M. Louguinine.—On the products of decomposition of proteic matters, by M. Blennard.—On a synthetic homologue of pelletierine, by M. Étard.—On a cause of alteration of canvas, by M. Balland. This relates to an observation by Dr. Tripier on some rusty-coloured hammock canvas used by the Algerian army in 1847. This showed dark spots after washing, and went to pieces in use. The spots were probably due to iron sulphide produced by alkaline sulphides in the artificial soda and by iron oxide fixed by the stuff in manufacture. The sulphide passed to the state of sulphate in air by a combustion involving the tissue.—Contribution to the study of trichinosis, by M. Chatin.—Contribution to the physiological action of urea and of ammoniacal salts, by MM. Richet and Moutard-Martin. *Inter alia*, it is singular that injection of a concentrated solution of urea increases the elimination of water more than of urea. In uremia death cannot be attributed to non-elimination of the ammoniacal salts of urine.—On the inflammatory nature of the lesions produced by the poison of the Bothrops serpent, by MM. Couty and De Lacerda.—On the pulmonary alterations produced by long stay in the purifying chambers of gas-works, by M. Poincaré. Animals kept eight months in those chambers showed in the lungs an accumulation of epithelial cells in some alveoli, but especially a prodigious nuclear proliferation in the connective tissue. This shows that it is not without danger to subject children with whooping-cough to similar treatment.—Relation of the cylinder axis and the peripheral nerve-cells with organs of sense in insects, by MM. Künckel and Gazagnaire. In insects every nervous enlargement consists essentially of a bipolar cell (true nerve-termination), connected on one hand with the cylinder axis of the nerve-fibre, and on the other with a nerve-rod which is its prolongation; this rod is surmounted by a hair properly so called, or a transformed hair.—On the gemmation of Pyrosoma, by M. Joliet.—Antiquity of *Elephas primigenius* (Blum) in the sub-Pyrenean Valley, by M. Caraven-Cachin. It seems to have appeared first after the diluvium of the plateaux on the old Pleistocene spread in a nearly horizontal sheet over Tertiary and other strata.

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